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Toward Multisensory Customer Experiences: A Cross-Disciplinary Bibliometric Review and Future Research Directions

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Toward Multisensory Customer Experiences: A Cross-Disciplinary Bibliometric Review and Future Research Directions

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Abstract

An in-depth understanding of multisensory customer experiences could inform and transform service experiences across the touchpoints of customer journeys. Sensory research in service and marketing disciplines mostly refers to individual senses in isolation. However, relevant insights could be gleaned from other disciplines to explore the multisensory nature of customer experiences. Noting the fragmented state of research surrounding such topics, the current article presents a systematic, objective overview of the content and theoretical foundations underlying the notion of multisensory customer experiences. Seeking a holistic understanding and research agenda for service research, the authors adopt both text mining and co-citation analyses overlaying findings from the cross-disciplinary foundation to uncover relevant theoretical, conceptual, and methodological developments. The resulting research agenda encourages scholars to employ diverse theories and methods to investigate multisensory stimuli, their integration, and perception, as well as the link between multisensory customer experiences and emotions. These insights then can inform the design of multisensory omnichannel service experiences.

> *Bricks and mortar will truly not fuse into brick and click until we understand how human senses work and how we improve multisensory engagement in any brand.*
> —Ari Peralta (in Pinnock 2018)

Service providers increasingly invest in marketing tactics designed to stimulate customers' senses (vision, touch, smell, sound, and taste), trigger memories of past experiences, and encourage associations that guide their responses (Mishra et al. 2021). However, extant literature lacks a comprehensive, theoretical understanding of such sensory experiences (Mahr, Stead, and Odekerken-Schröder 2019), which impedes theoretical advances (Sample, Hagtvedt, and Brasel 2020) and undermines practical implementations of meaningful multisensory stimulation (*Forbes 2018*). Learning how to manage consistent customer experiences across touchpoints in an omnichannel customer journey is a research priority (Marketing Science Institute 2020). But to exploit the full potential of multisensory customer experiences, we need an expansive, cross-disciplinary perspective on sensory dimensions.

Instead, most service and sensory marketing researchers specify the unique effects of products' visual, tactile, olfactory, auditory, or gustatory properties on customer evaluations and behaviors (Biswas et al. 2014; Mishra et al. 2021). Although

studies of stimuli in service environments, spanning both the atmospherics of offline stores (Mattila and Wirtz 2001; Spence et al. 2014) and webmospherics of e-tailing (e.g., Kahn 2017; Petit, Velasco, and Spence 2019), provide important insights, they tend to be limited to distinct effects linked to individual senses (Helmefalk and Hultén 2017; Spence et al. 2014) or perhaps combinations of two senses (Roschk, Correia Loureiro, and Breitsohl 2017; Roschk and Hosseinpour 2020). That is, multisensory customer experiences hold great potential, but

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extant literature largely ignores the activation and interplay of multiple senses simultaneously (Scott and Uncles 2018; Spence et al. 2014). In calling for more explicit multisensory approaches, Fulkerson (2014, p. 372) notes that "Instead of focusing on the individual senses in unrealistic isolation … the individual senses are deeply intertwined, and … our perceptual experience is inherently multisensory," and Spence (2020, p. 20) further concludes that "Integrated sensory inputs produce far richer experiences than would be predicted from their simple coexistence or the linear sum of their individual products." Thus, considering the simultaneous activation and interplay of multiple sensory stimuli that trigger processing across different modalities is crucial for understanding multisensory customer experiences.

To do so, we should zoom out and look beyond service or sensory marketing research. However, while sensory research in multiple other disciplines tends to be richer and more mature, it also remains heterogenous, diverse, and fragmented (Zhu and Mehta 2017). With a comprehensive, cross-disciplinary overview of fragmented research, we attempt to reconcile various findings and establish a clear structure for service scholars who seek to understand multisensory customer experiences. We know already that customers rely on all their senses to form perceptions and adapt their behaviors in service environments, particularly when switching between different service channels, for example, from physical to online or omnichannel services (Spence et al. 2014; Stead, Odekerken-Schröder, and Mahr 2021). Therefore, we adopt a macro perspective to explore, systematically and objectively, existing literature within and beyond the service domain. Then with a services and sensory marketing lens, applied to findings from other disciplines, we propose ways to advance multisensory research in services and sensory marketing. Three research questions guide our inquiry:

(1) What research areas, theoretical concepts, and roots pertaining to multisensory customer experiences appear in prior service and sensory marketing literature?
(2) What sensory research areas, theoretical concepts, and roots pertaining to multisensory customer experience appear in other disciplines?
(3) How can cross-disciplinary research insights (theoretical and methodological) guide service research and advance multisensory customer experience research?

With relevant insights from diverse research domains, we address these questions and in turn make four main contributions to sensory research on customer experiences in services and marketing.

First, with an objective, systematic approach, we map the status of sensory research, within and beyond service and sensory marketing disciplines, which helps streamlining this diverse, fragmented literature stream. Second, our mixed-method approach generates visual maps that illustrate the theoretical foundation and evolution of sensory research from a cross-disciplinary perspective. By linking theories and methodologies from different disciplines, we identify relevant

research gaps, theoretical foundations, and methodological toolkits. Third, we set an agenda for further research that can integrate theories and concepts available in service, sensory marketing, and other relevant disciplines to advance insights into multisensory customer experiences. In particular, we highlight the need to investigate multisensory customer experiences systematically and in a multidisciplinary way, to integrate current knowledge on this complex phenomenon. Fourth, methodologically, we combine co-citation and text mining methods from bibliometric research (Randhawa, Wilden, and Hohberger 2016) to overcome some biases of traditional literature reviews (Podsakoff et al. 2005). Rather than personal recollection and conjecture, the co-citation component gathers data from scholarly articles and supports a systematic assessment of the origins, current status, and evolution of extant literature (Wilden et al. 2017). Then the text mining component helps remove bias from "within-text" dictionary development, text coding, concept correlation, and concept mapping steps (Liesch et al. 2011).

Theoretical Background

Senses in Service Environments

Although the service discipline recognizes sensory dimensions as integral, few studies specify how senses actually shape service experiences (Mahr, Stead, & Odekerken-Schröder 2019). The available research reveals that various stimuli in the servicescape evoke customer responses and behavior (Pareigis, Echeverri, & Edvardsson 2012). A servicescape refers to the combination of service provision and physical environments that shape customer experiences (Bitner 1992), and its three dimensions constitute stimuli: ambient conditions, spatial layout, and functionality. These dimensions are manifested as service-specific features and signs, symbols, and artifacts (Mari & Poggesi 2013), as part of the materially staged servicescape (Chronis 2019) that service providers create within the physical environment to influence customer behavior. They also reflect communicatively staged servicescapes or verbal communications among actors and their influences (Pareigis, Echeverri, & Edvardsson 2012). Both material and communicative staging can be strategically implemented and managed (Chronis 2019), though the actual connections of induced and uncontrolled stimuli, and how they relate to customers' five senses, are unclear (Scott and Uncles 2018).

Senses in Marketing Literature

Sensory research investigates the role of human senses (Krishna 2012); in the earliest entry, Aristotle proposed a theory of esthesis and hierarchical ordering of senses, with touch at the top, enhanced by all other senses (Krishna 2012). But humans appear to switch among sensory modalities almost simultaneously (Yanagisawa & Takatsuji 2017), which enables them to translate multisensory, rich stimuli into perceptions (Driver & Spence 2000; Mishra et al. 2021).

In turn, the concept of sensory marketing refers to the use of triggers to stimulate customers' senses and affect their perceptions, evaluations, and behaviors (Krishna 2012). In particular, sensory stimulation might enhance customer engagement with products or services and install strong associations in customers' memories (Petit, Velasco, and Spence 2019). Hirschman and Holbrook (1982) establish that customer experiences form when services or products interact with customers' inner realms, which requires switching among various sensory modalities, such as vision, taste, sound, scent, and tactile impressions. However, studies of external triggers and internal processing highlight the need to differentiate stimuli, such as visual, auditory, olfactory, taste, or tactile cues, versus sensory perceptions (Fürst, Pecornik, and Binder 2021), which refer to awareness and understanding of the sensory information received (Krishna 2012). Isolated stimuli might affect customer behavior (Grewal et al. 2014; Roschk and Hosseinpour 2020; Spence et al. 2014), but combined stimulations often activate multiple senses simultaneously (Petit, Velasco, and Spence 2019; Stead, Odekerken-Schröder, and Mahr 2021). That is, senses cannot be understood in isolation but must be investigated in combination (Helmefalk and Berndt 2018; Spence 2020).

Efforts to understand the senses in combination also refer to consumption imagery, or the process by which customers retrieve sensory information from their memories (Kim et al. 2021). Imagery experiences are multisensory, such that imagery is linked to multiple sensory modalities (Biswas 2019). Aydinoglu and Krishna (2019) suggest that when experiences activate multiple senses, it can lead to more meaningful, personalized associations. To broaden these emerging perspectives, other disciplines may offer relevant insights, so we undertake a systematic exploration of extant sensory literature across disciplines, to develop a comprehensive understanding of the simultaneous activation and interplay of multiple senses shaping customer experiences.

Stage 1: Text mining

Map focal articles' content (i.e., key research areas and concepts)

Services and sensory marketing   *Cross-disciplinary*

133 papers   277 papers

Stage 2: Co-citation analysis

Identify most deeply rooted publications and their literature streams per research area

Services and sensory marketing   *Cross-disciplinary*

Top 100 cited papers   Top 100 cited papers

Stage 3: Overlaying findings

Validate findings with experts and identify future research directions for marketing[1]

Services and sensory marketing   *Cross-disciplinary*

Supporting theories and methods

[1] An additional spotlight text mining analysis between 2016 - 2020 captures recent developments (n = 93 for services and sensory marketing and n = 2,291 for cross-disciplinary).
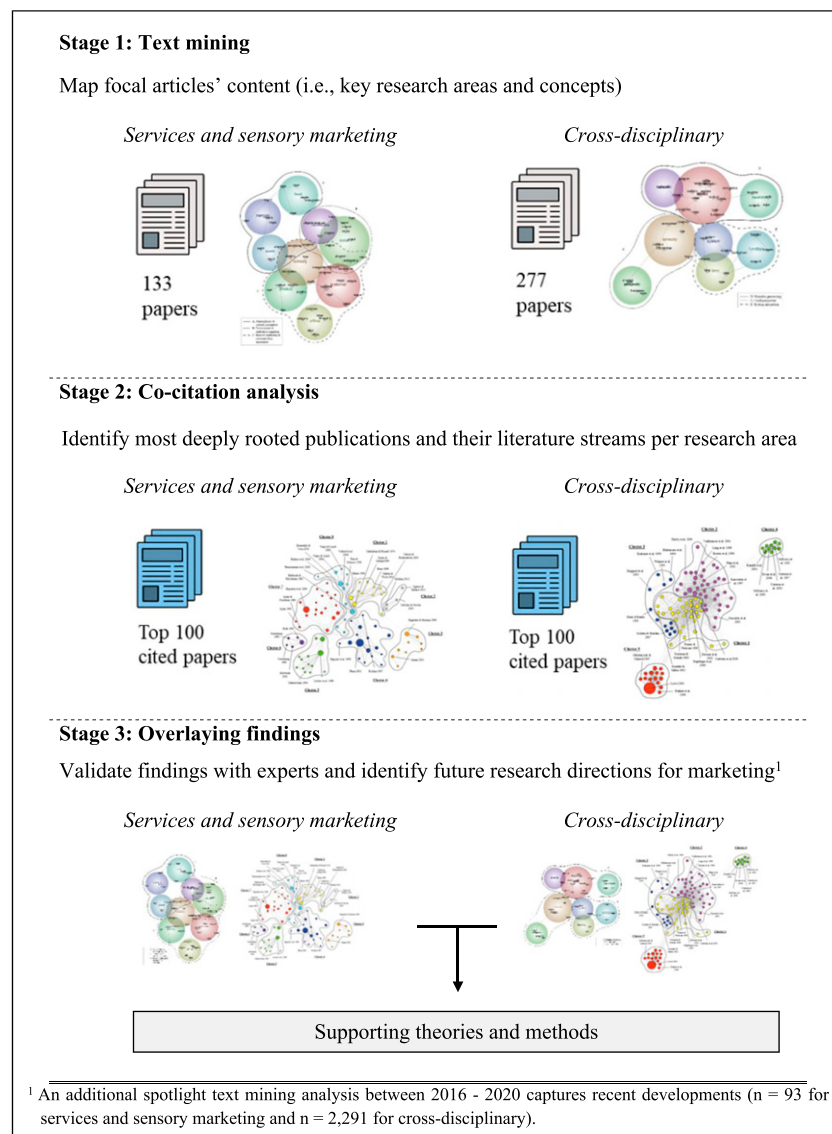
Figure 1. Overview of the mixed-method approach.

