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Predictors of food decision making: A systematic interdisciplinary mapping (SIM) review

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ABSTRACT

The number of publications on consumer food decision making and its predictors and correlates has been steadily increasing over the last three decades. Given that different scientific disciplines illuminate this topic from different perspectives, it is necessary to develop an interdisciplinary overview. The aim of this study is to conduct a systematic interdisciplinary mapping (SIM) review by using rapid review techniques to explore the state-of-the-art, and to identify hot topics and research gaps in this field. This interdisciplinary review includes 1,820 publications in 485 different journals and other types of publications from more than ten disciplines (including nutritional science, medicine/health science, psychology, food science and technology, business research, etc.) across a period of 60 years. The identified predictors of food decision making were categorized in line with the recently proposed DONE (Determinants Of Nutrition and Eating behavior) framework. After applying qualitative and quantitative analyses, this study reveals that most of the research emphasizes biological, psychological, and product-related predictors, whereas policy-related influences on food choice are scarcely considered.

1. Introduction

The topic of food decision making is central to many research disciplines, including nutritional science (Hoppert, Mai, Zahn, Hoffmann, & Rohm, 2012; Keim, Forester, Witbracht, Widaman, & Laugero, 2012; Vella, Stratton, Sheeshka, & Duncan, 2014), psychology (Chandon & Wansink, 2012; Hollands, Prestwich, & Marteau, 2011; Renner, Sproesser, Strohbach, & Schupp, 2012; Rozin, 1996; Wohldmann, 2013), business research (Ackermann & Palmer, 2014; Carroll & Vallen, 2014), and food science and technology (Jaros, Thamke, Raddatz, & Rohm, 2009; O'Neill, Hess, & Campbell, 2014). Each discipline contributes to the knowledge on food decision making from its own point of view and with its unique theories and methods. Despite a growing number of publications and although the disciplines share the same topic, there is still potential to merge findings. Some time ago, Köster (2009) highlighted that many factors jointly determine food choice, but interdisciplinary approaches are still scarce. The large amount of literature with heterogeneous, sometimes contradictory findings calls for ways to synthesize and generalize evidence about the key factors that guide food choice.

The scientific disciplines that explore food decision making focus on different aspects, behaviors, and mechanisms. Comparing respective studies is particularly challenging because different terms may be used for similar concepts, or because identical terms may be used for different concepts. In the marketing and consumer behavior literature, food decision making has been conceptualized, for instance, in terms of purchase intention or purchase decision (Baker, McCabe, Swithers, Payne, & Kranz, 2015; Mai & Hoffmann, 2015; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014; Tirelli & Martínez-Ruiz, 2014), or food choice (Carroll & Vallen, 2014; Peters-Texeira & Badrie, 2005). In the food science and technology literature, food acceptance or

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preference (Alm, Olsen, & Honkanen, 2015; García-Segovia, Harrington, & Seo, 2015; Hoppert et al., 2013; Miyagi & Ogaki, 2014) are commonly related to food decision making, and psychological research has a stronger focus on eating behavior (Schüz, Schüz, & Ferguson, 2015; Sproesser, Schupp, & Renner, 2013).

The aim of the present study is to achieve an enhanced understanding of the predictors of food decision making of adults. We intend to provide a comprehensive overview of existing knowledge in order to identify gaps in the literature, and to unravel promising contributors that are apparently under-researched. Our main research questions (RQ), derived from this general aim, focus on categorizing and structuring the research in food decision making:

RQ 1: What are the main disciplines that examine food decision making?
RQ 2: What are the predictors of food decision making that are mainly addressed, and which predictors suffer from a lack of research?
RQ 3: What are the most common predictors analyzed in the various disciplines?
RQ 4: In what way did the number and frequency of publications, and topics change over time?

To achieve these goals, we conduct an extensive and systematic screening of the current literature. More precisely, to obtain a better overview on the actual scientific discussion, and on research gaps that need to be addressed in interdisciplinary work, (a) we are looking at individual cognitive and affective processes that are mainly examined in psychology, consumer behavior research, and neuroscience, (b) we consider biological predictors, sensory processes and the influence of intrinsic product attributes to cover food science and technology, nutritional science, biology, and medicine, and (c) we focus on predictors within the physical and social environment of consumers that play a major role in sociology, marketing, and social psychology.

