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The effect of packaging, branding and labeling on the experience of unhealthy food and drink: A review

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ABSTRACT

Extrinsic information, such as packaging, branding and labeling, can significantly alter our experience of food and drink through a process of 'sensation transfer', in which extrinsic attributes are transferred to our sensory perception of a product. The aim of this review was to summarize the literature on sensation transfer for unhealthy food and drink and to investigate personal factors that may influence its occurrence. Seventy-eight studies in 69 articles, published between 1966 and 2014 were identified which evaluated sensation transfer. Sixty-five of the 78 studies found an effect of extrinsic information on taste and/or hedonic outcomes, providing strong evidence for sensation transfer. The majority of studies identified that specific extrinsic information influenced particular products or specific sensory outcomes. Study designs incorporating a measure of expectation allowed a tighter assessment of sensation transfer. The results of such studies confirm the hypothesis that these effects occur when extrinsic information elicits an expectation of product taste, which then forms a framework to guide sensory perception. These studies also support the hypothesis that where sensation transfer does not occur, this is likely due to a mismatch between the expectations elicited by the extrinsic information and the sensory characteristics being measured, or the failure of the extrinsic information to elicit an expectation of taste for that product.

Contents

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The potential for extrinsic information such as packaging, branding and labeling to change consumers' experiences of food and drink has been studied across marketing, economics/business, neuroscience, consumer and sensory psychology domains. This ability for sensory attributes denoted by extrinsic information to 'transfer' to the actual experience of the product has been termed 'sensation transfer' (Cheskin, 1954, 1957), though a subset of this phenomenon has sometimes been termed a 'halo effect' or 'assimilation'. Sensation transfer is generally thought to occur when extrinsic information elicits expectations of product flavor, which then act as a framework for the interpretation of sensory input (Cardello & Sawyer, 1992; Deliza & MacFie, 1996). A recent review by Piqueras-Fiszman and Spence (2015) provided comprehensive support for this model of sensation transfer, meaning that sensation transfer will largely depend on whether extrinsic information engenders expectations and what type of expectations are engendered.

There have been many reviews of selected areas of the sensation transfer literature (see e.g., Schifferstein, 2010; Spence, 2011; Spence, Harrar, & Piqueras-Fiszman, 2012; Spence & Wan, 2015; Wansink, 2004), including a recent overview of branding effects on hedonic evaluations (Fernqvist & Ekelund, 2014). These reviews have provided strong evidence for the existence of sensation transfer. However, greater insight into the occurrence of this effect and the factors that contribute to it would be obtained through an exhaustive review of the evidence within a given subset of this literature. Accordingly, the current review aimed to consider all the available evidence for the effect of *packaging, branding* and *labeling* on the taste and liking of *unhealthy food* and *drink*.

Unhealthy food and drink contribute to the development and maintenance of overweight and obesity, which is linked to a number of health problems, including diabetes, cardiovascular disease and some forms of cancer (World Health Organization, 2013). Marketing of products through packaging, branding or labeling aims to increase product appeal and promote consumption, leading to consumption above recommended levels (Chandon, 2013; Wansink & Chandon, 2014). Whether extrinsic information is capable of changing the experience of these foods has important implications for both public health strategies (such as the implementation of effective nutrition labeling) as well as the regulation of product marketing.

In considering the evidence for extrinsic information, studies have indicated that the same extrinsic information may have markedly different effects when applied to different products. For instance, a 'healthy' label might induce a negative expectation of taste. When applied to an appealing dessert, this may induce a contrast effect, in which the negative expectation is disconfirmed and the product is experienced positively (Wansink, van Ittersum, & Painter, 2004). Conversely, similar labels applied to healthy products, such as cheese, yoghurt or soup, have been shown to induce a negative sensory experience (Wardle & Solomons, 1994; Westcombe & Wardle, 1997; Yeomans, Lartamo, Procter, Lee, & Gray, 2001). Additionally, these labels can also have no influence over healthy foods that are already presumed to be low in fat (Wansink et al., 2004).

Since unhealthy food and drink are indulgences ideally consumed infrequently, consumers may place more importance on packaging, branding and labeling in their choice of these products compared to staple food items. Further, well-known brands such as McDonalds may have strong consumer appeal and brand loyalty, which may have further implications for the strength of expectations engendered from product packaging, branding and labeling. Therefore, a comparison of studies examining similar types of products such as unhealthy food and drink might better identify why sensation transfer occurs in some situations but not others.

Additionally, this review examined literature on the effects of packaging, branding and labeling, as they are unique forms of extrinsic information that are crucial at the point of sale and the point of consumption. These forms of information are 'extrinsic', in that they are objectively independent from the physiochemical attributes of the product (Piqueras-Fiszman & Spence, 2015). While one cannot evaluate the flavor of a biscuit without feeling its texture on the tongue or hearing the sound of its crunch, the flavor of a biscuit *should* be independent of the brand name or the color of the packet.

The review therefore aimed to determine the strength of evidence for sensation transfer for packaging, branding and labeling of unhealthy food and drink, to examine the role of expectations in this process and the factors that promote or inhibit this effect.

1. Methods

In December 2014–January 2015, a search of several databases was conducted spanning the neuroscience, psychology and marketing literature, with no restriction on the year of publication (see Table 1). The basic search parameters are shown in Table 2 and took the form of outcome + extrinsic information + product. Limits were imposed on each database (see Table 1) and various exclusion terms were applied to refine search results. These included requirements that the article must be written in English, peer-reviewed and published in an academic journal. The review included studies of any methodology which allowed for a clear comparison to be made between information conditions, including neuroscientific studies. Citations were managed using Endnote X5.

1.1. Outcome measure

Search terms used to address the consumer's experience of the product encompassed general and specific attributes of product taste, flavor and liking/enjoyment. Product 'purchase' was also included in the search terms, since many studies originating from marketing disciplines were primarily concerned with purchase-promotion effects (Grunert, 2003). However, these studies were only retained during the review stage where it was clear that

Table 1
Limits applied to each database.

Limit	PsycINFO	PubMed	Food Science & Technology Abstracts	EBSCO databases (ERIC, Academic Search Complete, Business Source Complete, Communication & Mass Media Complete, Health Source – Consumer Edition, Psychology and Behavioral Sciences)
Record Type	Journal article, peer-reviewed	Journal article, full text	Journal article/review, full text	Journal/article, full text, peer-reviewed[a]
Population	Human, female, male	Human		
Language	English	English	English	English[a]
Other limits		MeSH classifications (e.g., choice behavior, food labeling, beverages, magnetic resonance imaging, product labeling) Publication exclusions (e.g., J Agric Food Chem)	Section code: alcoholic & non-alcoholic beverages, economics, food science, milk & dairy, cereals & bakery products, cocoa, chocolate & confectionary, packaging.	Publication restrictions: - Advances in Consumer Research - International Journal of Advertising - International Journal of Consumer Studies - International Journal of Food Science & Technology - Journal of Advertising Research - Journal of Advertising - Journal of Brand Management - Journal of Consumer Affairs - Journal of Consumer Behaviour - Journal of Consumer Psychology - Journal of Consumer Research - Journal of Food Quality - Journal of Food Science - Journal of Marketing - Journal of Marketing Research - Journal of Public Policy & Marketing - Journal of Retailing - Marketing Science - Psychology and Marketing
Excluded terms	e.g., viral, bacterial, HIV, aggression, television, violence, gambling, pregnancy, pharmaceutical, genetics	e.g., viral, bacterial, HIV, aggression, television, violence, gambling, pregnancy, pharmaceutical, genetics	e.g., viral, bacterial, HIV, aggression, television, violence, gambling, pregnancy, pharmaceutical, genetics	e.g., viral, bacterial, HIV, aggression, television, violence, gambling, pregnancy, pharmaceutical, genetics

[a] Variously applied as allowed by each of the selected databases within EBSCO.

Table 2
Search terms used in each database.

Outcome	Extrinsic Information	Assimilation	Product
Identif[a]	Pack[a]	Assimilation	Fast food
Discrimin[a]	Brand[a]		Junk
Distinguish	Label[a]		Snack[a]
Tast[a]			Dessert[a]
Flavor			Chocolate
Flavour			Chip[a]
Consum[a]			Crisp[a]
Purchase			Candy
Buy			Loll[a]
Accepta[a]			Confectionery
Lik[a]			Soft drink[a]
Hedonic			Soda
Quality			Cola
Pref[a]			Lemonade
Affect[a]			Cake[a]
Enjoy[a]			Biscuit[a]
Satisf[a]			Cookie[a]
Appeal[a]			Burger[a]
Attractiv[a]			Pizza
Perce[a]			Pudding[a]
Expect[a]			Ice cream
"sensory transfer"			Doughnut[a]
"sensation transfer"			Food[a]
Crossmodal			Drink
Cross-modal			Drinks
Calorie[a]			Beverage[a]
			Cereal[a]

The search strategy took the form of {([*outcome* AND *extrinsic information*] OR *assimilation*) AND *product*}.
[a] Indicates that all variations of the base word are included in the search (by using the * wildcard).

purchase was a proxy for liking. In the synthesis of results, purchase intent was not reported where a more targeted sensory measure was available. Product 'consumption' was included with the same caveat. Perceptions of calorie content or fattiness were reported where the extrinsic information did not explicitly cue these outcomes or where there was no better indicator of sensation transfer.