Method

This study combines text mining and co-citation methods in an effort to expand the conceptual and theoretical understanding of multisensory experiences (Figure 1). It offers two major advantages. First, with this combination, we can systematically and objectively review a substantial corpus of heterogenous literature that would be impossible for an individual researcher to read and interpret manually (Antons and Breidbach 2018). Second, it reduces the risk of researcher bias that can affect traditional literature reviews (Wilden et al. 2017).

The analysis spans three stages, as we detail in Figure 1. With text mining in Stage 1, we transform the unstructured text data into meaningful information. Recent studies describe text mining as a method of unstructured ontological discovery (Randhawa, Wilden, and Hohberger 2016) that identifies concepts and themes across a vast body of literature. We used Leximancer 4.5, which applies a Bayesian learning algorithm, to review these complex, interwoven phenomena (i.e., contributions to sensory research) in a rigorous, systematic way (Biesenthal and Wilden 2014). Then in Stage 2, we perform a co-citation analysis by tracking pairs of sources, cited together in other research. Depicting co-citation patterns in a network reveals the underlying structure of a research field and its connections with other research streams. Each article's position can be approximated by the path length (shortest connection between two articles) and the strength of the connections (number of co-citations) (Wilden et al. 2017). Thus, it represents a finer-grained analysis of the roots of the literature domain, with which we can outline the development of the research field and define how senses have been integrated conceptually into other literature streams. We perform Stages 1 and 2 with two sets of articles, obtained from either the service and sensory marketing discipline or other relevant disciplines, beyond these domain boundaries. On the basis of the most deeply rooted publications in both sets, we can identify underlying research streams. Finally, in Stage 3 we overlay the visual maps for both sets of articles, to find research gaps and important themes in more developed disciplines. To embed these findings in recent research endeavors, we have added an additional analysis, providing a snapshot of sensory research efforts within and beyond the service and sensory marketing discipline that have been published between 2016 and 2020. Following the same systematic approach, this 5-year selection is used to connect the foundational insights to the most recent topic developments. An overview of the process and analysis can be found in Web Appendix, Figure I, II and III). This three-layered analysis enables us to establish a theoretically grounded research agenda, embedded in recent topic developments, that can guide future research efforts in the service and sensory marketing discipline.

Sample Selection

To define the status quo of multisensory research in service and sensory marketing, we used Thompson Reuters' *InCite Citation*

Index to identify the top peer-reviewed journals by impact factor (IF). The analysis included service and marketing journals with a 5-year IF equal to or higher than 2, which represented a set of 34 journals (Figure 2). To identify publications focused on multisensory research, we developed a list of keywords in discussions with experienced researchers in the field, as follows: "sensory," "sensorial," "multisensory," "multi-sensory," "sense," and "senses." All these search terms explicitly reflect our focus on the simultaneous activation and interplay of multiple senses and signal how sensory stimuli can trigger processing across different modalities. Our time-unrestricted issue-by-issue search of the six keywords in *Web of Science* included titles, abstracts, and keywords for all 34 journals, to ensure "senses" or "sensory perception" were a central topic. In addition, we required the included articles to (1) be published in English; (2) contain at least one of the search words in the title, abstract, or keyword section; (3) be available in an online archive or database; and (4) represent a full article (cf. calls for papers, abstracts, proceedings).

This search resulted in an initial set of 536 articles (Figure 2). Two authors independently read and coded the articles, to ensure that "senses" or "sensory stimuli" were the main topics. They agreed on 93% of the decisions and, for the relatively few articles that prompted distinct decisions, we involved a third independent coder. The final sample comprised 133 articles, after excluding 402 articles, mostly because their abstracts included general phrasing, such as "in a sense," so they were not related to our central research topic.

With the recognition that sensory topics attract scholarly research beyond service and sensory marketing domains, we also sought to identify (1) the main disciplines that contribute to the topic, (2) focal articles in these categories and their theoretical foundations, and (3) the themes and concepts that emerge. In an iterative process, we derived another set of articles. To start, using the same list of keywords and search criteria, we conducted a discipline- and time-unrestricted open search to identify relevant multisensory research in *Web of Science*. We identified four major research disciplines, according to the quantity of studies related to sensory phenomena within them: neuroscience, psychology, food science, and computer science. An enormous set of articles matched our search and inclusion criteria across these four disciplines (Figure 2), so we further restricted the set of focal articles for coding to the top 1000 articles, in proportion to the number of publications per discipline. That is, of the top 1000 journal articles, 51% were from neuroscience, 19% from psychology, 17% from food science, and 13% from computer science (Figure 2).

In a second step, we identified the top 20 journals per discipline according to their 5-year IF, then conducted an issue-by-issue search of the top 20 journals per discipline. To identify the most influential papers for each discipline, we selected the most cited papers: 521 from neuroscience, 187 from psychology, 168 from food science, and 133 from computer science. These articles constitute the sample of top 1000 articles. However, articles in the *Web of Science* database can be classified to more
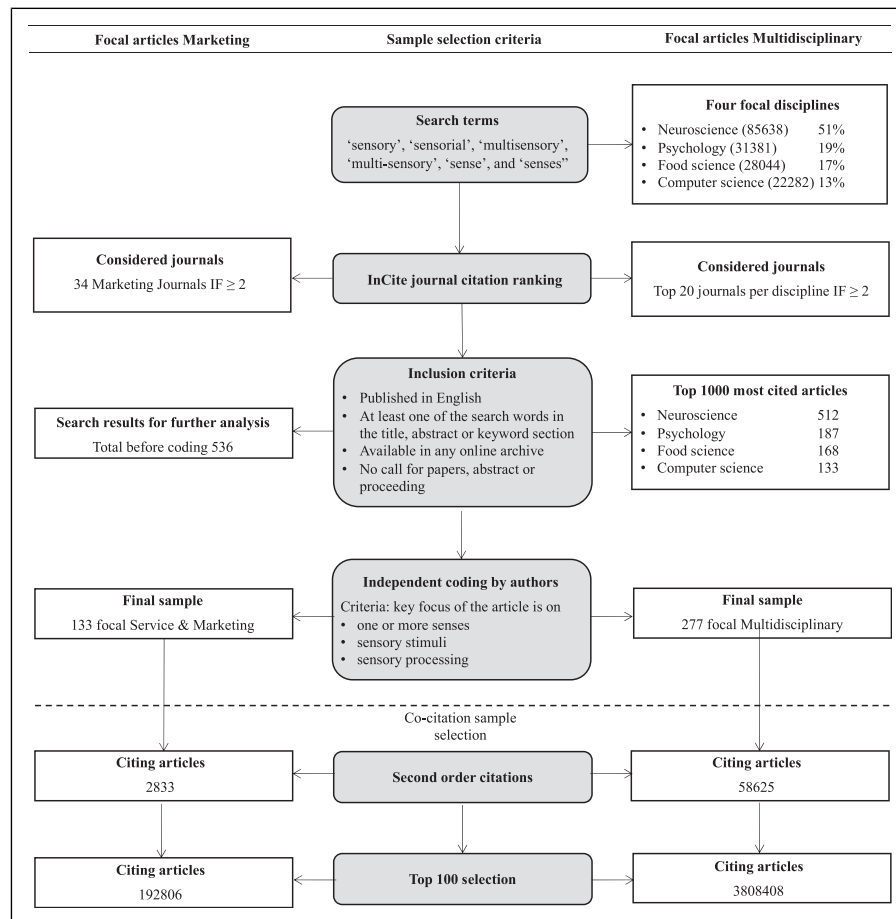
Figure 2. Data collection overview of sample articles for text mining and co-citation analysis. Note: The average number of senses discussed in the focal set of articles is 1.21, with 83.70% of the articles discussing one sense, 12.77% two senses, and 3.53% three or more senses. The most dominantly researched sense is taste (38.42%), followed by sight (36.14%), touch (16.41%), smell (16.20%), and hearing (13.91%).

than one discipline; we explicitly assigned each article to a discipline if it is either fully or partly classified as such in the *Web of Science* database. The coding procedure was the same as that for the sensory marketing articles, resulting in 96.5% agreement between coders. After involving a third coder, we identified 277 cross-disciplinary articles as the focal sample for further analysis.

Finally, we sought publications that represent a broader perspective on the theoretical foundations of sensory research, using co-citation analysis. This method identifies relationships and communities among authors, theories, and concepts (Randhawa, Wilden, and Hohberger 2016). To initiate the co-citation sample selection, we turned to the article sets: 133 sensory marketing and 277 cross-disciplinary articles (Figure 2, below the dotted line). From *Web of Science*, we identified all citing articles of each set, which produced 2833 sensory marketing papers and 58,625 cross-disciplinary papers. From this pool of articles, we identified all cited references, resulting in collections of 192,806 sensory marketing papers and 3,808,408 cross-disciplinary papers.

Following common practice in bibliometric studies, we identified the top publications for both sets of articles, according

to the network-related properties degree range (number of connections to and from a node), edge weight (strength of connections between nodes, based on the number of co-citations), and number of citations of a node (Wilden et al. 2017). This prioritization of the most cited and connected articles reflects our goal of uncovering the connections across the relevant research fields.

Analysis

Text Mining

In the first, text-mining stage of analysis, we sought a more detailed understanding of the themes and concepts of sensory research that emerged from the article corpus. That is, we were interested in defining the status quo of sensory research within the service and sensory marketing discipline and from a cross-disciplinary perspective. Converting the textual corpus, comprised of all the identified publications, into meaningful themes and concepts first required several data preparation steps. After downloading the focal articles from online archives, we cleaned them by removing headers and footers, journal and publisher information, author names, year of

publication, acknowledgments, and reference lists, all of which could provoke meaningless or biased co-occurrences in the analysis.