2. Conceptual background: The DONE framework

The conceptual frameworks of food decision making that are available (e. g., Booth et al., 2001; Furst, Connors, Bisogni, Sobal, & Falk, 1996; Köster, 2009; van der Merwe, Kempen, Breedt, & de Beer, 2010) have in common that they generally stem from one specific discipline (Köster, 2009), or that they focus only on specific factors that affect food choice (Booth et al., 2001). Keeping these limitations in mind, the interdisciplinary DONE framework (**D**eterminants **O**f **N**utrition and **E**ating behavior framework) was recently developed to structure food choice determinants and influencing factors (Stok et al., 2016; Fig. 1). The aim of this framework is to identify all determinants of nutrition and eating that are relevant across age groups, and across research disciplines. It is intended as a dynamic, interactive framework that evolves and improves as experts can continue to contribute to it. The DONE framework is meant to facilitate the evolvement of a "common language" across disciplines, and to encourage collaboration and joint research efforts between the disciplines.

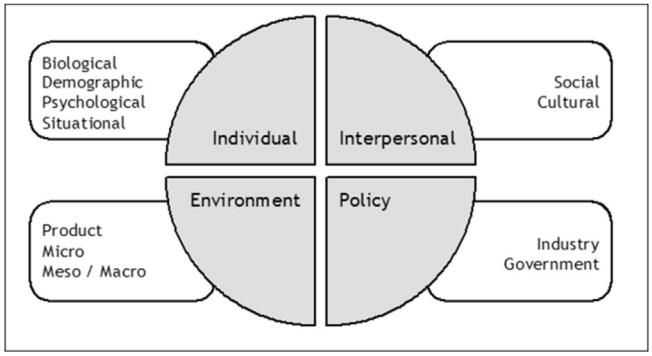

Fig. 1. Simplified representation of main levels (grey) and stem-categories (white) in the DONE framework.

The DONE framework was developed, evaluated and visualized in a multiphase process over a period of almost two years. The work took place in the context of the European research network and knowledge hub DEDIPAC (Determinants of Diet and Physical Activity) (Lakerveld et al., 2014). One working group with more than 80 scholars of different academic background was assigned to develop a multidisciplinary life-course framework of the determinants of nutrition and eating. This group of DEDIPAC partners developed the DONE framework in two steps. After creating a taxonomy of relevant outcomes (food choice, intake of nutrients, eating behavior, etc.) for which the DONE framework should provide potential determinants, the partners systematically nominated relevant determinants per age group (children – adults – elderly) and integrated and categorized these determinants into one life-course framework. The framework follows a socio-ecological structure, with determinants being structured along four main levels of influence: individual, interpersonal, environment, and policy. Within each of these main levels, determinants are grouped into eleven distinct stem-categories (see Fig. 1). Each stem-category is further subclassified into 51 more specific leaf-categories of which 47 currently exist in the framework of determinants shaping nutrition and eating of adults.

For the evaluation of the framework, the DEDIPAC partners as well as 123 external experts from different disciplines and different countries rated the determinants on the dimensions modifiability, relationship strength and population-level effect to identify areas of priority for research. In the second step, 129 external experts with different background evaluated the usefulness, completeness and applicability of the DONE framework for research, intervention, and policy making. Feedback from the evaluation phase was incorporated into the framework. The current, visualized version of the DONE framework is freely accessible and can be utilized in a highly flexible and interactive way (www.uni-konstanz.de/DONE). The 441 determinants[1] that are currently included can be filtered, selected, sorted, and visualized for specific research questions, but also for more general overview approaches. Moreover, new determinants and categories can continuously be added to the framework, and the framework's evolution can be tracked and recorded.

3. Design

3.1. Research approach

To the best of our knowledge, no study has attempted to synthesize the literature on food decision making across different disciplines. Given that traditional review methods have severe limitations, previous interdisciplinary reviews on food choice are centred on specific domains to handle a large number of publications (e.g., Hollands et al., 2015). This work examines prior investigations at the meta-level of the food decision making complex by applying a method that we denote as systematic interdisciplinary mapping (SIM) review. Our SIM approach builds on the rapid review method, a specific form of literature review that

[1] Note: As causality was not checked, we further use the term predictor instead of determinant in this study.

synthesizes evidence in a shortened time frame and that is widely used in medicine and healthcare (Brearley et al., 2011; Harker & Kleijnen, 2012; Khangura, Polisena, Clifford, Farrah, & Kamel, 2014). We extend this method by integrating mapping techniques from information technology research which do neither discuss and aggregate the outcomes of the primary studies nor extract specific details, but rather analyze research activities and aggregate studies within sub-topics of defined categories (Kitchenham, Budgen, & Pearl Brereton, 2011; Li, Avgeriou, & Liang, 2015; Pedreira, García, Brisaboa, & Piattini, 2015). Both review types use methods to accelerate or streamline conventional systematic review processes by, for instance, searching in fewer databases, and considering time or scope constraints (Ganann, Ciliska, & Thomas, 2010; Grant & Booth, 2009).