Since this review sought evidence of how extrinsic information can change the *actual* experience of flavor, a criterion for abstract and full-text review was that the study methodology required participants to have sampled the product.

1.2. Extrinsic information

Search terms for extrinsic information were limited to 'packaging', 'branding' and 'labeling'. For the purpose of this review, 'packaging' was defined as the receptacle in which a product is marketed and purchased. The cup out of which a drink was consumed or the plate or bowl from which food was eaten were not included in this definition (for a recent review of this literature, see Spence et al., 2012). A 'brand' was defined as "a name, term, design, symbol, or any other feature that identifies one seller's good or service as distinct from those of other sellers." (American Marketing Association, 2013). Thus, included in this definition was not only the brand name but its logo, mascot, slogan or any other symbols or colors that distinguished one company from its competitors.

'Labeling' was defined to encompass any form of information that indicated product identity or composition. Examples include country-of-origin (COO) labels, ingredient lists, health claims and nutrition panels, or fat-content and calorie labels. Information was

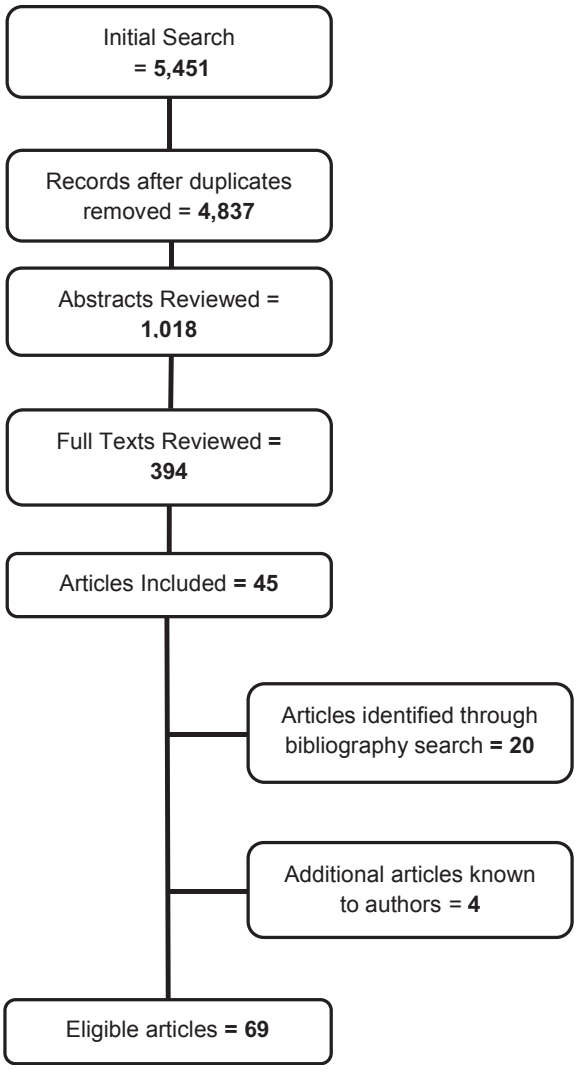

Fig. 1. Flowchart depicting article selection process.

taken to constitute a label if it was clearly related to the product in question. The label could therefore be written or verbal and did not need to be directly attached to the product (e.g., a menu board or a card placed next to the item).

1.3. Product

Terms for unhealthy food 'products' were gathered from the Australian Dietary Guidelines for Healthy Eating (National Health and Medical Research Council, 2013) and extended to include a large variety of unhealthy food and drink. The relevance of unhealthy foods in this review is linked to their classification by consumers as an indulgence. Terms were therefore limited to food/drink that the majority of the general public would consider 'unhealthy' (see Table 2). Using this criterion, products such as energy drinks, pretzels, muesli/fruit bars or healthy breakfast cereals were excluded, since it is possible many participants would not have considered these products to be unhealthy.

1.4. Selection and evaluation of studies

The initial search yielded 4837 records (after the removal of duplicates). A review of the titles and abstracts identified 394 articles for full text review (see Fig. 1). From these references, 45 primary articles were deemed eligible. These articles were screened for relevant references not caught by the primary search. Sixteen review articles were identified and screened for relevant references. A further four reviews were identified through bibliography searches and four reviews were known to the authors. These were also screened for relevant references. These supplementary searches yielded an additional 20 eligible articles. A further four articles were known to the authors to fit the inclusion criteria. In total, 69 primary articles relating to unhealthy foods/drink were eligible for review.

2. Results

Studies were broadly categorized according to their design, with four main designs being identified within this literature. All four designs assessed whether extrinsic information induced a changed product experience. The first design compared ratings of the same product presented under two or more different forms of extrinsic information (*multiple informed conditions*), allowing an evaluation of whether a change in extrinsic information induced a change in sensory experience. The second study design compared the same product in the presence and absence of extrinsic information *(blind vs. informed)*. The third and fourth study designs incorporated a measure of pre-taste expectation. These designs allowed an analysis of whether a change in sensory experience resulting from a change in extrinsic information occurred in the direction of one's expectation or whether ratings of a product in the presence of extrinsic information aligned with the expectation of that product induced by the pack/brand/label. Within each section, studies were further grouped according to whether they examined packaging, branding or labeling.

The review also summarizes factors discussed in the literature as influencing the occurrence of sensation transfer. These factors fell into two broad categories: (1) participant familiarity with the extrinsic information, and (2) participant characteristics.

Studies are discussed below and outlined in Table 3. A detailed summary is provided in Supplementary Materials 1: Tables 4–6 (see Supplementary Materials 2 for information on how study details were summarized in these tables). Table 3 also highlights whether the study measured ratings of the product in within- or between-subjects conditions.

2.1. Studies comparing multiple informed conditions

The first type of study design asked participants to examine the same product in *multiple informed conditions*. Thirty-five studies, reported in 30 articles, employed this study design, of which only five did not identify an effect of extrinsic information on product experience. The majority of studies employed a between-subjects design (24/35), in which the same product was given to different groups of participants, with each group receiving the product under a different pack/brand/label.

2.1.1. Packaging

Five studies considered the influence of packaging, with four providing evidence in support of sensation transfer. Richardson et al. (1994) found that packaging and brand names altered the experience of a variety of products, as discussed in the next section. Lapierre et al. (2011) found that sugary cereal with a cartoon character on the box was liked by 4–6 year olds more than cereal without the cartoon character. Additionally, Madzharov and Block (2010) found that participants consumed more when a package displayed an image of 25 crackers compared to five crackers. However, the package in this instance may have conveyed serving

Table 3
Effect of packaging, branding and labeling on sensory ratings.