The Leximancer analysis extracts vocabulary words that carry semantically related meanings, and the output includes visual and tabular representations of identified themes and concepts (Randhawa, Wilden, and Hohberger 2016). Words that co-occur frequently in a body of text appear as concepts; and concepts that appear frequently in a similar context are grouped as themes (Mathies and Burford 2011). The color of the themes gives an indication of their importance to other themes and concepts, such that hot colors (e.g., red, orange) denote the most important themes, and cold colors (e.g., blue, green) denote the least important themes. The semantic relationship between concepts is indicated by their relative distance or closeness (Smith and Humphreys 2006). Thus, strongly connected concepts appear in close proximity.

Although Leximancer uses an automated machine learning algorithm (Wilden et al. 2017), text mining still requires manual cleaning and grouping of seed words that can be clustered into concepts. Examples of general terms that we excluded from the analysis are seed words such as "research," "study," "method," and "significant." They are commonly used in most articles but do not add any particular meaning to the analysis. We also grouped singular and plural versions of seed words (e.g., product and products) into one concept.

Co-Citation

The second, co-citation stage of analysis involves an exploration of the intellectual structure of the field, including its theoretical roots, to gain insights into the surrounding network of the research field. The references act as proxies for research streams that influence a set of articles (Wilden et al. 2017). Due to the vast numbers of references that we identify (192,806 and 3,808,408, respectively), we could not include the full sets of references in the analysis. Instead, we selected the top 100 publications of each set, based on degree range, edge weight, and number of citations, such that we exclude references that are not central to the network, while still maintaining a meaningful representation (Zupic and Čater 2015). For the top 100 references per set, we analyze how the most deeply rooted focal publications (i.e., those that appear among the top 100 publications) in the two sets integrate with other research streams, such that other publications have contributed to or drawn on the two focal sets of articles. The most deeply rooted articles were 13 publications in the service and sensory marketing focal set and 28 publications in the cross-disciplinary focal set (Figures 3, Panel B and 4, Panel B).

Next, we used the Bibexcel and Gephi software packages to create network diagrams based on co-citations. In the resulting graphs, the distance between publications is reflected in the path length, and connections between publications are based on the number of co-citations (Randhawa, Wilden, and Hohberger 2016). With a Lovain modularity optimization method (Blondel et al. 2008), we also identified clusters of closely connected publications. The clustering quality depends on the modularity parameter, which should exceed .4 (Blondel et al. 2008). For the service and sensory marketing set, the modularity parameter was .53, and for the cross-disciplinary results, we found a modularity parameter of .58.
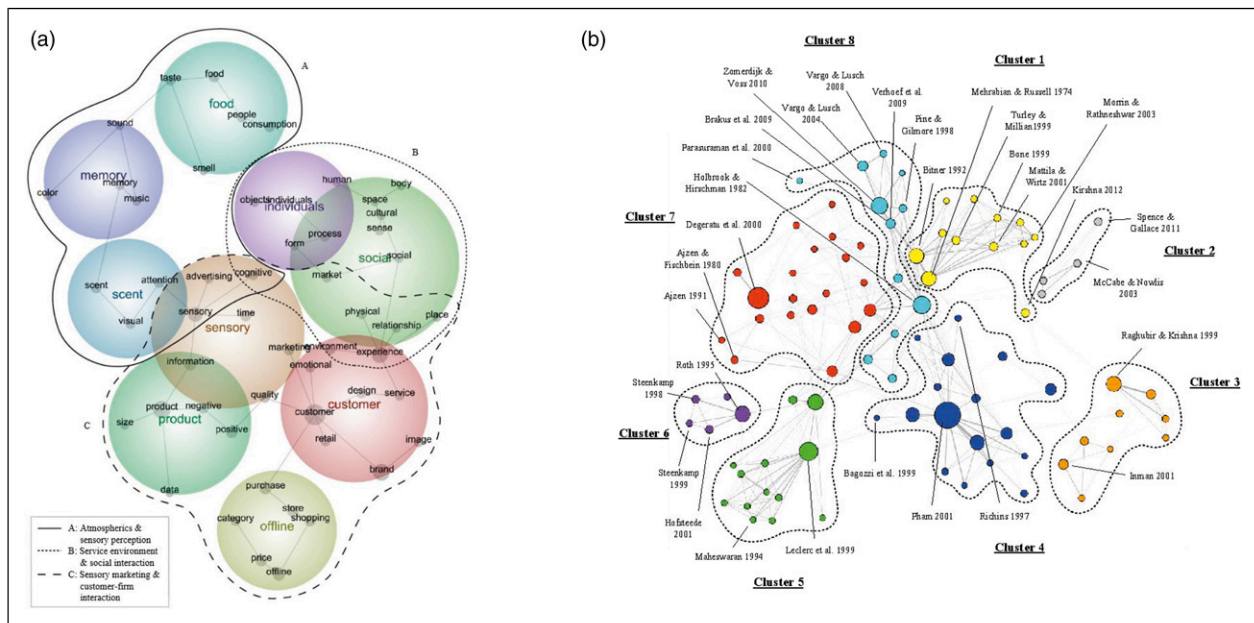
Figure 3. Focal Publications in Service and Sensory Marketing Set. Panel A: Concept map of focal publications in the service and sensory marketing set. Panel B: Co-citation map of the theoretical roots in the service and sensory marketing set. Notes: Node (circle) size is determined by number of citations, and edge (line) strength is determined by number of co-citations. To increase readability, only edges between articles with more than 11 co-citations, publications with a degree range >3, and selected publications are displayed.

Figure 4. Focal Publications in the Cross-disciplinary Set. Panel A: Concept map of focal publications in the cross-disciplinary set. Panel B: Co-citation map of the theoretical roots in the cross-disciplinary set. Notes: Node (circle) size is determined by the number of citations, and edge (line) strength is determined by number of co-citations. To increase readability, only edges between articles with more than 10 co-citations, publications with a degree range >3, and selected publications are displayed.
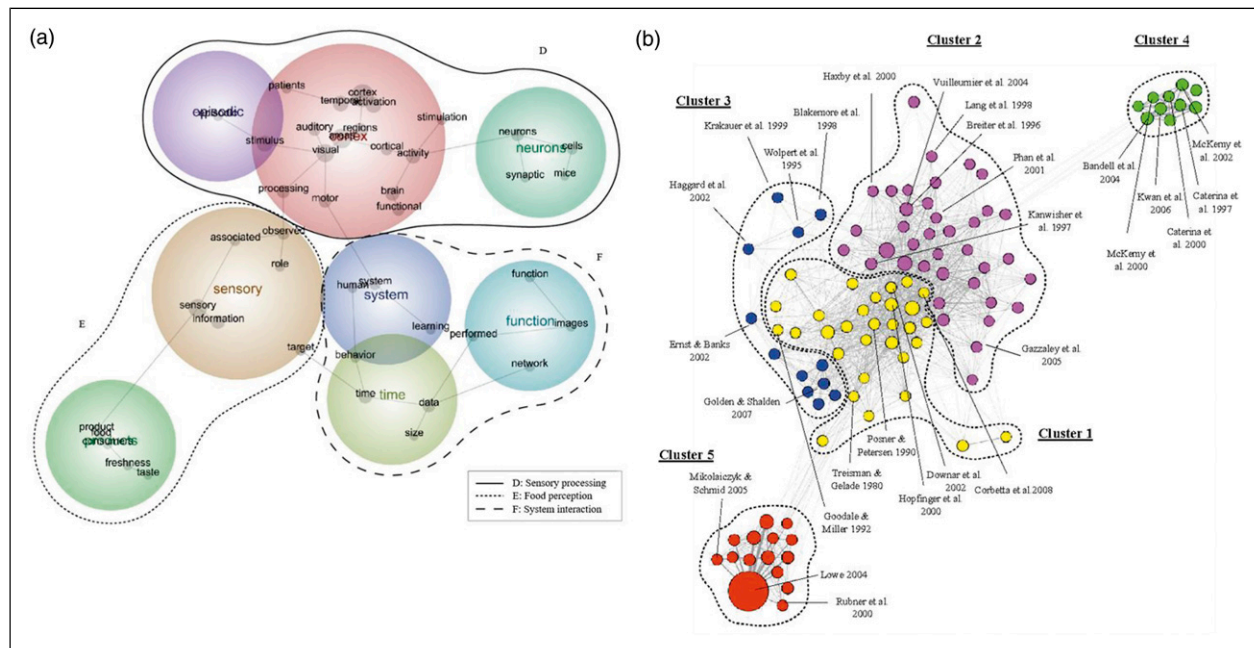
Overlaying Findings

In the third stage, we bring together the four visual maps we generated through the text mining and co-citation visualization for services and sensory marketing and then for the cross-disciplinary set, overlaying the two sets of maps to identify research gaps. A gap exists if a research theme is not yet studied in the services and sensory marketing discipline, but that theme appears in disciplines outside its boundaries. With this approach, we derive a theoretically grounded research agenda, suggesting investigations that involve established themes in other disciplines, and we also identify potential supporting theories and methods that might guide other research efforts in the services and sensory marketing discipline.

Results

To shed light on the conceptual structure of sensory research, within and beyond service research, we integrated the findings of our text mining analyses with the results of the co-citation analyses involving both related research streams. In Figure 1, Stages 1–3 depict the synthesized analysis. Through text mining, we identified the conceptual structure of sensory research, and then with the co-citation analyses, we uncovered the theoretical roots of the most deeply rooted publications.[1]

Status Quo of Sensory Research in Service and Sensory Marketing Literature

Figure 3, Panel A presents the text mining results for the 133 service and sensory marketing articles. Several themes appear

closely linked; others are more distant. The two most dominant themes, as depicted in the center, are *customer* and *sensory*, which is not surprising, because sensory research mainly involves customers, though *sensory* appears to be the primary connection to most other themes. In turn, we analyze other themes and concepts that were semantically closely related to these two dominant themes, which reveal the three main research areas in Figure 3, Panel A: (A) atmospherics and sensory perception, (B) service environment and social interaction, and (C) customer- and firm-related outcomes. When we apply the co-citation analysis to undertake a more detailed examination of the most deeply rooted publications for each research area (Figure 3, Panel B), we clarify their integration with other research streams, thereby highlighting their theoretical roots.

Research Area A: Atmospherics and Sensory Perception. The Stage 1 text mining results show that research on atmospherics and sensory perception mainly focuses on themes of *food*, *scent*, *memory*, and *sensory*, and the related key concepts being investigated are the atmospheric influences of vision, scent, and sound. Similarly, Roschk, Correia Loureiro, and Breitsohl's (2017) meta-analysis identifies music, scent, and color as the three atmospherics that have received the most research attention in the past 30 years. These three atmospherics all connect to the theme of *memory*, and research in this area investigates the effect of various scents, background music, and colors on customers' memories (e.g., Herz and Engen 1996; Shapiro and Spence 2002). The themes of *scent* and *sensory* also are linked through the concept of attention; attention and scent

are important drivers of brand name recognition and recall (Morrin and Rahneshwar 2000). Cognitive theory research indicates that customers' cognitive perceptions mediate their relationships with ambient scents and emotions (Chebat and Michon 2003). Finally, studies of atmospherics related to food consumption tend to address the concepts of taste and smell, with another link of taste to sound. Thus, multiple senses have been investigated.