3.2. Search process

3.2.1. Selection of data sources and search strategies

To achieve a comprehensive overview about interdisciplinary research in food decision making, we searched ten electronic databases: Academic Search Complete, Business Source Complete, Cinahl, EconLit, PsycArticles and PsycInfo of EBSCO, Embase, PubMed, Web of Science, and Cochrane. The variation in database profiles ensured that publications of the most important research domains were covered, e. g., nutritional science, (evidence-based) medicine, business administration, behavioral science, food science and technology, and psychology.

'Food decision making', 'food choice', 'food purchase intention', etc. are often used interchangeably to describe the behavior of individuals in which they decide for (or against) particular foods and beverages. The use of the respective term depends on the discipline in which food consumption is analyzed, and on the background of the researcher. In the initial stage of this study, we identified the most common terms by conducting test searches and by evaluating references in sample articles. Because our focus is on quantitative studies that can be linked to the predictors, we added methodological keywords for identifying empirical papers (David & Han, 2004). After conducting a first title screening, we identified several studies that deal with animals or age groups that are not in the focus of the present research. For this reason, we added two exclusion criteria in our keyword combination (Table 1).

3.2.2. Inclusion and exclusion criteria

To ensure that only relevant articles are included in the final analysis, we identified three types of exclusion criteria: publication-based, content-based, and method-based criteria. The publication-based criterion controls for the fact that only academic journals, PhD theses, books or book sections, working papers and conference proceedings were considered. Non-academic articles, opinions, and experience papers were excluded. The content-based criterion eliminates articles which do not focus on food decision making (e. g., studies on the role of food in certain diseases). Due to the focus on human adults, we excluded all studies on animals, children, and infants (although the keyword combination contained these exclusion criteria, we received a number of hits that had to be dropped). From a methodological standpoint, the search terms had to appear in the title, in the abstract, or in the keywords of the article. In addition, the article should contain empirical analysis that is accompanied by information on sample size, statistical tests, and analytic techniques. In line with our primary research objective, conceptual papers, qualitative studies, overviews, or reviews were excluded. We considered papers without any time constraints because RQ 4 addresses the changes over time.

3.2.3. Identification of relevant publications

For the search process, we applied a stepwise approach that is illustrated in Fig. 2. The initial search revealed 10,380 entries in all databases. Two researchers independently screened titles and, if necessary, abstracts and keywords using the predefined inclusion and exclusion criteria. If a discrepancy about the inclusion of a publication occurred, the two researchers re-read and discussed the paper until they agreed. To minimize the risk of (falsely) eliminating relevant publications, the critical papers were thoroughly checked. After removing publications without available full text, 5,328 publications remained across all databases. After removing all duplicates, the final sample included 1,820 unique

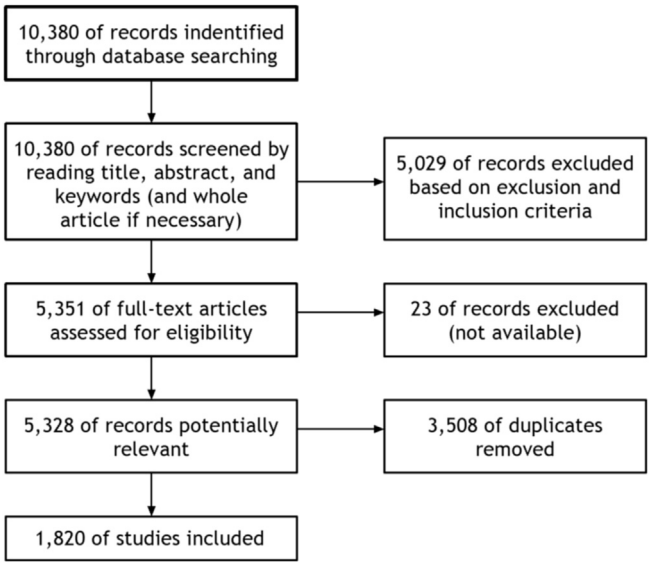

Fig. 2. Illustration of the search process.