Study	Design B: between-subjects W: within-subjects	Country, n, notable sample characteristic	Product	Extrinsic information B: Brand L: Label P: Package	Sensory effects^	Sub-group effects^^
Multiple Informed Conditions						
Allen, Gupta, and Monnier (2008)	B	Australia, n = 160	Soft drink	B	HEDONIC[a]	ATTIT[a]
Bowen, Tomoyasu, Anderson, Carney, and Kristal (1992)	B	US, n = 97	Ice cream	L – fat content	CONS[a], CREAM, FLAV, HEDONIC[a], OIL[a], SALT, SAT[a], SWE	GENDER[a]
	B	US, n = 310	Ice cream	L – fat content	FAT[a], HEDONIC[a]	
Bowen et al. (2003)	B	US, n = 192, diet-conscious women	Milkshake	L – fat content	CREAM, HEDONIC[a], OIL[a]	
Cavanagh and Forestell (2013)	B	US, n = 99 (66 for analysis), women	Cookies	B	BIT, CRUNCH, FLAV[a], HEDONIC[a], SALT, SAT[a], SOUR, SWE	
Cavanagh, Kruja, and Forestell (2014)	B	US, n = 188, women	Cookies	B L – calorie BxL	**B:** FLAV[a], HEDONIC[a], SAT[b] **BxL[a]:** FLAV[a], HEDONIC[b], SAT[a]	
Crum, Corbin, Brownell, and Salovey (2011)	W	US, n = 46	Milkshake	L - nutrition	PHYSIO[a]	DIET
Ebneter, Latner, and Nigg (2013)	B	US, n = 175, women	Chocolate	L1 – fat content L2 – calorie LxL	**L1:** HEDONIC[a] **LxL:** HEDONIC[a]	
Geiger, Weinstein, and Bothwell (2005)	W	US, n = 39	Muffins Cookies	L – fat content	HEDONIC[a]	DIET[a]
	W	US, n = 68	Muffins	L – fat content	HEDONIC	DIET
Gravel et al. (2012)	B	Canada, n = 352	Cookies	L – health	CAL[a], CONS, FAT[a]	DIET[a]
Irmak, Vallen, and Robinson (2011)	B	US, n = 168 (135 for analysis)	Candy	L – health	HEDONIC[a]	DIET[a]
Lapierre, Vaala, and Linebarger (2011)	B	US (authors), n = 80 (77 for analysis), children	Sugary cereal	P – cartoon character L – health PxL	**P:** HEDONIC[a] **L:** HEDONIC[a] **PxL[a]:** HEDONIC[a]	RECOG, LIKE
Lee, Shimizu, Kniffin, and Wansink (2013)	W	US, n = 115	Cookies Potato chips	L - organic	CAL[a], FAT[a], FLAV[a], HEDONIC[a]	AGE, DIET, FREQ[a], GENDER, WEIGHT
Madzharov and Block (2010)	B	US, n = 77	Crackers (sweet)	P – no. items	CONS[a]	
Pierce (1987)	B	Canada, n = 80 (79 for sub-group analysis)	Soft drink	B	HEDONIC[a]	AGE, FREQ[a], GENDER, MARITAL, OCCUP
Piqueras-Fiszman and Spence (2011)	W	UK, n = 25	Potato chips	P – color	HEDONIC	
Piqueras-Fiszman and Spence (2012)	W	UK, n = 58	Biscuits	P - texture	CRUNCH[a], FRESH, HARD[a], HEDONIC	
Pope and Wolf (2012)	W	Canada, n = 68, children & adolescents	Chocolate chip bread Cookies Cake	L – health	HEDONIC[a]	AGE
Provencher, Polivy, and Herman (2009)	B	US, n = 99, women	Cookies	L – health	CAL, CONS[a]	DIET, WEIGHT
Raghunathan, Naylor, and Hoyer (2006)	B	US (authors), n = 40 (39 for analysis)	Mango lassi (i.e. milkshake)	L – health	HEDONIC[a]	ATTIT
Richardson, Dick, and Jain (1994)	B	US, n = 1564	Potato chips Cookies Cheese Dip Jelly	B/P	QUAL[a]	
Roefs and Jansen (2004)	W	Netherlands (authors), n = 44, women	Strawberry milkshake	L – fat content	PALAT	WEIGHT
Shankar, Levitan, Prescott, and Spence (2009)	W	UK, n = 30	Chocolate	L – milk/dark	CHOC[a], HEDONIC	
Soldavini, Crawford, and Ritchie (2012)	W	US, n = 43, children	Cookie	L – fat content	PREF[a]	
Stubenitsky, Aaron, Catt, and Mela (1999)	B	UK (authors), n = 71, regular chocolate consumers, non-frequent users of reduced-fat samples	Chocolate	L – fat content	HEDONIC[a]	ATTIT, DIET
Wansink, Painter, and van Ittersum (2002)	B	US, n = 140	Pudding Cookies Cheesecake Chicken Seafood Red beans with rice	L – descriptive product name	QUAL[a]	

(*continued on next page*)

Table 3 (*continued*)

Study	Design B: between-subjects W: within-subjects	Country, n, notable sample characteristic	Product	Extrinsic information B: Brand L: Label P: Package	Sensory effects^	Sub-group effects^^
Wansink, van Ittersum, and Painter (2005)	B	US, n = 140	Pudding Cookies Chicken x 2 Seafood Red beans with rice	L – descriptive product name	HEDONIC[a]	
Wansink et al. (2004)	B	US, n = 334	Cheesecake Pudding Apple crisp Chocolate cream pie Muffins Cookies	L – diet/health	HEDONIC[a]	
Wilcox, Roggeveen, and Grewal (2011)	B	US, n = 216	Chocolate	L – country of origin	HEDONIC[a]	
	B	US, n = 157	Chocolate	L – country of origin	PREF[a]	
Wolfson and Oshinsky (1966)	W	US, n = 60	Chocolate milk Chocolate-flavored liquid drink	L – product name	PREF	
	B	US	Chocolate milk Chocolate-flavored liquid drink	L – product name	PREF[c]	
Yeomans, Chambers, Blumenthal, and Blake (2008)	B	UK, n = 32	Frozen smoked-salmon mousse	L – product name	BIT[b], CREAM, FRU, HEDONIC[a], SALT[a], SAV, SOUR, STR[a], SWE	
	B	UK, n = 44	Frozen smoked-salmon mousse	L – product name	BIT, CREAM, FRU, HEDONIC[a], SALT[a], SAV, SOUR, STR[a], SWE	
Blind vs. Informed Conditions						
Allison, Gualtieri, and Craig-Petsinger (2004)	B	US, n = 300, adolescents, regular consumers of pre-sweetened breakfast cereal	Chocolate breakfast cereal	P/L – product name, brand, picture	CHOC, CRISP, FLAV, HEDONIC, TEX, SWE	
Bonham et al. (1995)	W	US, n = 38 (36 for informed condition)	Chocolate	B	PREF[c]	GENDER
Bower and Turner (2001)	W	UK, n = 60	Potato chips	B	HEDONIC	BODY
Breneiser and Allen (2011)	W	US, n = 48	Soft drink	B	PREF[a]	GENDER[a]
Cavanagh et al. (2014)	B	US, n = 188, women	Cookies	B L – calorie BxL	**L:** FLAV[a] **BxL[a]:** FLAV[a], HEDONIC[b], SAT[a]	
Didier and Lucie (2008)	W	France, n = 102	Chocolate	L – organic/fair trade	HEDONIC[a]	
Ebneter et al. (2013)	B	US, n = 175, women	Chocolate	L1 – fat content L2 – calorie LxL	**L2:** HEDONIC[a] **LxL:** HEDONIC[a]	
Engell, Bordi, Borja, Lambert, and Rolls (1998)	W	US, n = 33, children	Cookies	L – fat content	CRUNCH, FLAV, HEDONIC, PREF[a], SWE, TEX	ATTIT[a]
Forman, Halford, Summe, MacDougall, and Keller (2009)	W	US, n = 43, children	Pizza Cookies Potato chips Jammers Chocolate milk Fruit cups Yoghurt Pretzels	B	CONS[b]	GENDER[a], WEIGHT[b]
Gates, Copeland, Stevenson, and Dillon (2007)	W	Australia, n = 350, children & adults	Chocolate milk Soft drinks (Coca Cola & Fanta)	B/P	HEDONIC[a]	AGE[a], APPEAL[a], GENDER
Giménez, Ares, and Gámbaro (2008)	W	Uruguay, n = 50, regular consumers of dulce de leche	Dulce de leche (sweet dairy product)	L – shelf life	HEDONIC	
Keller et al. (2012)	W	US, n = 41, children	Chocolate milk Pudding Graham crackers Plain milk Turkey & cheese sandwich	B	CONS[a]	GENDER[a], WEIGHT

Table 3 (*continued*)

Study	Design B: between-subjects W: within-subjects	Country, n, notable sample characteristic	Product	Extrinsic information B: Brand L: Label P: Package	Sensory effects^	Sub-group effects^^
			Ham & cheese sandwich Peanut butter & jelly sandwich Pretzels Apple slices Carrot			
Kim, Lopetcharat, and Drake (2013)	W	US, n = 108, regular chocolate milk consumers	Chocolate milk	B/L – fat content	FLAV[a], HEDONIC[a], MF, SWE[a], TEX	
Koenigs and Tranel (2008)	W	US, n = 44, VMPC lesion group, brain damaged comparison group, healthy group	Soft drink	B	PREF[c]	BRAIN
Letona, Chacon, Roberto, and Barnoya (2014)	W	Guatemala, n = 121, children	Honey graham crackers Potato chips	P – cartoon character	HEDONIC[a], PREF[a]	AGE[a], GENDER, LIKE, RECOG, TV
Levis and Chambers (1996)	W	US, n = 120	Potato chips	L – product type/fat content	HEDONIC[a]	
Light, Heymann, and Holt (1992)	W	US, n = 100	Ice cream	L - health	HEDONIC[b]	
McDaniel and Baker (1977)	B	US, n = 100 (blind) + 400 (informed)	Potato chips	P - texture	CRISP[c], HEDONIC[c]	
Miller, Castellanos, Shide, Peters, and Rolls (1998)	B	US, n = 95	Potato chips	L – fat content	CONS[c], HEDONIC	DIET[c], GENDER
Parker and Penfield (2005)	B	US, n = 294	Ice cream	L – flavoring type	FLAV[a], HEDONIC[a], VANILLA[a]	
	B	US, n = 270	Ice cream	L – flavoring type	FLAV[a], HEDONIC[a], SWE[a], VANILLA[a]	
Roberto, Baik, Harris, and Brownell (2010)	W	US, n = 40, children	Graham crackers Gummy fruit snacks	P – cartoon character	HEDONIC[a], PREF[a]	AGE, GENDER, LIKE, RACE, RECOG, TV,
Robinson, Borzekowski, Matheson, and Kraemer (2007)	W	US, n = 63, children	Hamburger Chicken nuggets French fries	B	PREF[a]	AGE, GENDER, FREQ[a], RACE, TV
Shepherd, Sparks, Bellier, and Raats (1991/92)	W	UK, n = 60	Flavored milk	L – fat + sugar content	BODY[a], HEDONIC[a], SWE[a]	ATTIT[a]
Steenhuis et al. (2010)	W	Amsterdam, n = 36 (31 for analysis), women	Chocolate mousse cake	L - health	CONS, HEDONIC	DIET, WEIGHT
Vidal, Barreiro, Gómez, Ares, and Giménez (2013)	W	Uruguay, n = 100, regular milk dessert consumers	Milk desserts	B/L – fat content	HEDONIC[a]	
Expected vs. Blind/Informed Conditions						
Cardello (2003)	W	US, n = 88	Chocolate pudding	L – product name/product name + description of technology/product name + description of technology + technology benefit	HEDONIC[a]	ATTIT[a]
Carrillo, Varela, and Fiszman (2012)	B	Spain, n = 90, regular biscuit consumers	Biscuits	P/L – health	HEDONIC	
Dougherty and Shanteau (1999)	W	US, n = 12	Corn chips	L – quality	QUAL[c]	
	W	US, n = 42	Corn chips	L – quality	QUAL[c]	
Kähkönen, Hakanpää, and Tuorila (1999)	B & W	Finland, n = 91	Chocolate	L – fat content	FLAV, HEDONIC[a], MELT	GENDER[a]
Kühn and Gallinat (2013)	W	Germany, n = 15	Soft drink	B	HEDONIC[c], NEURO[c]	FREQ[a]
Lotz, Christandl, and Fetchenhauer (2013)	B & W	Germany, n = 241, regular chocolate consumers	Chocolate	L – fair trade	HEDONIC[c]	HABIT
	B & W	Germany, n = 69, regular chocolate consumers	Chocolate	L – fair trade	HEDONIC[c]	
McClure et al. (2004)	B & W	US (authors), n = 67	Soft drink	B	NEURO[a], PREF[a]	
Ng, Chaya, and Hort (2013)	W	UK, n = 100, regular squash consumers	Blackcurrant squash	B/L – sugar content	HEDONIC[a]	
Ng, Stice, Yokum, and Bohon (2011)	W	US, n = 34, women	Chocolate milkshake	L – fat content	NEURO[c]	WEIGHT[a]