Then the Stage 2 co-citation analysis reveals that Clusters 1 and 2 are strongly related to atmospheric and sensory perception research (Figure 3, Panel B). Research in Cluster 1 focuses on atmospherics that surround the focal service or product offerings. In early atmospheric research, Mehrabian and Russell (1974) proposed that environmental stimuli induce customers' behavioral responses, such that factors such as light, sound, heat, and color can evoke emotional responses. Bitner (1992) proposed the servicescape as a framework, to highlight the influence of physical surroundings on customer–employee interactions. In servicescape studies, olfactory and auditory senses are the most dominant units of analysis (e.g., Bone and Ellen 1999; Mattila and Wirtz 2001). Cluster 1 links closely to Cluster 2; for example, Krishna (2012) presents an integrative review of sensory marketing research and also highlights less examined areas that provide rich opportunities, including findings that taste relies on all the other senses, such that taste alone cannot distinguish food items. Bone and Ellen (1999) also raise the concern that retailers lack theories to predict olfactory effects reliably. Although the concept of touch does not emerge as a theme or concept from our text mining analysis, it appears as an important concept in Cluster 2, obtained from our co-citation analysis. Research in this cluster further highlights the role of haptic information processing: McCabe and Nowlis (2003) reveal that customers prefer to touch products, especially those with material properties, such as clothing. Furthermore, they find that vision is highly diagnostic; if product properties are clearly visible, the need for touch decreases. Finally, Spence and Gallace (2011) argue that a single sense, such as touch, can steer all other senses and modulate customers' multisensory experiences. The hedonic attributes of products perceived by one modality (e.g., touch) then can leverage or bias evaluations of product qualities, derived through other senses. As a result, sensory alignment or cross-modal connections define the overall multisensory experience (Spence and Gallace 2011).

Research Area B: Service Environment and Social Interaction. The second research area comprises themes related to service environments and social interactions, namely, *social*, *customer*, and *individual*, along with a partial *sensory* theme (see Figure 3, Panel A). These themes reflect key concepts, such as objects, space, environment, human, physical, culture, relationship, body, sense, design, brand, image, and experience. In line with servicescape literature, we find that the interaction of customers and service environments is prominent. These findings also align with theories of grounded cognition and embodied cognition, which suggest customer actions are situated in bodily

states and influenced by contextual stimulation from the environment (Borghi and Cimatti 2010).

The co-citation analysis in Stage 2 also reveals that Clusters 1, 5, and 6 provide insights on the theoretical lenses adopted by the various articles (Figure 3, Panel B). Scholars identify social and cultural influences on experiences and relationships (Leclerc, Schmitt, and Dubé 1994), as well as human sensemaking processes involving body-related information (Rosa, Garbarino, and Maller 2006) and physical surroundings (Bitner 1992). Whereas Cluster 1 provides the theoretical grounds for understanding physical surroundings, Clusters 5 and 6 focus on theories related to cultural differences and the effects of foreign branding (Leclerc, Schmitt, and Dubé 1994). A notable literature stream that we identify with the co-citation analysis is based in Hofstede's (1980) cultural dimensions theory, which provides the grounding for research that identifies the impact of foreign markets (Maheswaran 1994) on brand image, product performance, and customer innovativeness (Steenkamp, ter Hofstede, and Wedel 1999). As Roth (1995) highlights, power distance, regional socioeconomics, and individualism influence brand image strategies at the functional, social, and sensory strategic marketing levels.

Research Area C: Customer- and Firm-Related Outcome Measures. Finally, in this third research area, we include customer- and firm-related outcomes, linked to the key themes of *customers*, *product*, and *offline*, along with partial themes of *sensory* and *social*. The dominant *customer* theme consists of concepts such as brand, experience, retail, emotional, image design, and service. Marketing and quality concepts relate to the theme of *sensory*, and information, advertising, time, and cognitive are the most investigated concepts. The *consumer* theme also links, through quality, to the *product* theme, within which assessment and evaluation concepts such as information, negative, positive, data, and size appear. In line with research that adopts a service-dominant logic (Vargo and Lusch 2004, 2008), the *consumer* theme closely ties to the *social* theme. As attention shifts to customer experiences in the service context (Mahr, Stead, and Odekerken-Schröder 2019), researchers increasingly investigate customer–firm relationships through experiences and emotional measures of, for example, products and services (Bitner 1992; Rosenbaum and Massiah 2011). Experience and emotion concepts also appear in close proximity to the *sensory* theme and provide important indicators of customer perceptions and intentions (Bagozzi, Gopinath, and Nyer 1999). The appearance of the *offline* theme indicates a strong research focus on traditional service experiences in brick-and-mortar stores; it connects to the *customer* theme through the concept of purchase. Furthermore, concepts of store, shopping, price, and category reflect research attention to customer shopping behavior (Chu et al. 2010), the impact of category allocations (Breugelmans and Campo 2016), and customer price sensitivity (Chu, Chintagunta, and Cebollada-Calvo 2008).

According to the co-citation analysis in Stage 2, four research streams contribute to customer- and firm-related outcome measures. First, with their contribution to information

processing models, Holbrook and Hirschman (1982) direct attention to the symbolic, hedonic, and esthetic nature of consumption (Cluster 8). In applying their paradigm, other scholars have detailed dimensions of the consumption experience and measurable outcome variables such as perceived quality, satisfaction, and loyalty (Brakus, Schmitt, and Zarantonello 2009; Parasuraman, Zeithaml, and Berry 1985; Pine and Gillmore 1998). The emergence of the service-dominant logic in the early 2000s (Vargo and Lusch 2004, 2008) then shifted researchers' attention from products to services; services became prominent in the *customer* theme. In particular, these authors emphasized that organizations should design and manage experience-centric services (Verhoef et al. 2009; Zomerdijk and Voss 2010).

Second, researchers began to focus on the role of emotions, according to customer states, which may be important drivers of decision-making processes (Pham 1998; Richins 1997). Affect-confirmation and goal-directed behavior (Bagozzi, Gopinath, and Nyer 1999) are key topics in these studies (see Figure 3, Panel B, Cluster 4).

Third, the co-citation analysis identifies a separate literature stream (Cluster 3) that relates to customer variety-seeking and volume perception. This cluster largely is influenced by Raghubir and Krishna's (1999) theorizing about the role of vision and perceptions of volume consumption. The resulting studies indicate that product choice is influenced by, for example, packaging and variety (Inman 2001; Ratner, Kahn, and Kahneman 1999). The role of senses, perception, and experience are common themes. Vision and touch are the two most represented senses in these studies, and though the text mining analysis reveals links between sensory and vision, it does not refer to touch.

Fourth, some theoretical advances emerge from the co-citation analysis for Research Area C (Clusters 7 and 8). For example, Ajzen has significantly advanced understanding of customer behavior and perception through his work on the theory of reasoned action (Ajzen and Fishbein 1980) and the theory of planned behavior (Ajzen 1991). Moreover, Degeratu, Rangaswamy, and Wu's (2000) research on consumer choice behavior shows that brand names are more valuable in online contexts that have fewer attributes and less information than other contexts. In such settings, customers are more price sensitive and likely to value factual (non-sensory) information. The co-citation results highlight a research interest shift towards online retailing contexts; surprisingly though, the text mining analysis of focal articles does not reveal this interest.

Summary. An aggregated view across all three research areas reveals that sensory research in service and marketing literature focuses on the design of atmospherics, sensory perception (Research Area A), service environments, social interaction (Research Area B), and customer- and firm-related outcomes (Research Area C). Surprisingly, extant service and marketing literature seems to neglect the role of senses and stimuli processing. Although the *sensory* theme is connected to scent through attention, we find no direct connection to sound, taste,

or smell. Furthermore, focal articles in the co-citation network highlight the importance of understanding the connection and processing of multiple stimuli across all modalities (Krishna 2012; Spence and Gallace 2011), but consumers' inner realms (Lipkin 2016) remain a "black box" in service and sensory marketing research. With the exception of significant research on atmospherics and some studies of evaluation concepts such as attention and cognition, we do not identify any concepts that could help us understand the conceptual structure of multisensory perception. Therefore, we sought a more holistic view, by mapping the content of cross-disciplinary articles and the co-citation network of the most influential articles.

Cross-Disciplinary Perspective on Sensory Research

By broadening our scope and taking a cross-disciplinary perspective on multisensory research, we seek to gather insights that are available beyond the traditional boundaries of service research. Figure 4, Panel A depicts the results of the text mining analysis of the 277 cross-disciplinary articles we found. Similar to the analysis of the service and sensory marketing articles, we found three research areas connected by the theme of *sensory*: stimulus processing (Research Area D), food perception (Research Area E), and system interaction (Research Area F). We again detail the most deeply rooted publications in each research area to uncover their integration with other research streams, as highlighted by the clusters in Figure 4, Panel B.

Research Area D: Stimulus Processing. In Stage 1 for the cross-disciplinary literature pool, we identify a first research area linked to stimulus processing. Research in this area involves themes of *cortex*, *neurons*, and *episodic*. The *cortex* and *episodic* themes are closely connected through *stimulus*. In turn, important concepts that constitute the *cortex* theme are functional, brain, activity, visual, auditory, and motor, whereas *neurons* consist mainly of synaptic and cells. These themes reflect research on the principal (i.e., sensory, motor, and attention) systems of the human brain (Posner and Petersen 1990).

Then the co-citation analysis in Stage 2 reveals that the most deeply rooted publications in Research Area D stem from cognitive psychology and neuroscience. They revolve around the interplay of the three systems (Clusters 1, 2, and 3 in Figure 4, Panel B, respectively). The neural systems area contains publications that focus on multisensory integration and stimulus-driven visual attention. For example, Angelaki and Gu (2010) suggest that the brain seamlessly integrates information from different sensory modalities into a unified perception. The formation of perception in the neural system thus entails incorporating input from all sensorial modalities; neuroscience research accordingly focuses on multisensory integration. Ernst and Banks (2002) posit that when a person visually and tactilely explores an object, vision and touch both provide information about it, and then the nervous system combines the visual and haptic information. Visual dominance occurs when visual processing connects more easily than haptic processing with existing memories. According to Downar et al. (2000), changes in visual, auditory,

and tactile stimuli activate different regions of the brain, suggesting simultaneous multisensory stimuli integration.

The role of attention in multisensory integration also is evident in prior research. Gazzaniga, Ivry, and Mangun (2011) investigate whether stimulus-driven visual attention, defined as focusing on one source of visual sensory inputs at the expense of others, operates during early, perceptual stages or late, post-perceptual stages. They find that it occurs in both stages, depending on the nature of the stimuli and task. For example, according to a feature-integration theory of attention (Treisman and Gelade 1980), recognition of a novel object requires information integration across multiple modalities until the full object can be identified.

From an empirical perspective, Hopfinger, Bunonocore, and Mangun (2000) show that functional magnetic resonance imaging (fMRI) can indicate selective visual attention, by revealing the interplay of attentional control systems and sensory brain structures. The superior frontal, inferior parietal, and superior temporal cortexes (i.e., specific regions in the temporal cortex, the part of the human brain associated with processing sensory input) are selectively activated by stimuli, so they appear to belong to a network for selective attentional control. Corbetta, Gaurav, and Shulman (2008) further unravel the role of adaptive behavior—involving a reorientation between two environmental stimuli—within a neuroanatomical model of attention. They show that attention consists of dorsal and ventral attention networks. The former are goal-directed, such that the network enables the selection of stimuli according to current goals or expectations and preexisting information about presented stimuli (Corbetta, Gaurav, and Shulman 2008). In contrast, rather than selectively assigning attention and behavior toward stimuli, the ventral network reorients attention toward unexpected or unfamiliar stimuli (Posner and Peterson 1990).

In addition, the stimulus processing area (Figure 4, Panel A, Area D) features research on emotional processing. Lang, Bradley, and Cuthbert (1998) propose a theoretical model of emotion in which humans process visual stimuli that trigger emotional arousal, and an underlying motivational structure (appetitive vs aversive) elicits visceral and behavioral responses. Several foundational studies in this area investigate the role of habituation and emotions linked to facial perceptions. Using fMRI, Breiter et al. (1996) study emotional processing (i.e., amygdala activity) when participants encounter visual stimuli depicting fearful, happy, and neutral faces and show that people rapidly habituate to emotionally valenced (cf. neutral) faces. Kanwisher, McDermott, and Chun (1997) also use fMRI, seeking to identify a brain region associated with recognition (i.e., fusiform gyrus). Attention is considerably more prominent when participants encounter faces rather than common objects. Another foundational research stream relates to the mind–body connection; Damasio, Everitt, and Bishop (1996) propose somatic marker theory, which relates to feelings in the body that are connected to emotions and drive decision-making. For example, a rapid heartbeat associated with anxiety influences responses, consciously or subconsciously, to environmental stimuli.

Another set of publications focuses on sensorimotor integration. For example, Wolpert, Ghahramani, and Jordan (1995) offer direct support for the prediction that the central nervous system simulates the motor system to perform tasks such as planning, control, and learning. In their study of sensory and motor systems, Shadlen and Newsome (2001) similarly find that rather than reflecting a separate process, decisions are embodied in direct transformations across the relevant systems. Citing kinematics, Krakauer, Ghilardi, and Chez (2017) suggest that when people reach for objects, neural processing transforms visuospatial information about the target location of an object into motor commands that specify muscle forces and joint motions that move the hand to the desired location, as part of working memory systems.

Research Area E: Food Perception. The research area of food perception is described by the themes of *products* and *sensory.* Concepts related to *products* are food, taste, and consumers; concepts related to *sensory* are information, associated, and observed.

The co-citation analysis in Stage 2 then reveals that the most deeply rooted publications in this research area entail perceptions of extreme food items, as well as auditory and thermal stimuli perception. Bandell et al. (2004) find that the transient receptor potential (TRPA1) family of ion channels (i.e., gateway for ionized cells) is activated by the natural components of extreme foods (e.g., cinnamon oil, mustard oil, and ginger). These compounds elicit painful sensations and offer a molecular model for why extreme cold paradoxically can be experienced as painful burning. Relatedly, Kwan et al. (2006) highlight a distinct role of TRPA1 in the inner ear: It facilitates sensing sound, painful cold, and irritating chemicals. These publications are strongly integrated with the food science field (see Figure 4, Panel B, Cluster 4).

Connected studies also revolve around the neural bases for thermosensation and for extreme food perception. Caterina et al. (2000) identify the capsaicin (vanilloid) receptor VR1 as a cation channel, connected by primary sensory neurons of the pain pathway. It fulfills an essential role for selective modalities of pain sensation and tissue-injury–induced thermal hyperalgesia, which is a condition of heightened sensitivity to noxious heat or cold. With a closer consideration of thermal sensation, McKemy, Neuhausser, and Julius (2002) focus on how humans sense cold (i.e., cellular and molecular mechanisms). Together with the heat-sensitive channels VR1 and VRL-1, TRP channels detect temperatures and act as principal sensors of thermal stimuli in peripheral nervous system (e.g., hands). For example, addressing extreme food perceptions, a study that uses hot chili peppers as a trigger for the sensation of burning pain demonstrates selective activation of sensory neurons that transmit information about noxious stimuli to the central nervous system (Caterina et al. 1997).

Research Area F: System Interaction. The last research area we identify, system and interaction, can be described by the themes of *time*, *function*, and *system* and the concept of target, which is

connected to the *sensory* theme. The themes of *time* and *system* also are connected closely through concepts such learning and behavior. Whereas human is an important concept in system-related research, the theme of *time* comprises the two additional concepts of data and size. Finally, data provides the connection to the third theme of *function*, which consists of the concepts of images, network, and performed.

The most deeply rooted publications in this research area, according to the co-citation analysis, deal with object recognition, image matching, and image retrieval. Rubner, Tomasi, and Guibas (2000) investigate perceptual metrics for content-based image retrieval, with a focus on color and texture. Similarly, Lowe (2004) proposes a scale-invariant feature transform (SIFT) method for extracting distinctive image features that allow for matching across different views of objects or scenes. These publications seem strongly integrated with the computer science field (see Figure 4, Panel B, Cluster 5), and connected studies in this field revolve around computer vision. For example, a component of the SIFT method is local descriptors, which provides the basis for object recognition, texture recognition, and image retrieval. Furthermore, Mikolajczyk and Schmid (2004) assess the performance of various descriptors and find that SIFT-based descriptors perform best. With a focus on human detection though, Dalal and Triggs (2005) show that histograms of oriented gradient (HOG) descriptors perform best for this kind of detection. Relatedly, Bay et al. (2008) address camera calibration and propose that the speeded-up robust features (SURF) descriptor outperforms previously proposed schemes in this context.

Summary. An aggregate view reveals that sensory research beyond marketing takes a mostly human perspective; it focuses on understanding the sensory neural system (Research Area D) and explaining how humans perceive food (Research Area E). Discussions of sensory processing focus on sensory neural, attention, and motor systems. Furthermore, discussions of food perception strongly emphasize how humans infer taste from extreme foods. However, Research Area F adopts a provider (developer) perspective, addressing how to optimize systems for human stimulus processing. Discussions of system interaction also address how to optimize images to encourage processing and ultimately influence behavior.

The publications in the sensory processing Research Area D mainly come from neuroscience and cognitive psychology, in studies that seek to understand (1) the interplay of the sensory system and the attention system, (2) the role of emotions in this interplay, and (3) the interplay of the sensory system and the motor system. In turn, the research highlights stimulus-driven visual attention, multisensory input integration, emotional processing, and sensorimotor integration. In the food perception Research Area E, emerging from food sciences, the research topics include perceptions of extreme food items and auditory and thermal stimuli processing. Finally, the system interaction Research Area F is rooted mainly in computer science, and the studies within it focus on object recognition, image matching, image retrieval, and (indirectly) local descriptors. Although all

three research areas provide interesting avenues for investigating multisensory integration, the sensory processing area (Research Area D) seems best established; it also connects closely to the service research area. Therefore, this cross-disciplinary analysis suggests links to important theories in neuroscience and cognitive science that might address key research gaps in service research.

Findings

Our study is motivated by the need to identify clear pathways to develop a comprehensive understanding of the simultaneous occurrence and interplay of senses in multisensory customer experiences (Mishra et al. 2021; Mahr, Stead, and Odekerken-Schröder 2019). To this end, we systematically explore extant sensory literature and construct two status quo maps of existing research (within service and sensory marketing and across relevant other disciplines), to encourage service researchers to learn and benefit from research in other domains. The text mining and co-citation analyses reveal both theoretical and conceptual roots of multisensory research.

To complete the picture, we wanted a snapshot of recent developments, so that we could connect our foundational findings to the most recent cross-disciplinary research endeavors. In an additional systematic literature search, with the same procedure, we focused exclusively on publications that appeared in the past five years (Web Appendix, Figure I). As a complement to our foundational analysis, this iteration sought to highlight recent topics in sensory research, within service and sensory marketing and beyond, and link them with their theoretical and conceptual roots to derive meaningful research directions for service research (for the text mining maps, see the Web Appendix, Figure II and III). Table 1 provides an overview of the key findings from both analyses.

According to our foundational text mining analysis, sensory research in service and sensory marketing focuses mainly on atmospherics and sensory perception (Research Area A), service environment and social interaction (Research Area B), and customer- and firm-related outcome measures (Research Area C). The text mining and co-citation analyses consistently confirm the concern that service and sensory marketing research has tended to study individual senses, where more than 96% study one or two senses in isolation (see Table 2). In the past five years, these trends have not changed; in terms of atmospherics and sensory perception research, the most frequently investigated concepts remain largely the same, and key concepts such as color, ambient, scent, and light appear in close proximity, while food, taste, and memory are slightly more distant. The processing and physical themes relate to the concepts of time and attention to visual cues. Furthermore, recent findings affirm the strong anchoring in servicescapes research, environmental psychology, and haptic information processing.

Furthermore, Research Areas B and C have trended toward closer links. In the past five years, the most dominant theme, consumer, closely relates to the concepts of behavior, environment, and retail. The key marketing research phenomena pertain to the close connection of sensory and experience

Table I. Text Mining and Co-citation Analysis Results.

	Text mining results: Services and sensory marketing			Text mining results: Cross-disciplinary		
	Area A	Area B	Area C	Area D	Area E	Area F
Research areas	Atmospherics and sensory perception	Service environment and social interaction	Customer- and firm-related measures	Sensory processing	Food perception	System interaction
Key concepts	Memory, food, scent, visual, sound, smell, taste, attention, consumption	Social, individual, experience, human, process, market, culture, environment, space, body	Consumers, sensory, product, offline, retail, brand, image, marketing, information, advertising, design, emotional, cognitive	Cortex, neurons, episodic, visual, auditory, motor, functional, brain, processing	Products, sensory, food, freshness, taste, information, observed	System, function, time, images, network, human, data, behavior, learning
Key concepts past five years	Processing, messages images, smell, scent, ambient, physical, color, light, memory, food, taste, design, perception, music			Sensory, perception, processing, activity, area, role, light, network, visual, stimuli, behavior, brain, memory, function, cortex, neurons, activation, cells, mice	Acids, production, sensory, green, red, positive, fermentation, aroma, meat, wine, quality, products, taste, foods, perception, intensity, consumers, water, storage, temperature, values, days	Time, system, form, activity, light, area, role, data

	Co-citation results: Services and sensory marketing			Co-citation results: Cross-disciplinary		
Focal article topics	• Effects of atmospherics on customer intentions experiences • Role of scents in perceptions and memory • Role of touch in customer perception and intention	• Effects of culture and origin on perception and on attitudes • Design of experience-centric services	• Volume perception and variety seeking • Role of emotions in decision-making • Customer choice behavior	• Interplay of sensory system and attention system • Role of emotional processing • Interplay of sensory and motor system	• Perceptions of extreme food items • Auditory and thermal stimuli processing	• Object recognition • Image matching • Image retrieval
Theoretical roots	• Servicescape • Environmental psychology • Haptic information processing and product perceptions	• Brand origin, cognitive and affective perceptions • Cultural dimensions and differences • Service-dominant logic • Service quality • Dimensions of customer experience	• Sensory attributes and brand switching • Sensory stimuli and actual consumption • Role of hedonic and utilitarian experiences • Theory of planned behavior and reasoned action • Commitment–trust theory of relationship marketing	• Stimulus-driven visual attention • Multisensory input integration • Emotional processing • Sensorimotor integration	• Neural basis of extreme food perceptions • Neural basis of thermosensation	• Local descriptors

concepts with brand, marketing, and advertisement. The value theme also appears more closely connected with virtual and online concepts, suggesting a shifting servicescape toward a more digital service environment.