(*continued on next page*)

Table 3 (*continued*)

Study	Design B: between-subjects W: within-subjects	Country, n, notable sample characteristic	Product	Extrinsic information B: Brand L: Label P: Package	Sensory effects^	Sub-group effects^^
Norton, Fryer, and Parkinson (2013)	W	UK, n = 87, majority regular chocolate consumers	Chocolate	L – fat content	CREAM, HEDONIC, MILK, RICH, SMO, SWE, THICK	DIET, GENDER, WEIGHT
Roberto et al. (2012)	B & W	US, n = 216	Sugary cereal	L - health	HEDONIC	ATTIT, DIET, WEIGHT
Sosa and Hough (2006)	W	Argentina, n = 127, adolescents	Alfajores (chocolate cake)	B	HEDONIC[c]	INCOME[a]
Torres-Moreno, Tarrega, Torrescasana, and Blanch (2012)	W	Spain (authors), n = 109	Chocolate	B/L – % cocoa + country of origin	HEDONIC[a]	
Tuorila, Cardello, and Lesher (1994)	W	US, n = 33	Cake	L – fat content	HEDONIC[a]	ATTIT[a], FAMILIAR[a], FREQ[a]
Tuorila, Meiselman, Bell, Cardello, and Johnson (1994)	B & W	US, n = 121	Pudding Root beer	L – product name/ description	HEDONIC[a]	NEO
Woolfolk, Castellan, and Brooks (1983)	W	US (authors), n = 30	Soft drinks	B	PREF[a]	
Yeomans et al. (2008)	B & W	UK, n = 60	Frozen smoked-salmon mousse	L – product name	BIT, CREAM, FRU, HEDONIC[a], SALT[c], SAV, SOUR, STR, SWE[a]	

^ Where one study examines more than one form of extrinsic information, results for each form of extrinsic information are indicated by bolded B, L, P letters. Results of any interaction effects are indicated by multiplication of bolded letters (e.g., BxL). Letters indicate sensory outcomes: BIT = bitterness, BODY = body, CAL = calorie content, CHOC = chocolate, CONS = consumption, CREAM = creaminess, CRISP = crispness, CRUNCH = crunchiness, FAT = fattiness, FLAV = flavor, FRESH = freshness, FRU = fruitiness, HARD = hardness, HEDONIC = overall sample evaluation (e.g., taste, pleasantness, liking, good-bad), MELT = melting rate, MF = mouthfeel, MILK = milkiness, NEURO = neurological response, OIL = oiliness, PHYSIO = physiological response, PALAT = palatability, PREF = preference, QUAL = quality, RICH = richness, SALT = saltiness, SAT = satisfaction, SAV = savoriness, SMO = smoothness, SOUR = sourness, STR = strength, SWE = sweetness, TEX = texture, THICK = thickness, VANILLA = vanilla flavor.
^^Letters indicate variables influencing the effect of extrinsic information on the sensory ratings. Effects are either within a group defined by this characteristic or an interaction effect between the characteristic and information conditions. APPEAL = appeal of the product, ATTIT = attitudes/attitudes towards fat content/beliefs/values/concern over processing technology, BODY = body consciousness, BRAIN = brain region, DIET = dietary restraint/concern, FAMILIAR = familiarity, FREQ = frequency of product usage, HABIT = consumption habits, NEO = neophobia, TV = time spent watching TV/movies, RECOG = character recognition, LIKE = character liking, MARITAL = marital status, OCCUP = occupation, WEIGHT = weight status.
[a] Indicates significant effect ($p < .05$) of the extrinsic information alone, or with the effect of a mediating/moderating variable(s).
[b] Indicates a close-to-significant effect ($p < .10$) of the extrinsic information alone, or with the effect of a mediating/moderating variable(s).
[c] Indicates that extrinsic information influenced sensory experience, though blind, informed and expected conditions (as applicable) were not statistically compared.

size norms and inclusion of an explicit measure of taste would have better indicated sensation transfer, though this was not the study aim.

Packaging color had no influence on consumers' liking of potato chips (Piqueras-Fiszman & Spence, 2011) and packaging texture had no influence on the freshness or liking of biscuits, though the roughness of the container did alter perceptions of crunchiness and hardness (Piqueras-Fiszman & Spence, 2012). These null results could be explained as a product of the extrinsic information being irrelevant to the measured outcome. For instance, package texture may not signify freshness or promote liking of a biscuit and package color may not be considered relevant to consumers' liking of potato chips. As reported throughout this review, this mismatch between extrinsic information and the measured sensory outcome is a recurring issue that may explain many of the instances where sensation transfer does not result.

2.1.2. Branding

Five of five studies reported evidence that brand name influenced ratings of taste. Two studies found that cookies branded as 'Kashi' (a brand normally associated with healthy eating) were rated by young women as higher in flavor, satisfaction and overall liking than the same cookies branded as 'Nabisco' (a brand not normally associated with healthy eating) (Cavanagh & Forestell, 2013; Cavanagh et al., 2014). However, brand name did not influence more specific sensory attributes of sweetness, crunchiness, bitterness, sourness or saltiness (Cavanagh & Forestell, 2013). Richardson et al. (1994) identified that products presented under national or well-known brand names were perceived as higher quality than products presented under a cheaper store or generic brand name, while Allen et al. (2008) identified a similar effect for soft drinks. Another study found that changing the brand name of Coca Cola to New Coke did not alter the liking of the drink across the overall sample; however, there was a significant interaction with participant's regularity of Coca Cola consumption (Pierce, 1987). Frequent consumers of Coca Cola rated a sample labeled 'regular Coke' better than a sample labeled 'New Coke', while infrequent consumers preferred the sample labeled 'New Coke', irrespective of the actual drink consumed.

2.1.3. Labeling

Twenty-seven studies examined the influence of labeling on product experience, with 19 identifying sensation transfer, four identifying a contrast effect and four identifying no effect of labeling on product experience.

Descriptive product names were examined in a number of studies. In an early study, Wolfson and Oshinsky (1966) found that a chocolate-flavored liquid space drink was preferred when labeled as 'space food' compared to when it was labeled 'unknown'. However, significance for this between-subjects comparison was not reported and an additional study which conducted the same manipulation within-subjects found no effect of the label. Additionally, the same label manipulation had no effect on chocolate milk samples in either test.

A series of cafeteria-based studies found that savory and sweet items (aggregated together for analysis) were rated as higher quality and tastier when presented with descriptive product names than non-descriptive names (Wansink et al., 2002; Wansink et al.,

2005). Similarly, identical chocolate samples were rated more chocolatey when presented as 'dark' chocolate than when presented as 'milk' chocolate, though the labels did not influence participants' liking of the samples (Shankar et al., 2009), and organically labeled cookies and chips were rated lower in calories, lower in fat and more nutritious than a 'regular' cookie or chip (Lee et al., 2013). Cookies labeled as 'organic' were also liked less and had worse flavor than cookies labeled as 'regular', though organic labeling had no influence on these attributes for potato chips (Lee et al., 2013).