Beyond sensory marketing, sensory research in other domains focuses mainly on sensory processing (Research Area D), food perception (Research Area E), and system interaction (Research Area D). First, in terms of sensory processing literature, which focuses mainly on the key concepts of visual, auditory, motor, brain, cortex, neurons, and processing, research in the past five years indicates a closer consideration of concepts such as processing, perception, behavior, activities, and networks, closely connected to neurons. Visual stimuli remain the most prominent research focus.

Second, the discussion of food perception, pertaining to the key concepts of food, taste, and freshness, also has shifted in recent years, toward themes involving *products*, *acids*, *value,* and *time*. In this context, value refers to absolute numbers, such as temperature, storage, or days; *acid* relates to processes of fermentation, aroma, and production. Third, the system interaction research area, centered on system, images, and human learning as key concepts, reveals a shift in the past five years, toward more publications involving activities, time, and network functions.

Thus, by noting recent developments in multisensory research, we determine that Research Areas B and C have gained prominence and merged, marked by less obvious topic boundaries. Research Area D, stemming from neuroscience and cognitive science, also provides interesting theoretical and conceptual insights.

Research Agenda

By combining insights from text mining and co-citation analyses, we identify research gaps in service research, reveal the crux of multidisciplinary future research, and propose several avenues for research—accompanied by relevant theories and methods—to move the field forward and contribute to a better understanding of multisensory customer service experiences. Table 2 synthesizes these findings that we discuss in the following. The visual maps we derived vividly display the vast room remaining for conceptual growth in sensory research in the service discipline. In particular, the service field should integrate new theories and methods to (1) clarify multisensory stimuli integration and perception, (2) identify the influence of multisensory stimuli as integral to customer experiences, (3) recommend designs for effective multisensory omnichannel experiences, and (4) outline the role of multisensory stimuli for transformative service research. We zoom in on these four research streams, drawing on our cross-disciplinary findings, and offer specific research questions, ideas for theories, and research methods that might overcome existing gaps to produce a more comprehensive view.

Understanding Multisensory Stimuli Integration and Perception

Existing sensory research in service and marketing has addressed both offline (Biswas et al. 2014; Massara, Porcheddu,

and Melara 2014) and online (Kahn 2017) service environments, focusing mainly on visual, auditory, and olfactory stimuli (Roschk, Correia Loureiro, and Breitsohl 2017). A prominent topic in sensory research in marketing is visual attention, sometimes combined with another sensory modality (Sample, Hagtvedt, and Brasel 2020). However, we note the continued need to explore the interplay and simultaneous activation of multiple sensory modalities in complex service environments (Spence et al. 2014). Theories and empirical insights from neuroscience, cognitive science, and psychology offer relevant options. Research into sensory processing has established the role of neural systems, which bundle the input of all sensorial modalities (Angelaki and Gu 2010). Neuroscientific research that simultaneously examines multisensory input integration could identify activity in different regions of the brain to specify the effect of diverse stimuli across multiple sensorial modalities (cf. singular modality; Downar et al. 2000). Such research might reveal which modalities get activated, where customer attention is most prominent, and which stimuli influence customer perceptions most powerfully. Information along these lines would be particularly helpful in new service environments. Notably, of the various modalities, the role of the tactile modality seems absent from existing service research. A more comprehensive analysis of multisensory integration could offer more meticulous insights into how various stimuli shape experiences (Aydınğlu and Krishna 2019).

Cross-modal correspondence in turn offers a compelling theoretical lens for integrating diverse stimuli and combining them into perceptions; it pertains to environmental stimuli across multisensory modalities (Spence 2011). In addition, environmental sensitivity theory (Greven et al. 2019) predicts individual differences in the ability to capture and integrate environmental stimuli. Combining this theory with sensorimotor contingency theory, which deals with spatial knowledge and how it is grounded in people's (i.e., customers) experience (Laflaquière et al. 2018), might indicate which sensory information is important for customers to extract and how it relates to their perceptions across their customer journeys. Multisensory experience features in a plethora of service settings from department stores, food retailing, restaurants, bars, sports, fashion retailing, events, culture, etc. (see McQuarrie 2015). For instance, in June 2020 Kitchen Theory introduced a multisensory dining service, which includes tableware, audio, texture cubes, wireless headphones, levitating plates, and even a virtual chef to create a multisensory dining experience (Godbold et al. 2020). Similarly, Gartner in its Digital Technology Trends for 2020 highlights the need for a multiexperience strategy across different multisensory touchpoints in the customer journey (Sakpal 2019).

Another important theory bridges sensory stimuli with perception, namely, goal-directed attention. From a neuroscientific perspective, attention consists of both dorsal and ventral attention networks (Corbetta, Gaurav, and Shulman 2008). Assessing their interplay might offer important insights into how customers direct their visual attention in service environments. From a theoretical perspective, considering goal- and

Table 2. Research Gaps and Agenda.

Research direction	Research area	Research streams	Research questions	Suggested theories	Suggested methods	Suggested references
Understanding multisensory stimuli integration and perception	A/B B A/B/C A/B	Multisensory integration and perception Sensory perception Sensory stimulation and atmospherics Sensory perception	What determines the activation of multiple sensory stimuli across different customer journey touchpoints? How does multisensory integration change in unfamiliar environments (e.g., technology-driven service interactions)? What is the optimal level of sensory stimulation, and what causes overstimulation? How can sensory stimuli be configured to overcome the absence of one sense (e.g., taste and smell in an online service environment? What constitutes multisensory overstimulation, and what influence does it have on the overall customer experience?	Cross-modal correspondence Goal-directed attention Sensorimotor contingency theory Labeled line theory Environmental sensitivity theory Stimulus-driven attention	Instrumental-sensory analysis technique ESET Sensory processing sensitivity scale with fMRI scan	Theory: Corbetta, Gaurav, and Shulman (2008) Ernst and Banks (2002) Laflaquière et al. (2018) Spence (2011) Posner and Petersen (1990) Treisman and Gelade (1980) Methods: Greven et al. (2019) Llobell et al. (2020) Stead, Odekerken-Schroeder, and Mahr (2020) Yang et al. (2019)
Understanding the link between multisensory customer experiences and emotions	B A/B/C B/C A/B	Customer experience Multisensory integration/ affective and cognitive responses Multisensory integration	What is the influence of the sensory dimension on the other four customer experience dimensions (affective, physical, social, cognitive)? Is there a causal link across dimensions? What is the underlying mechanism between multisensory integration and customer responses (e.g., emotional and cognitive replies)? How can the influence of multisensory stimuli be captured and measured in a multimodal measurement tool for customer experiences? To what extent do customers hierarchically or sequentially integrate multisensory stimuli at different customer journey touchpoints?	Cross-modal correspondence Sensorimotor Contingency Theory Sensorimotor contingency theory/ Cross-modal correspondence	Experimental set-up for serial dependencies ESET and fMRI scan Sensometrics Automated facial recognition Instrumental-sensory analysis technique	Theory: Chao et al. (2018) Treisman and Gelade (1980) Methods: Cassani et al. (2020) Cicchini, Mikellidou, and Burr (2017) Greven et al. (2019); Stead, Odekerken-Schroeder, and Mahr (2020)

Table 2. (continued)

Research direction	Research area	Research streams	Research questions	Suggested theories	Suggested methods	Suggested references
Understanding and designing multisensory omnichannel experiences	A/B A/B/C A/B A/B/C	Service architecture and service system design Digital Trans-formation Emotions and technology Omnichannel design	How can multisensory stimuli facilitate customers' navigation of new technology-driven service environments? How can virtual service environments (e.g., using technologies such as AI or virtual reality) facilitate multisensory customer experiences? How does the weight assigned to different sensory stimuli change for customers in digital or virtual service environments? What roles do emotionally valenced stimuli have in interactions with technology (e.g., service robots)? How can service providers facilitate a consistent multisensory rich experience across different channels (e.g., online vs. offline)?	Sensorimotor contingency theory Social semiotic theory of multimodality Sensorimotor learning in robots Environmental sensitivity theory Theory of cognitive balance Emotional valence Stimulus-driven attention	Automated facial recognition Check-all-that-apply approach AI applications, robots, biometric measures, infrared thermal camera, heart rate measures, eye tracking, bio-sensory computers Instilling senses into AI (e.g., robots) Behavior-based navigation	Theory: Kauschke et al. (2019) Raheel, Majid, and Anwar (2020) Xiong, Worgotter, and Manoonpong (2016) Methods: Cassani et al. (2020) Tsai, Hsu, and Shih (2017) Veijo et al. (2018) Worch et al. (2020)
Understanding the role of multisensory stimuli for transformative service research	A/B/C A/B/C A/B/C A/B/C	Transformative service Sociological and cultural perspectives	How can multisensory stimulation facilitate more health-conscious behavior? How can multisensory stimulation be used to guide customer change in exceptional circumstances that require fast behavioral adoptions (e.g., pandemic regulations) What is the effect of cultural differences on multisensory integration across diverse service contexts (e.g., public services, healthcare services)? How can service providers use technology to design multisensory customer experiences for sensory-impaired customers?	Cross-modal sensory compensation Cross-modal correspondence Culture as situated cognition theory Cross-modal sensory compensation	Check-all-that-apply approach Virtual reality navigation Emotion recognition ability Multisensory impairment measurement and sensory encoding	Theory: Biswas and Szocs (2019) Fang et al. (2014) Lee and Lopetcharat (2017) Raheel, Majid, and Anwar (2021) Schlegel et al. (2021) Method: Bernowitz, Kaup, and Yaffe (2020) Ketzef et al. (2017) Worch et al. (2020)

stimulus-driven attention might facilitate exploration of which stimuli conflict with customer perceptions and which trigger attention, regardless of preexisting, goal-directed motivations or behavioral intentions. Feature-integration theory also relates to visual attention in unfamiliar environments (Treisman and Gelade 1980) and might contribute to explaining customers' visual attention in novel surroundings, such as new service environments.

From a methodological perspective, the complexity of multisensory stimuli and the simultaneous activation of different modalities requires novel methods. For example, combining ethnographic approaches (e.g., ethnographic schema elicitation technique, ESET; Stead, Odekerken-Schroeder, and Mahr 2020) with STATIS and CLUSTATIS (e.g., Llobell et al. 2020), generate and cluster sensory information. Sensory processing sensitivity methods, in combination with fMRI, can produce a well-developed scale of differences in positive or negative perceptions of service environments (Greven et al. 2019). Similar to fMRI, functional near-infrared spectroscopy and electroencephalogram tap into neural bases (Hopfinger, Bunonocore, and Mangun 2000) and can capture physiological manifestations of emotional reactions (Raheel et al. 2021) to multisensory stimuli in service environments.