Labels referencing food healthiness or fat-content were the subject of 16 studies. Seven studies identified that a low-fat/healthy label improved the taste or liking of cereal (Lapierre et al., 2011), candy (Irmak et al., 2011), milkshakes (Bowen et al., 2003), ice cream (Bowen et al., 1992), chocolate (Ebneter et al., 2013) or cookies (Soldavini et al., 2012), compared to when the same product was presented with a high-fat/unhealthy label. Without a measure of expectations to determine whether low-fat labels induced a positive expectation, the results of these studies could indicate sensation transfer or contrast. However, two of these studies may shed light on this question by considering the diet status of participants. Diet-conscious women rated milkshakes better when they were labeled 'low-fat' compared to 'high-fat' (Bowen et al., 2003). Further, Irmak, et al. (2011) found that dieting participants rated a candy labeled 'fruit chews' higher than the same product labeled 'candy chews', though non-dieting participants were not similarly influenced. Diet-conscious participants might be assumed to view low-fat labeling favorably, therefore supporting the proposition that low-fat labels induced a positive expectation and prompted sensation transfer, where the supposedly low-fat product was experienced as tasting better.

Conversely, six studies indicated that food with high-fat/unhealthy labels were preferred to the same food presented with low-fat/healthy labels. Four of these studies specifically measured ratings of taste, finding that labeling chocolate (Stubenitsky et al., 1999), mango lassi (similar to a milkshake) (Raghunathan et al., 2006), cookies, cake or muffins (Geiger et al., 2005; Pope & Wolf, 2012) as regular-fat/unhealthy caused them to be rated as tasting better than when they were labeled as low-fat/healthy. One study found that 'hedonically' labeled cookies were rated as more caloric than the same cookies with a 'healthy' label, though it is important to note that calorie perception may be indicative of a successful label manipulation and there was no associated effect of this labeling on product consumption (Gravel et al., 2012). One study measured physiological responses to 'Indulgent' versus 'Sensible' labeling of milkshakes, finding that 'Indulgent' labeling induced a stronger physiological response. However, ratings of taste were not reported and this limits the conclusions that may be drawn about sensation transfer (Crum et al., 2011).

Three studies found no effect of fat-content or health-labeling on taste for muffins (Geiger et al., 2005), cookies (Provencher et al., 2009) or milkshakes (Roefs & Jansen, 2004). In these studies, it is possible that the label was not perceived as relevant to the product taste, with participants expecting a milkshake or a cookie to taste good regardless of the fat content. Provencher et al. (2009) found that young women's assessment of cookie calorie content was not influenced by healthy/unhealthy labeling, though their consumption was higher when the cookie displayed a healthy label. These results clearly demonstrate the limitation of using consumption as a measure of sensation transfer; though the label may induce a change in consumption, this does not guarantee that consumers' perceptions of the product sensory attributes have been altered.

Four studies demonstrated contrast effects, in which the rating of the product is contrasted away from (what is presumed to be) the expectation induced by the extrinsic information. Though these studies do not show sensation transfer, they provide evidence for the ability of extrinsic information to influence taste. Wansink et al. (2004) identified this effect for desserts labeled as 'diet' or 'healthy', Yeomans, et al. (2008) identified this effect for smoked salmon mousse labeled as ice cream, and Wilcox et al. (2011) identified both sensation transfer and contrast effects for country-of-origin labeling and chocolate samples, with the effect of the label dependent upon when this information was provided to consumers.

2.2. Studies comparing blind and informed conditions

The second study design compared products in *blind* (unpackaged/unbranded/unlabeled) and *informed* (packaged/branded/labeled) conditions. Twenty-six studies, reported in 25 articles performed this comparison, of which five studies found no effect of extrinsic information on taste or product liking. In comparison to the previous section, the majority of studies (19/26) employed within-subjects designs.

2.2.1. Packaging

Packaging was examined in five studies, with four finding an effect of extrinsic information on the experience of soft drink and chocolate milk (Gates et al., 2007), crackers, candy (Letona et al., 2014; Roberto et al., 2010) and potato chips (Letona et al., 2014; McDaniel & Baker, 1977). In an early study, McDaniel and Baker (1977) found potato chips from a polyvinyl bag were rated as crisper, tastier and more preferable compared to when the same participants consumed chips from a wax bag. This is despite the fact that the authors had found a separate group of participants to perceive no difference between the chips in a blind taste test. However, no statistical comparison was made between the blind and the informed ratings, limiting the strength of this evidence.

Allison et al. (2004) found that teens who were regular consumers of pre-sweetened breakfast cereal did not rate the product differently in the presence or absence of label and packaging information, though the between-subjects nature of the study design limits this conclusion. In comparison, two studies of children found that the presence of packaging improved hedonic and preference ratings of potato chips, sweet crackers and gummy fruit snacks, compared to a blind condition (Letona et al., 2014; Roberto et al., 2010).

2.2.2. Branding

Ten studies examined the influence of brand name. Two studies suggested that the presence of the brand name altered the experience of chocolate (Bonham et al., 1995) and soft drink (Koenigs & Tranel, 2008), though the lack of a statistical comparison between blind and informed conditions in either study limits this conclusion.

Breneiser and Allen (2011) also found that the presence of the Coca Cola branding improved self-reported preference relative to a blind condition. The study also found that the presence of a store brand name decreased preference for one sample and made no difference for another sample, indicating different effects of sensation transfer according to the type of branding used. Gates et al. (2007) similarly found that younger participants liked soft drink and chocolate milk more in the branded, relative to the unbranded condition.

Two studies examining consumption of pizza, cookies, pudding, chips and chocolate milk found mixed results. Keller et al. (2012) found that children generally consumed more of the branded food than the unbranded food, though this analysis collapsed across savory and sweet products and no effect was found when the

products were considered separately. Conversely, Forman, et al. (2009) found that unbranded chocolate milk was preferred to branded chocolate milk, though there was no effect of branding on the other products. In another study, Robinson, et al. (2007) found that brand information improved preference for chicken nuggets and French fries, but had no effect on hamburgers. Similarly, two studies found that brand and label information influenced ratings of chocolate milk (Kim et al., 2013) and milk desserts (Vidal et al., 2013), though these effects differed across the samples and labels tested.

One study found no evidence for sensation transfer, with participants rating potato chips equally in informed and blind conditions (Bower & Turner, 2001).

2.2.3. Labeling

Fifteen studies examined labeling. Four studies found no effect of labeling on the likeability or taste of dulce de leche (a sweet dairy product) (Giménez et al., 2008), chocolate mousse cake (Steenhuis et al., 2010), chocolate-flavored cereal (Allison et al., 2004) or potato chips (Miller et al., 1998). The latter study did find an effect of the label on product consumption (Miller et al., 1998), which indicates that consumption outcomes may be influenced by a number of factors besides taste and are not necessarily an appropriate measure of sensation transfer.

Eleven studies reported that the presence of label information changed the taste or liking of potato chips (Levis & Chambers, 1996), chocolate (Didier & Lucie, 2008; Ebneter et al., 2013), cookies (Cavanagh et al., 2014; Engell et al., 1998), ice cream (Parker & Penfield, 2005; Light et al., 1992), milk desserts (Vidal et al., 2013) and flavored milk (Kim et al., 2013; Shepherd et al., 1991/92). However, several reported that these effects were limited to, or differed across, different product samples (Didier & Lucie, 2008; Kim et al., 2013; Levis & Chambers, 1996; Parker & Penfield, 2005; Vidal et al., 2013), or were limited to particular sensory outcomes (Engell et al., 1998; Kim et al., 2013; Parker & Penfield, 2005).

Additionally, many studies reported contradictory results. For instance, taste preference for chocolate was higher without a calorie label in Ebneter et al. (2013), though the flavor of cookies was rated lower without a calorie label compared to a low-calorie label (Cavanagh et al., 2014). Further, Kim, et al. (2013) found that organic milk was not rated differently in the presence or absence of an organic label, yet Didier and Lucie (2008) found that organic labeling improved ratings of chocolate relative to a blind condition and non-organic labeling decreased ratings of one product relative to a blind condition. These results indicate that the product being tested can significantly alter the impact of any particular label.

2.3. Studies incorporating a measure of expectations

Two study designs incorporated a measure of expectation. The first design measured the same product under *multiple informed* conditions, but also incorporated a pre-taste measure of *expectation* of the pack, brand or label. Seven studies (reported in six articles) employed this design. The second study design in this section compared products in *blind* and *informed* conditions while also measuring pre-taste *expectations*. Twelve studies (reported in 11 articles) employed this design. Overall, three studies found no effect of extrinsic information on product experience and one study found a contrast effect. The majority of the studies in this section (18/19) employed a within-subjects comparison between expectations and blind/informed ratings, though seven studies compared blind and informed, or multiple informed ratings, between subjects.

Three additional studies (discussed in previous sections) included a measure of expectations but have not been included here, either because the measure was not for the same hedonic outcome as reported in blind and informed conditions (Bower & Turner, 2001; Didier & Lucie, 2008), or because the measure consisted of a product ranking that was not statistically compared to blind or informed rankings and a clearer statistical comparison of blind and informed conditions was otherwise provided (Bower & Turner, 2001; Levis & Chambers, 1996).

2.3.1. Packaging

One study examined the influence of packaging/labeling on hedonic ratings of biscuits, finding that the presence compared to the absence of extrinsic information did not influence ratings (Carrillo et al., 2012). Interestingly, the expectations induced by the packs/labels differed from blind ratings of the product for only 2/10 of the samples, indicating that the expectation engendered by the extrinsic information accurately matched the objective properties of the biscuits, leaving no room for a transfer of additional sensory attributes.