Understanding the Links of Multisensory Customer Experiences and Emotions

Emotions are highly relevant in sensory marketing and service research. Environmental psychology research implies that consumers' emotional states mediate the link between atmospherics in the environment and their behaviors (Poncin and Minoun 2014). Although sensory marketing research has established a link between individual sensory stimuli and emotions (Mattila and Wirtz 2001; Pham 1998; Spence et al. 2014), a multisensory perspective is missing (Helmefalk and Berndt 2018). The cross-disciplinary analysis reveals that multiple stimuli can simultaneously trigger diverse sensory modalities (Shams and Beierholm 2010), so studies of the effects of individual stimuli on customers' emotional states likely are providing incomplete pictures, which is especially problematic in technology-enabled service environments. Castellano, Kessous, and Caridakis (2008) offer a multimodal approach that integrates eight emotions, according to facial expressions, body movements, gestures, and speech. Existing service and marketing research focuses mostly on emotions as mediators of stimuli inputs and customer responses (Bagozzi, Gopinath, and Nyer 1999), whereas studies outside the discipline investigate emotions as triggers of human reactions. As we noted, Breiter et al. (1996) show that emotionally valenced stimuli (i.e., facial pictures) receive significantly more attention than neutral versions. Such visual suppression–specific attention (Gazzaley et al. 2005) suggests new opportunities for customer engagement, beyond face-to-face customer–employee interactions. For example, to complete complex social and emotional tasks, customers value physical interactions with employees more

than interactions with robots (Wirtz et al. 2018), but they also express appreciation for service interactions in computer-generated shopping environments (i.e., virtual reality) that are less crowded (e.g., Van Kerrebroeck, Brengman, and Willems 2017). Research in online and offline contexts should seek more comprehensive depictions of the interplay of multisensory simulation and emotional states and the effects on holistic multisensory customer experiences.

Cross-disciplinary theories such as cross-modal correspondence and sensorimotor contingency theory can address the dependency and activation between modalities and provide a structure for understanding how knowledge is grounded in experience. Furthermore, sensorimotor contingency theory deals with which sensory information gets extracted and why it is relevant for an individual's perception of the environment. To map how multisensory stimuli are activated and integrated along the customer journey, service research would benefit from sensometrics, instrumental-sensory analysis, and automated facial recognition methods, which can separate sensory stimuli and match each of them with customer reactions, such as emotions.

Understanding and Designing Multisensory Omnichannel Experiences

Extensive service and marketing research pertains to the influence of the service environment and social interaction on customer behavior. Especially in recent years, the focus has shifted toward an online service environment, though we lack understanding of how multisensory stimulation affects omnichannel customer experiences. Omnichannel customer experience management aims to optimize the customer experience and performance over many available channels and customer touchpoints, through their synergetic management (Verhoef, Kannan, and Inman 2015). Recent technological developments have boosted the number of available customer touchpoints and thus the challenge of offering a coherent customer experience across channels (Singh et al. 2020). Achieving coherence demands understanding how customers process information available at digital and physical touchpoints, which requires involving all relevant senses and using that information to optimize multisensory information processing during omnichannel customer experiences.

A cross-disciplinary perspective highlights the need for finergrained analyses of the internal processes that guide customer perception and responses. According to research on embodied cognition (Borghi and Cimatti 2010), customers' perceptions depend largely on body-related information, derived from the exposure to service environments (Rosa, Garbarino, and Maller 2016) or through the body itself (Yim and Park 2019), known as somatosensory experience (Möller and Herm 2013). Cognitive science scholars also suggest that relationships between sensory stimuli integration and embodied cognition depend on the interplay of the sensory system and the motor system (Haggard, Clark, and Kalogeras 2002). This internal mechanism, which

selectively integrates multisensory stimuli, facilitates a sequential learning process that ultimately enables people to understand service environments, including new, innovative servicescapes. This finding is highly relevant to digital services; it raises questions about the extent to which service providers can facilitate consistent multisensory customer experiences. Furthermore, building on Wolpert, Ghahramani, and Jordan's (1995) finding that sensorimotor integration enables stimulus processing that leads to planning, control, and learning of actual movements, researchers could explore how multisensory stimuli in unfamiliar, technology-driven, digital service environments that require customers to change their habits might help those customers understand, learn, and adapt their behaviors.

Theories that support a better understanding of the role of senses in a technology-driven online service environment include sensory motor contingency theory, environmental sensitivity theory, and the theory of cognitive balance. They predict which relevant, emotionally valenced stimuli affect consumer interactions with technology or digital interfaces. In addition, the social semiotic theory of multimodality deals with the effect of social valuation in speech and written text; it might yield important insights for online service environments. In an omnichannel context, analyzing multisensory customer experiences demands methods that support comparisons across diverse service environments, and using novel technologies to study multisensory integration could offer unique insights toward that end (Cornelio, Velasco, & Obrist 2021). In addition, automated facial recognition and artificial intelligence applications such as biometrics, infrared thermal cameras, heart rate measures, eye tracking, and bio-sensory computer apps might provide rich parameters and enable finer-grained analyses of multisensory customer experiences.

Understanding the Role of Multisensory Stimuli for Transformative Service Research

Online and virtual service environments are attracting more research attention. In changing service landscapes, driven by technology advancements, transformative service research is especially relevant. We need research that looks beyond quantifiable, firm-related outcome measures to gauge the effects of service interactions on customer well-being (Anderson and Ostrom 2015; Anderson et al. 2013). Modern global crises also highlight the need for service research that addresses vulnerable populations of customers (Verma and Gustafsson 2020), as well as the difficultly of changing customer behavior. For example, COVID-19 lockdowns required service providers to adapt their business models but relied on customers to adapt to new service environments. In such contexts, multisensory investigations are of profound importance. Roschk and Hosseinpour (2020) even highlight the lack of evidence related to how customers perceive the environment through all their senses.

From a theoretical perspective, cross-modal correspondence, in combination with theories such as embodied cognition, might help explain how customers connect sensory information, which helps them navigate and adapt their behavior across channels (Hannum et al. 2020). Methods such as check-all-that-apply (Worch et al. 2020) and emotion recognition ability (Schlegel et al. 2021) can assess how interactions in different service environments (e.g., technology-enabled self-services) influence customer emotions and perceptions. Worch et al. (2020) also recommend virtual reality as an experimental tool to study sensory perception. Finally, our cross-disciplinary insights suggest methods to study more vulnerable customer groups, such as those with sensory impairments. Neuroscientific multisensory impairment measurement and impaired sensory encoding scales can assist this effort (Bernowitz, Kaup, and Yaffe 2020; Ketzef et al. 2017).

Conclusion and Limitations

Multisensory customer experiences constitute a complex research topic, garnering increasing attention in service and sensory marketing research. This study offers a cross-disciplinary review of sensory research. We seek to provide a comprehensive perspective on multisensory research, though the sample reflects our keyword selection and coding criteria. We explicitly consider research that refers to senses in a *multisensory* way, with the goal of capturing research endeavors designed to explain the role and interplay of multiple senses and paving the way for future research to potentially encompass and simultaneously investigate all senses involved at diverse service touchpoints. Continued research might consider other search terms to advance our findings, for example, further exploring recent work on a sixth sensory system (see e.g., Angelaki and Cullen 2008; Biswas et al. 2019). Our findings describe the status quo of sensory research, highlight gaps, and provide theoretically grounded avenues for continued multidisciplinary research that relies on various methodologies and transcends research boundaries to move the field forward. Research-based steps along the agenda we propose can expand understanding of multisensory customer experiences, within and beyond service contexts.

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Supplemental Material

Supplemental material for this article is available online.

Note

1. The reference list for the focal articles, discussed in the result section, is available in the web appendix.

References

Ajzen, Icek and Martin Fishbein (1980), *Understanding Attitudes and Predicting Social Behavior.* Englewood Cliffs, NJ: Prentice-Hall.

Antons, David and Christop F. Breidbach (2018), "Big Data, Big Insights? Advancing Service Innovation and Design with Machine Learning," *Journal of Service Research*, 21 (1), 17–39.

Aydinoglu, Nilüfer Z. and Aradhna Krishna (2019), "The Power of Consumption-Imagery in Communication Retail-Store Deals," *Journal of Retailing*, 95 (4), 116–127.

Biesenthal, Christopher and Ralf Wilden (2014), "Multi-level Project Governance: Trends and Opportunities," *International Journal of Project Management*, 32 (8), 1291–1308.

Biswas, Dipayan (2019), "Sensory Aspects of Retailing: Theoretical and Practical Implications," *Journal of Retailing*, 95 (4), 111–115.

Biswas, Dipayan and Courtney Szocs (2019), "The Smell of Healthy Choices: Cross-Modal Sensory Compensation Effects of Ambient Scent on Food Purchases," *Journal of Marketing Research*, 56 (1), 123–141.

Biswas, Dipayan, Lauren Labrecque, Donald Lehmann, and Ereni Markos (2014), "Making Choices while Smelling, Tasting, and Listening: The Role of Sensory (Dis)similarity when Sequentially Sampling Products," *Journal of Marketing*, 78 (1), 112–126.

Bitner, Mary J. (1992), "Servicescape: The Impact of Physical Surroundings on Customers and Employees," *Journal of Marketing*, 56 (2), 57–71.

Blondel, Vincent D., Jean-Loup Guillaume, Renaud Lambiotte, and Etienne Lefebvre (2008), "Fast Unfolding of Communities in Large Networks," *Journal of Statistical Mechanics: Theory and Experiment*, 2008 (10), 1742–5468.

Breugelmans, Els and Katia Campo (2016), "Cross-Channel Effects of Price Promotions: An Empirical Analysis of the Multi-Channel Grocery Retail Sector," *Journal of Retailing*, 92 (3), 333–351.

Cassani, Lucía, Susana Fiszman, María V. Alvarez, María R. Moreira, Laura Laguna, and Amparo Tarrega (2020), "Emotional Response Evoked When Looking at and Trying a New Food Product, Measured Through Images and Words. A Case-Study with Novel Fruit and Vegetable Smoothies," *Food Quality and Preference*, 84 (103955), 1–12.

Caterina, Michael J., Mark A. Schuhmacher, Makoto Tominago, Tobias A. Rosen, Jon D. Leven, and David Julius (1997), "The Capsaicin Receptor: A Heat-Activated Ion Channel in the Pain Pathway," *Nature*, 389 (6653), 816–834.

Chao, Zenas C., Kana Takaura, Liping Wang, Naotaka Fuji, and Stanislas Dehaene (2018), "Large-Scale Cortical Networks for Hierarchical Prediction and Prediction Error in the Primate Brain," *Neuron*, 100 (5), 1252–1266.

Chronis, Athinodoros (2019), "The Staging of Contested Servicescapes," *Journal of Service Research*, 22 (4), 456–473.

Cicchini, Guido Marco, Kyriaki Mikellidou, and David Burr (2017), "Serial Dependencies Act Directly on Perception," *Journal of Vision*, 17 (14), 1–9.

Driver, Jon and Charles Spence (2000), "Multisensory Perception: Beyond Modularity and Convergence", *Current Biology*, 10 (20), 731–735.

Fang, Hui, Jie Zhang, Murat Sensory, and Nadia Magnenat-Thalmann (2014), "Reputation Mechanism for E-commerce in Virtual Reality Environments, *Electronic Commerce Research and Applications*, 13 (6), 409–422.

Forbes (2018), "Using Neuroscience to Transform Retail," *Forbes Media*. Retrieved October 10th, 2019 from https://www.forbes.com/sites/oliviapinnock/2018/06/18/using-neuroscience-to-transform-retail/#2dabfe9c5300.

Fulkerson, M. (2014). "*Explaining multisensory experience,*" in *Consciousness Inside and out: Phenomenology, Neuroscience, and the Nature of Exper*ience. R. Brown, eds. Dordrecht: Springer, 365-373.

Fürst, Andreas, Nina Pečornik, and Christian Binder (2021), "All or Nothing in Sensory Marketing: Must All or Only Some Sensory Attributes Be Congruent With a Product's Primary Function?," *Journal of Retailing*, 97 (3) 439–458.