2.3.2. Branding

Six studies found that brand name induced sensation transfer for soft drink (Kühn & Gallinat, 2013; McClure et al., 2004; Woolfolk et al., 1983), chocolate cake (Sosa & Hough, 2006), chocolate (Torres-Moreno et al., 2012) and blackcurrant squash (Ng et al., 2013). However, the latter two studies found that the effect differed according to the product sample being tested. Torres-Moreno et al. (2012) found that brand information induced sensation transfer, but only for one of the six chocolates tested. Though the expected and blind ratings of another three samples significantly differed, the informed ratings did not shift in the direction of the expectation. Ng et al. (2013) also found different results for different products tested. Seven of the 11 blackcurrant squash samples in that study demonstrated sensation transfer, yet the expected ratings for six of the brands were higher than the blind rating, while one brand showed the opposite pattern.

Two studies examining neurological correlates of sensation transfer indicated that extrinsic information changed patterns of brain activation. McClure et al. (2004) identified greater brain activity in areas involved in emotion and behavior when Coca Cola branding was present compared to absent, though Pepsi branding had no such effect. These results suggest that extrinsic information activates areas of the brain, which subsequently alters how sensory information is processed.

In another study, Kühn and Gallinat (2013) found that prior to tasting, weak brand cues (River Cola and T-Cola) activated brain regions involved in encoding stimulus value to a greater extent than strong brand cues (Coca Cola and Pepsi Cola). When the sample was tasted, areas of the brain involved in encoding reward value were activated more by strong brand cues than weak brand cues. This suggests that extrinsic information biases both the anticipatory and actual response to a stimulus and that well-known brands may bias the brain to perceive a reward without as much need for the stimulus value to be encoded.

2.3.3. Labeling

Fifteen studies examined the effect of labeling. Three found no evidence of sensation transfer, though the reasons for this differed across studies. As reported previously, Carrillo, et al. (2012) found that the expectation induced by the packaging/labeling accurately reflected the sensory properties of the product. Roberto et al. (2012) found that the extrinsic information failed to elicit any expectation of cereal taste, while Norton et al. (2013) found that although an expectation was elicited, it did not change consumers' experiences.

Ten studies found evidence for sensation transfer for

blackcurrant squash (Ng et al., 2013), chocolate (Kähkönen et al., 1999; Lotz et al., 2013; Torres-Moreno et al., 2012), pudding and root beer (Tuorila, Meiselman, et al., 1994), corn chips (Dougherty & Shanteau, 1999), cake (Tuorila, Cardello, et al., 1994) and chocolate pudding (Cardello, 2003). However, Kähkönen, et al. (1999) found that the effect on chocolate taste did not operate through an effect of expectation as induced by the label. Informed ratings of 'flavorful', 'basic' and 'reduced fat' chocolates differed for the male participants, providing evidence for sensation transfer. However, informed ratings did not shift away from the lower blind ratings and towards the higher expectation, as would be hypothesized.

Tuorila, Cardello, et al. (1994) further indicated that the analysis method can significantly influence whether an effect is observed. The study identified that individually, ratings of cake in the informed condition shifted towards each participant's expectation, providing evidence for sensation transfer. However, some subjects expected the 'diet' cake to taste worse and others expected it to taste better, leading to a null result when analyzed on a group level.

Two studies provide evidence for the mechanism of sensation transfer. Ng et al. (2011) found that the presence of a 'regular' label prior to tasting activated areas of the brain involved in reward evaluation, somatosensory and gustatory processing more than a 'low-fat' label, and this effect was stronger for obese participants. These results suggest that extrinsic information elicits neurological responses even before the product is tasted, illustrating the potential for extrinsic information to bias subsequent processing of sensory input. Additionally, in two studies, Lotz, et al. (2013) found 'fair trade' chocolate was rated as better tasting than the same chocolate provided with a conventional label. Though most studies in this review are based on the premise that extrinsic information induces expectations of taste, extrinsic information that has an emotional or 'social responsibility' component may also change perception by biasing consumers' mood. Lotz et al. (2013) found that the majority of the sample expected there to be *no* difference in taste between the chocolates, with further analysis identifying that the fair trade label instead induced positive affect.

One study identified a contrast effect. Yeomans et al. (2008) identified that participants expected smoked-salmon mousse to taste more pleasant, sweet, fruity, creamy and less salty than when it was labeled as 'ice cream' compared to 'savory mousse'. However, the hedonic and sweetness ratings of ice cream in the informed condition were significantly lower than the expected ratings of these attributes. Participants' ratings of the products in the informed conditions also showed that the product with the 'ice cream' label was significantly less pleasant, less sweet and more salty than the product with the 'savory' label, though informed ratings of creaminess, fruitiness, savoriness, bitterness, sourness and strength did not differ. This study therefore illustrates a contrast effect, in which the ratings of the ice cream were exaggerated away from the expectation due to a surprisingly negative experience.

2.4. The influence of frequency of consumption and familiarity

Nine studies included regular consumption of the target product or brand as an inclusion criterion for participants (Allison et al., 2004; Carrillo et al., 2012; Giménez et al., 2008; Kim et al., 2013; Lotz et al., 2013; Ng et al., 2013; Stubenitsky et al., 1999; Vidal et al., 2013) and many additional studies specifically investigated these factors.

Frequency of consumption of the product category (e.g., chocolate) or use of a type of label may influence sensation transfer by altering how knowledgeable the participant is about the product, which may make them *less* susceptible to the effect of extrinsic information. Lee et al. (2013) found that non-users of nutrition labels or those who did not purchase organic foods frequently were more influenced by the label in their calorie judgments. Use of nutrition labels or frequency of organic food purchase had no effect on ratings of nutrition, perhaps suggesting that use of nutrition labels/organic foods did not influence sensation transfer, but that frequent users were more aware of nutritional properties and were able to judge calorie content without relying on label claims. Similarly, fat-content labeling had no influence in Norton et al. (2013), in which the majority of participants were regular chocolate consumers and may have been more knowledgeable about the quality of reduced-fat chocolate products. This compares to Ebneter et al. (2013), who found a significant effect of low-fat labeling on chocolate products and who did not specify regular consumption as a recruitment criterion. Similar reasoning may explain the disparities in findings between Allison et al. (2004) and Lapierre et al. (2011).

Frequency of use of low-fat foods may also engender a more favorable attitude towards the product category (Tuorila, Cardello, et al., 1994), as experience may have taught participants that low-fat cake does not necessarily differ from regular-fat cake.

On the other hand, familiarity with the brand name or frequency of consumption of a particular brand is likely to signal brand loyalty, which may influence sensation transfer in different ways. In the case of a well-known brand such as Coca Cola, both frequent and infrequent consumers are likely to hold expectations of the drink. In this circumstance, both groups may be influenced by the extrinsic information, though the type of influence that the branding has will differ between groups, as occurred in Pierce (1987).

Kühn and Gallinat (2013) found that Coca Cola and Pepsi Cola brand cues activated brain areas associated with reward processing more than River Cola and T-Cola brand cues and this was particularly apparent among irregular cola drinkers. These results indicate that unfamiliar consumers may place more reliance on the brand cue. Studies of self-reported taste have found that being familiar with the brand can induce a stronger sensation transfer effect, presumably because the expectation of the brand is stronger among this group. Indeed, Robinson, et al. (2007), collapsing across healthy and unhealthy products, found that children who ate McDonald's frequently were more strongly influenced by McDonald's branding than those who ate McDonald's infrequently.

2.5. The influence of personal characteristics

The results of this review suggest that personal characteristics can influence sensation transfer, but only where the characteristic is relevant to how the extrinsic information is interpreted. As seen in Table 3, a variety of different characteristics were examined by various studies. The characteristics receiving repeated attention in the literature are summarized below.

The influence of age was examined in seven studies (Gates et al., 2007; Lee et al., 2013; Letona et al., 2014; Pierce, 1987; Pope & Wolf, 2012; Roberto et al., 2010; Robinson et al., 2007). In a sample of 12–30 year-olds, increased age was shown to decrease informed hedonic ratings relative to a blind condition, in an investigation of product packaging for soft drinks and chocolate milk (Gates et al., 2007). The influence of age in this study could be attributed to the fact that younger participants were more likely than older participants to identify with the brand names of chocolate milk and soft drinks. Indeed, Gates, et al. (2007) also found that participants who thought the packaging was designed to appeal to them gave higher ratings of the branded beverages than those who did not think the packaging was designed to appeal to them. This suggests

that it is the perceived relevance of the extrinsic information or the product that may be driving differences between demographic groups. The null-effect of age in other studies may be explained in similar terms. For instance, young and old participants may find equal relevance in organic labeling for cookies and chips (explaining the results in Lee et al., 2013), or in reduced-fat labeling for chocolate (explaining the results in Norton et al., 2013). Equally, null-effects of age may be due to equal relevance of the extrinsic information to all participants within a narrow age range (Pope & Wolf, 2012; Roberto et al., 2010; Robinson et al., 2007).

Eight studies included a specific gender as an inclusion criterion (Bowen et al., 2003; Cavanagh & Forestell, 2013; Cavanagh et al., 2014; Ebneter et al., 2013; Ng et al., 2011; Provencher et al., 2009; Roefs & Jansen, 2004; Steenhuis et al., 2010). Fourteen additional studies examined the effect of gender, with some finding that males and females showed different patterns of responses to extrinsic information (Bowen et al., 1992; Breneiser & Allen, 2011; Kähkönen et al., 1999; Keller et al., 2012) and others finding no effect of gender (Bonham et al., 1995; Gates et al., 2007; Lee et al., 2013; Letona et al., 2014; Miller et al., 1998; Norton et al., 2013; Pierce, 1987; Roberto et al., 2010; Robinson et al., 2007). Gender may influence sensation transfer where it is relevant to how the extrinsic information is perceived, which will depend on the study context. Stronger effects of fat-content labeling observed among women (Bowen et al., 1992) might be explained by the fact that women are more likely to be dissatisfied with their body and are more likely to avoid fattening foods than men (Markey & Markey, 2005; Rolls, Fedoroff, & Guthrie, 1991). Indeed, three of the seven studies finding that low-fat/healthy labels were *preferred* to high-fat/unhealthy labels only included women (Bowen et al., 2003; Ebneter et al., 2013; Soldavini et al., 2012).

However, three studies in this review which found no difference between low- and high-fat content labels included only women (Cavanagh et al., 2014; Provencher et al., 2009; Roefs & Jansen, 2004), suggesting that other factors may contribute to sensation transfer and the context of the study should be taken into account. The fact that women were not more strongly influenced by fat content labeling for chocolate in Norton et al. (2013) could be explained by the majority of participants being regular chocolate consumers. In that instance, gender may not have influenced the results because participants' experience was the dominant factor in determining sensation transfer. Further, where gender is not relevant to interpretation of extrinsic information it would not be likely to influence sensation transfer. For instance, males and females may react equally to the influence of a gender-neutral organic label, perhaps explaining the null effect of gender in Lee et al. (2013).

Another demographic factor considered by Sosa and Hough (2006) was the socio-economic status (SES) of participants. Children from medium and high-income families rated chocolate cake better when it was presented under an expensive brand name, compared to a cheaper brand name, while children from low-income families rated the samples equally. Lower-SES participants might be assumed to have less disposable income and more experience with cheaper products. Thus, SES might have influenced how the information about expensive and cheap brands was interpreted.

The effect of weight status, dietary restraint or attitudes to fat-content may be explained in a similar way. Nine studies examined the influence of participants' weight with seven finding no effect (Keller et al., 2012; Lee et al., 2013; Norton et al., 2013; Provencher et al., 2009; Roberto et al., 2012; Roefs & Jansen, 2004; Steenhuis et al., 2010). Of the two studies which did find an effect of weight status, Ng, et al. (2011) examined the influence of fat-content labeling, finding that obese participants were more strongly influenced than lean participants. Forman et al. (2009) also found that overweight children ate more when food was branded and non-overweight children ate less when food was branded, compared to unbranded. However, the difference between branded and unbranded was not significantly different within either group, corroborating the findings of Keller et al. (2012).

Eight studies found no effect of dietary restraint or attitudes towards low- or high-fat foods (Crum et al., 2011; Geiger et al., 2005; Lee et al., 2013; Norton et al., 2013; Provencher et al., 2009; Roberto et al., 2012; Steenhuis et al., 2010; Stubenitsky et al., 1999), though seven studies found that sensation transfer was influenced by these factors (Engell et al., 1998; Geiger et al., 2005; Gravel et al., 2012; Irmak et al., 2011; Miller et al., 1998; Shepherd et al., 1991/92; Tuorila, Cardello, et al., 1994).

Tuorila, Cardello, et al. (1994) found that participants' tendency to eat low-fat foods positively predicted their expectations of these foods, confirming the hypothesis that personal characteristics exert influence when they are relevant to how the extrinsic information is interpreted. In Shepherd et al. (1991/92) fat-content labeling had no influence on hedonic ratings for the sample as a whole, though significant effects were found within subgroups with different attitudes towards fat content. This suggests that the low- and high-fat labels held different meanings for different participants. Interestingly, attributes of sweetness and 'body' showed significant effects for the sample as a whole, but not for the groups of participants with different attitudes. This suggests that participant characteristics can also influence the relevance of particular sensory attributes: while general liking is likely to be influenced by one's attitude towards low-fat products, more specific sensory qualities may be equally relevant to all consumers. Similarly in Engell et al. (1998), attitudes towards high-fat foods influenced preference for cookie samples but did not influence hedonic ratings, or ratings of crunchiness, texture or sweetness.

Irmak et al. (2011) found that dieters were affected by the label given to a candy while non-dieters were not influenced. Again, the influence of diet status needs to be considered in the context of the study. Labeling a candy as either a 'candy chew' or 'fruit chew', which subtly references healthiness, may make health concerns more salient among participants who have a predisposition to monitor what they eat.

All of the studies finding no effect of dietary factors, except Lee et al. (2013), investigated healthy/fat-content labeling, which might be expected to hold particular relevance for dieting participants. The null results in these studies might be explained by a consideration of the study context. As previously discussed, the small number of dieters in Geiger et al. (2005) may have limited the analysis. In the case of Roberto et al. (2012) and Roefs and Jansen (2004) the extrinsic information (nutritional/fat-content information) may not have been relevant to the *taste* of a cereal or milkshake and in Lee et al. (2013) organic labeling may have been equally relevant, in either dietary restraint/weight status group. Similarly, the null-effects in Steenhuis et al. (2010) may suggest that a nutrition logo is likely irrelevant to the perception of an obviously unhealthy product (cake) and would therefore not influence consumption regardless of dietary/weight status. Gravel et al. (2012) and Provencher et al. (2009) both had a similar label manipulation for cookies, but showed the opposite pattern of results in calorie and consumption ratings and in the influence of dietary restraint. In the same way that the composition of the participant sample may override the effect of gender, dietary restraint or weight status in Norton et al. (2013), it is notable that Provencher et al. (2009) surveyed only women while Gravel et al. (2012) had a sample of mixed genders.

3. Discussion

This review, covering 78 studies in 69 articles, provides strong evidence for the ability of packaging, branding and labeling to change the experience of unhealthy food and drink. Sixty-five of the 78 studies found that extrinsic information changed the self-reported sensory experience of unhealthy food and drink.

Of the 13 studies that did not find evidence of sensation transfer effects, nine studies did not find any effect of extrinsic information on sensory expectation and/or experience (Allison et al., 2004; Bower & Turner, 2001; Geiger et al., 2005; Giménez et al., 2008; Piqueras-Fiszman & Spence, 2011; Roberto et al., 2012; Roefs & Jansen, 2004; Steenhuis et al., 2010; Wolfson & Oshinsky, 1966), two studies found an effect on expectation but not subsequent experience for at least some of the products/extrinsic information tested (Carrillo et al., 2012; Norton et al., 2013) and two studies found an effect on consumption outcomes but not hedonic or calorie outcomes (Miller et al., 1998; Provencher et al., 2009), indicating that consumption is not a suitable indicator of sensation transfer. Four further studies found an effect on consumption/physiological outcomes and did not report a measure of self-reported taste (Crum et al., 2011; Forman et al., 2009; Keller et al., 2012; Madzharov & Block, 2010). As consumption/physiological outcomes may be influenced by other factors (such as consumption norms or hunger level), these studies should be considered as tentative support for sensation transfer, though it is acknowledged that the identification of this effect may not have been their primary aim.

Five studies identified a contrast effect as well as, or instead of, sensation transfer, in which the rating of taste was shifted *away from* the expectation (Wansink et al., 2004; Wilcox et al., 2011; Yeomans et al., 2008). Though these studies are evidence that extrinsic information can shape sensory perception, they do not demonstrate sensation transfer.

Overall, the studies measuring expectations support the explanation of sensation transfer adopted by the pre-existing literature; namely, that extrinsic information elicits an expectation, which then informs how sensory input is processed (Piqueras-Fiszman & Spence, 2015). Support for this explanation is further shown through studies which suggest that extrinsic information has the potential to activate brain regions involved in processing sensory information, even before the product is actually tasted (Kühn & Gallinat, 2013; Ng et al., 2011).

Study designs incorporating a measure of expectations also allowed a distinction to be made between situations in which a null-effect could be attributed to (a) the failure of extrinsic information to induce an expectation about the target attribute, or (b) the failure of that expectation to change product experience. Measurement of pre-taste expectations and post-taste experiences on the same scale provides the ability to directly compare expectations to experience. However, repeated measures of this kind may prime participants to the study aims and to particular experiences and study designs should attempt to separate (from the perspective of the consumer) the measurement of expectations from the measurement of product experience, as much as is reasonably practicable.