Godbold, Paul, Natasha Godbold, Simon Wittenberg, Sabi Phagura, Leanne Kelsall, Ong Chin Huat, Jeremy Webb, Jenny Allan, Helena Nicklin, Charlotte Kan, Jane Carley, Emily Roberts, Reena Patel, Simone Zeffiro, Gina Baska, Swee Oh, Paul Kinsley, Steven North, Peter Hayward, and Sarah Blake (2020), "Kitchen Theory to Bring Multisensory Dining into Your Own Home," *Luxurious Magazine*, April 29, available at https://www.luxuriousmagazine.com/kitchen-theory-multisensory-dining/ (accessed on August 2nd 2021).

Grewal, Dhruv, Anne I. Roggeven, Nancy M. Puccinelli, and Charles Spence (2014), "Atmospherics and In-Store Nonverbal Cues: An Introduction," *Psychology & Marketing*, 31 (7), 469–471.

Helmefalk, Miralem and Adele Berndt (2018), "Shedding Light on the Use of Single and Multisensory Cues and Their Effect on Consumer Behaviours," *International Journal of Retail & Distribution Management*, 46 (11/12), 1077–1091.

Helmefalk, Miralem and Bertil Hultén (2017), "Multisensory Congruent Cues in Designing Retail Store Atmosphere: Effect's on Shoppers Emotions and Purchase Behavior," *Journal of Retailing and Consumer Services*, 38 (September), 1–11.

Hirschman, Elizabeth, C. and Morris, B. Holbrook (1982), "Hedonic Consumption: Emerging Concepts, Methods and Propositions," *Journal of Marketing*, 46 (3), 92–101.

Kahn, Barbara E. (2017), "Using Visual Design to Improve Customer Perception of Online Assortments," *Journal of Retailing*, 93 (1), 29–42.

Kauschke, Christina, Daniela Bahn, Michael Vesker, and Gudrun Schwarzer (2019), "The Role of Emotional Valence for the Processing of Facial and Verbal Stimuli– Positivity and Negativity Bias?" *Frontiers in Psychology*, 10 (1654), 1–15.

Kim, Minjeong, Jung-Hwan Kim, Minjung Park, and Jungmin Yoo (2021), "The Roles of Sensory Perceptions and Metal Imagery in Consumer Decision-Making," *Journal of Retailling and Consumer Services*, 61 (July), 102517.

Krakauer, John W., Luca Cian, and Nilüfer Z. Aydinğlu (2017), "Sensory Aspects of Package Design," *Journal of Retailing*, 93 (1), 43–54.

Krishna, Aradhna (2012), "An Integrative Review of Sensory Marketing: Engaging the Senses to Affect Perception, Judgment, and Behavior," *Journal of Consumer Psychology*, 22 (3), 332–351.

Laflaquière, Alban, J. Kevin O'Regan, Bruno Gas, and Alexander Terekhov (2018), "Discovering Space – Grounding Spatial Topology and Metric Regularity in a Naive Agent's Sensorimotor Experience," *Neural Network*, 105 (September), 371–392.

Lee, Hye-Song and Kannapon Lopetcharat (2017), "Effect of Culture on Sensory and Consumer Research: Asian Perspectives," *Current Opinion in Food Science*, 15 (June), 22–29.

Liesch, Peter W., Lars Håkanson, Sara L. McGaughey, Stuart Middleton, and Julia Cretchley (2011), "The Evolution of the International Business Field: A Scientometric Investigation of Articles Published in its Premier Journal," *Socientometrics*, 88 (1), 17–42.

Lipkin, Michaela (2016), "Customer Experience Formation in Today's Service Landscape," *Journal of Service Management*, 27 (5), 678–703.

Mahr, Dominik, Susan Stead, and Gaby Odekerken-Schröder (2019), "Making Sense of Customer Service Experiences: A Text Mining Review, *Journal of Services Marketing*, 33 (1), 88–103.

Mari, Michela and Sara Poggesi (2013), "Servicescape Cues and Customer Behavior: A Systematic Literature Review and Research Agenda," *The Service Industries Journal*, 33 (2), 171–199.

Marketing Science Institute (2020), "*Research Priorities 2020 – 2022*," Cambridge, MA: Marketing Science Institute, available at https://www.msi.org/wp-content/uploads/2020/06/MSI_RP20-22.pdf (accessed December 12th 2020).

Mathies, Christine and Marion Burford (2011), "Customer Service Understanding: Gender Differences of Frontline Employees," *Managing Service Quality: An International Journal*, 21 (6), 636–648.

Mattila, Anna S. and Jochen Wirtz (2001), "Congruency of Scent and Music as a Driver of In-store Evaluations and Behavior," *Journal of Retailing*, 77 (2), 273–289.

McKemy, David D., Werner M. Neuhausser, and David Julius (2002), "Identification of a Cold Receptor Reveals a General Role of TRP Channels in Thermosensation," *Nature*, 416 (6876), 52–58.

McQuarrie, Laura (2015), "From Sound-Producing Posters to Scent-Emitting Bus Stops," *Trendhunter*, March 5, available at https://www.trendhunter.com/slideshow/multi-sensory-experience (accessed August 10th, 2021).

Mishra, Anubhav, Anuja Shukla, Nripendra P. Rana, and Yogesh K. Dwivedi (2021), "From "Touch" to a "Multisensory" Experience: The Impact of Technology Interface and Product Type on Consumer Responses," *Psychology & Marketing*, 38 (3), 385–396.

Pareigis, Jörg, Per Echeverri, and Bo Edvardsson (2012), "Exploring Internal Mechanisms Forming Customer Servicescape Experiences," *Journal of Service Management*, 23 (5), 677–695.

Petit, Olivia, Carlos Velasco, and Charles Spence (2019), "Digital Sensory Marketing: Integrating New Technologies into Multisensory Online Experience," *Journal of Interactive Marketing*, 45 (1), 42–61.

Pinnock, Olivia (2018), "Using Neuroscience To Transform Ratail," *Forbes*, June 18, available at https://www.forbes.com/sites/oliviapinnock/2018/06/18/using-neuroscience-to-transform-retail/?sh=143c9dae5300 (accessed August 14th 2021).

Podsakoff, Philip M., Scott B. MacKenzie, Daniel G. Bechrach, and Nathan P. Podsakoff (2005), "The Influence of Management Journals in the 1980s and 1990s," *Strategic Management Journal*, 26 (5), 473–488.

Raheel, Aasim, Muhammad Majid, and Syed Muhammad Anwar (2021), "DEAR-MULSEMEDIA: Dataset for Emotion Analysis and Recognition in Response to Multiple Sensorial Media," *Information Fusion*, 65 (January), 27–49.

Randhawa, Krithika, Ralf Wilden, and Jan Hohberger, (2016), "A Bibliometric Review of Open Innovation: Setting a Research Agenda," *Journal of Product Innovation Management*, 33 (6), 750–772.

Roschk, Holder, Sandra M. Correia Loureiro, and Jan Breitsohl (2017), "Calibrating 30 Years of Experimental Research: A Meta-Analysis of the Atmospheric Effects of Music, Scent, and Color." *Journal of Retailing*, 93 (2), 228–240.

Roschk, Holder and Masoumeh Hosseinpour (2020), "Pleasant Ambient Scents: A Meta-Analysis of Customer Responses and Situational Contingencies," *Journal of Marketing*, 84 (1), 125–145.

Sakpal, Manasi (2019), "5 Digital Technology Trends for 2020," *Gartner*, November 21, available at https://www.gartner.com/smarterwithgartner/5-digital-technology-trends-for-2020 (accessed on August, 15th 2021).

Sample, Kevin L., Henrik Hagtvedt, and S. Adam Brasel (2020), "Components of Visual Perception in Marketing Contexts: A Conceptual Framework and Review," *Journal of Academy of Marketing Science*, 48 (May), 405–421.

Scott, Rebecca O. and Mark D. Uncles (2018), "Bringing Sensory Anthropology to Consumer Research", *European Journal of Marketing*, 52 (1/2), 302–327.

Singh, Jagdip, Satish R. Nambisan, Gary R. Bridge, and Jürgen Kai-Uwe Brock (2020), "One-Voice Strategy for Customer Engagement," *Journal of Service Research*, 24 (1), 42–65.

Smith, Andrew E. and Michael S. Humphreys (2006), "Evaluation of Unsupervised Semantic Mapping of Neural Language with Leximancer Concept Mapping," *Behavior Research Methods*, 38 (2), 262–279.

Spence, Charles, (2020), "Senses of Place: Architectural Design for the Multisensory Mind," *Cognitive Research: Principles and Implications*, 5 (1), 1–26.

Spence, Charles, Nancy M. Puccinelli, Dhruv Grewal, and Anne L. Roggeveen (2014), "Store Atmospherics: A Multisensory Perspective," *Psychology & Marketing*, 31 (7), 472–488.

Stead, Susan, Gaby Odekerken-Schröder, and Dominik Mahr (2021) "Unraveling Customer Experiences in a New Servicescape: An Ethnographic Schema Elicitation Technique (ESET)," *Journal of Service Management*, 32 (4), 612–641.

Tsai, Feng-Sheng, Sheng-Yi Hsu, and Mau-Hsiang Shih (2017), "Adaptive Tracking Control for Robots with an Interneural Computing System," *IEEE Transactions on Neural Networks and Learning Systems*, 29 (4), 832–844.

Verhoef, Peter C., P.K. Kannan, and Jeffery J. Inman (2015), "From Multi-Channel Retailing to Omni-channel Retailing: Introduction to the Special Issue on Multi-Channel Retailing," *Journal of Retailing*, 91(2), 174–181.

Viejo, Claudia Gonzalez, Sigfredo Fuentes, Kate Howell, Damir Torrico, and Frank B. Dunshea (2018), "Robotics and Computer Vision Techniques Combined with Non-Invasive Consumer

Biometrics to Assess Quality Traits from Beer Foamability Using Machine Learning: A Potential for Artificial Intelligence Application," *Food Control*, 92 (October), 72–79.

Wilden, Ralf, Melissa A. Akaka, Ingo O. Karpen, and Jan Hohberger (2017), "The Evolution and Prospects of Service-Dominant Logic: An Investigation of Past, Present, and Future Research," *Journal of Service Research*, 20 (4), 345–361.

Xiong, Xiaofeng, Florentin Wörgötter, and Poramente Manoonpong (2016), "Adaptive and Energy Efficient Walking in a Hexapod Robot Under Neuromechanical Control and Sensorimotor Learning," *IEEE Transactions on Cybernetics*, 46 (11), 2521–2534.

Yanagisawa, Hideyoshi and Kenji Takatsuji (2017), "Expectation Effect of Perceptual Experience in Sensory Modality Transitions: Modeling with Information Theory," *Journal of Intelligent Manufacturing*, 28 (7), 1635–1644.

Yang, Wenxi, Keith R. Cadwallander, Yuping Liu, Mingquan Huang, and Baoguo Sun (2019), "Characterization of Typical Potent Odorants in Raw and Cooked Toona Sinensis (A. Juss.) M. Roem. by Instrumental-Sensory Analysis Techniques," *Food Chemistry*, 282 (June), 153–163.

Zhu, Rui J. and Ravi Mehta (2017), "Sensory Experiences and Consumer Creativity," *Journal of Association of Consumer Research*, 2 (4), 472–484.

Zupic, Ivan and Tomaž Čater (2015), "Bibliometric Methods in Management and Organization," *Organizational Research Methods*, 18 (3), 429-472.

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