Where extrinsic information does not elicit an expectation about the target attribute, it could be that the extrinsic information is irrelevant to that attribute for that particular product. For instance, the results of Roberto et al. (2012) could be attributed to the fact that consumers do not consider a nutrition label to be relevant to their liking of sugary cereal. Similarly, high-fat labels might be relevant to the perception of oiliness and fattiness, but fat content might be considered irrelevant to flavor, sweetness, saltiness or creaminess of ice cream, explaining the results in Bowen et al. (1992). It could also be that the expectation elicited accurately represents the sensory properties of the product, leading to a match between expectations and blind ratings as in Torres-Moreno et al. (2012). Sensation transfer does not occur in this instance because there are no additional attributes represented by the extrinsic information to be transferred to the product, and not because sensation transfer is not possible. Where an expectation is induced but does not change product perception, as in Carrillo et al. (2012), Kähkönen et al. (1999) or Norton et al. (2013), it is possible that expectations elicited may not have been strong enough to override the objective sensory input. Further research should consider examining the strength of the expectation, as has been suggested by previous authors (Shankar et al., 2010).

Many studies showed that, particularly in the case of labeling, extrinsic information changed some sensory attributes but not others. For instance, fat-content labeling may not change the expectation (or subsequent experience) of mouthfeel or thickness, but it might induce expectations of liking, explaining the results in Kim et al. (2013). It is therefore important to consider the match between the extrinsic information, the type of expectations it might induce and the outcome being measured. Additionally, measures should aim to capture all elements of product experience. It is possible that certain attributes only displayed significant results due to the absence of other, more relevant descriptors. For example, the significant effect on ice cream 'flavor' identified in Parker and Penfield (2005) may only have been observed due to the absence of other attributes, such as oiliness or satisfaction, as measured in Bowen et al. (1992).

Assessing more targeted as well as general outcomes may also provide a better picture of the circumstances under which sensation transfer occurs. Notably, 12 of the 13 studies finding no effect of extrinsic information only measured general, hedonic outcomes (Bower & Turner, 2001; Carrillo et al., 2012; Geiger et al., 2005; Giménez et al., 2008; Miller et al., 1998; Norton et al., 2013; Piqueras-Fiszman & Spence, 2011; Roberto et al., 2012; Roefs & Jansen, 2004; Steenhuis et al., 2010; Wolfson & Oshinsky, 1966) or limited specific outcomes (Provencher et al., 2009). It is possible that the extrinsic information in these studies did elicit expectations, but these expectations may have been about attributes that were not measured. The disjoint between expectations and outcome measures in these and other studies may be due to the fact that some studies in this review did not investigate sensation transfer as their primary aim. Further, it is possible that for certain products, packaging, branding and labeling may induce affective, rather than *sensory* expectations, as occurred in Lotz et al. (2013). This may explain the inconsistencies observed with studies addressing organic labeling. However, other recently published research found that participants' mood played no role in the establishment of taste expectations and instead, organic labeling influenced taste expectations by inducing moral satisfaction (Bratanova et al., 2015). This suggests that for extrinsic information with an ethical component, sensation transfer may involve a more complicated set of factors and may require a different approach to evaluation. In comparison, certain types of extrinsic information appear to be strong indicators of sensory properties. For instance, products presented with well-known branding consistently showed more favorable results than products presented with store/generic branding (Allen et al., 2008; Bonham et al., 1995; Richardson et al., 1994).

Consistent with the suggestion of Wansink et al., 2004, the studies in this review have shown that the product is an integral part of the sensation transfer process and should not be considered a merely passive medium for the demonstration of this effect. For instance, a hamburger might be expected to taste good regardless of the brand name and thus the presence or absence of branding

would not be expected to change how that product is experienced, explaining the results in Robinson et al. (2007). Of the products that were used in multiple studies (such as milkshakes, chips, cookies, chocolate), there was no evidence that any particular product would not display sensation transfer in any context, though the interplay between the product, extrinsic information, participant sample and study context may be important in explaining where sensation transfer is not observed. Future research therefore needs to specifically define the type and condition of products used and ought to carefully consider the justification for, and the potential implications of, collapsing results across different products or types of extrinsic information.

Additionally, consistent with Piqueras-Fiszman and Spence (2015), this review identified key roles for participant characteristics and familiarity with the product/brand as determinants of the effect of extrinsic information on taste. The conclusion of this review is that a demographic difference may be an important consideration in whether sensation transfer will be observed, when a particular demographic characteristic alters the *relevance* of the extrinsic information. Consideration of these factors might also explain the null results of some studies. For instance, Shepherd, et al. (1991/92) found that participants with positive attitudes towards full-fat milk preferred samples with a high-fat label to samples with a low-fat label, relative to a blind condition, while participants with positive attitudes towards low-fat milk showed the opposite pattern. Other studies finding no significant effect of fat-content/nutritional information on similar products (e.g. Light et al., 1992) may have found different results had the attitudes of participants towards fat content been considered, though within each study considerations of sample size and statistical power may have prohibited such an analysis.

Further, the variation in results across a participant sample ought to be considered. Shankar et al. (2009) hypothesized that while a 'dark chocolate' label may elicit an expectation of liking, people may vary in whether this is a positive or a negative hedonic expectation. Although the label may indeed have influenced the likeability of the chocolate, it may have done so in different directions for different participants, nullifying any overall effect. Indeed, Tuorila, Cardello, et al. (1994) found that sensation transfer was identified on an individual level, but not when ratings of the product were averaged across participants. This highlights the advantage of within-subjects designs, in which ratings are taken from the same person. Notably, the majority of designs comparing blind and informed conditions or including a measure of expectation utilized a within-subjects paradigm, while the majority of studies examining multiple informed conditions examined these effects between subjects. Practically, it may be difficult to provide participants with the same product under multiple conditions without alerting them to the aim of the experiment. Additionally, within-subjects designs are problematic because the measurement of expectations might cue participants to a product attribute that may have otherwise gone unnoticed. However, this review has indicated that personal characteristics and familiarity with the product play an influential role in this effect. Within-subjects designs generally provide stronger evidence for sensation transfer, showing that the same person experienced identical products differently in different information conditions. Between-subjects designs are problematic in that ratings are provided by participants with different prior experiences and different expectations, which limits the ability of the researcher to detect whether a consumer's expectation influences taste.

Frequency of consumption of the product or familiarity with the brand was an important factor specifically considered by several studies in this review – either as a recruitment criterion or as a moderating variable. In particular, familiarity with a brand may indicate brand loyalty and more favorable expectations of product taste than are held by unfamiliar consumers. Sensation transfer may be stronger among familiar participants, though it is also important to consider that products with a universally strong brand image may elicit expectations among both familiar and unfamiliar consumers. This review suggests that while frequency of use and familiarity are important factors, their effects may differ depending on the study context. Therefore, while this review cannot provide definitive evidence about how familiarity will influence sensation transfer, it recommends that this factor is considered in the design of future research.

3.1. Limitations & conclusions

This review found strong evidence of sensation transfer effects in the literature on unhealthy food and drink, though it is notable that the effect was significantly influenced by the study context, including the product, type of pack/brand/label and the individual participant. These factors should be carefully considered in future research. In particular, many of the studies in this review evaluated package, brand or label manipulations, but presented participants with food or drink in plastic cups or on plates (see e.g., Bonham et al., 1995; Dougherty & Shanteau, 1999; Forman et al., 2009; Pierce, 1987). Other studies have shown that cutlery and crockery can exert its own effect on the sensory experience of food (Harrar & Spence, 2013; Piqueras-Fiszman, Alcaide, Roura, & Spence, 2012; Schifferstein, 2009; Spence et al., 2012; Spence & Wan, 2015), as can portion size (Wansink & Chandon, 2014; Wansink & Kim, 2005) and the environment in which a meal is consumed (Wansink, 2004). Future research should also consider the combined effects of different forms of extrinsic information and aim to separate these as much as possible.

It is also notable that many studies in this review did not report effect sizes. Though the review provides evidence that sensation transfer is observed in the majority of cases, it does not allow a conclusion to be drawn about the strength of this effect or whether stronger effects are observed with different products or forms of extrinsic information.

Finally, the lack of a restriction on publication date for eligible studies is both a strength and a limitation of the current review. This review covers some of the earliest evidence of sensation transfer and indicates that these early findings are supported by more recent research. However, it is notable that consumption norms and attitudes towards food have changed dramatically over the last several decades. It cannot be assumed that the same label or product will be interpreted the same way in 1966 and 2015. For instance, greater awareness of the health implications of sugar and fat content in recent years may influence consumers' acceptance of health and nutrition labeling. Additionally, as noted by Piqueras-Fiszman and Spence (2015), modern consumers may be more inclined to seek out unique consumption experiences. Different results might therefore be observed in a modern experiment labeling a product as 'space food' (as in Wolfson & Oshinsky, 1966) or where smoked-salmon mousse is presented as ice cream (as in Yeomans et al., 2008).

Notwithstanding these limitations, this review has found strong evidence for sensation transfer effects of packaging, branding and labeling in the experience of unhealthy food and drink. The failure to identify sensation transfer and discrepancies between studies was generally linked to the experimental design or the participant sample, suggesting that all forms of extrinsic information were capable of inducing sensation transfer under the right circumstances. Further investigations of these effects would provide a greater understanding of consumer behavior.

Conflict of interest

The authors have no conflict of interest to declare.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.appet.2016.01.022.

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