Table 1
Keyword combination used in this study.

Aim of the keyword	Execution[a]
Relevant dependent variables	"food purchase intention*" OR food purchase behavior" OR food purchase decision*" OR food buying intention*" OR food buying behavior" OR food buying decision*" OR food decision making" OR food acceptance*" OR food preference*" OR food choice*"
Methodological keywords	AND (data OR regression OR empiric* OR variance OR evidence OR sampl* OR statistic* OR analysis OR signific* OR hypothes*)
Exclusion of animal studies	AND NOT (animal*)
Exclusion of young age groups	AND NOT (child* OR infant*)

* Wildcard indicator.
[a] Keyword combination is for all databases except PubMed. Search terms were adapted to respective database syntax to achieve valid results. For PubMed we used a specific combination of Mesh Terms: (food preferences/statistics and numerical data) AND humans.

relevant publications.

The final dataset contained different types of publications: articles in academic journals (1,737), PhD theses (57), and other outlets (26), including book sections, conference proceedings, books, and working papers. The articles were published in 485 journals (Table S1). The journal with the highest number of respective publications was *Appetite* (n = 244), followed by *Food Quality and Preference* (n = 113), and the *Journal of the American Dietetic Association* (n = 79). In ten more journals, the number of publications was larger than 20.

Of the 1,820 publications, 96.8% were published in English, 1.8% (= 33 articles) in one other language (16 Spanish, 6 Portuguese, 4 French, and some more), and 1.4% (= 26 articles) in another language with an English summary.

3.3. Coding of predictors and disciplines

In the next step, we categorized the predictors that are investigated in the 1,820 publications according to the DONE framework of food choice and eating behavior of adults. Two researchers independently analyzed the titles, abstracts and (if necessary) full texts of the publication to identify all predictors that the primary studies have examined. If there were doubts about the classification of a publication or disagreement between the researchers, the coding scheme that builds on the DONE framework was refined. That is, categories were added, expanded, or modified. Otherwise, both researchers discussed the issue until they achieved agreement. In this case, previously classified publications were checked again to validate their classification within the refined scheme. This iterative procedure proved to be very helpful as it led to a stable classification scheme after approximately 50 articles.

To assess coding reliability, a researcher with another scientific background coded a subsample of 100 randomly selected publications. We calculated the agreement between both coders for their leaf-category codings of the DONE framework. Across the eleven stem-categories, mean Krippendorff's alpha indicated acceptable agreement ($\alpha = 0.74$; see Hayes & Krippendorff, 2007). High agreement was also obtained when shifting the perspective by looking at the reliability of the coding of each paper. In this second agreement test, we checked whether both researchers independently assigned a paper to the same leaf-category. If both coders did not place a publication into any leaf-category, this was also counted as agreement (because multiple answers were possible). Regarding the agreement that is based on the coding of one leaf-category, this rather conservative test indicated an agreement of 77%. If multiple leaf-categories are considered for each paper, the agreement ranged from 84% (agreement on three categories) over 92% (agreement on seven categories) to 99% (taking all possible categories into account) which is due to the large number of empty categories per paper.

As the DONE framework is an interdisciplinary approach to classify the research efforts in food decision making, we also aimed at revealing relations between the disciplines. To operationalize the disciplines in which studies on food decision making are published, we used the journal as a proxy. The scope of an individual journal was extracted from the journal description in Web of Science, and one to three disciplines were assigned to a journal (e. g., Appetite: behavioral science and nutritional science; see Table S1). When a journal was not listed, we referred to Research Gate and Scientific Journal Rankings, or we visited the respective journal website (the same applies to books, book sections, PhD theses and conference proceedings). Subsequently, we grouped the journals (respectively the other types of publications) into ten disciplines: nutritional science, medicine/health science, food science and technology, behavioral science, biology, psychology, marketing and consumer research, social psychology, business administration and economics, and sociology.

4. Findings

4.1. Disciplines dealing with food decision making (RQ 1)

As a first result, we obtained a dataset of 2,996 codings coming from 1,820 publications (some publications examined multiple predictors) (Table 2). It is important to note that, because of the inductive coding procedure, some of the 39 leaf-categories presented here differ from the 51 leaf-categories in the conceptual DONE framework (Stok et al., 2016). Four of these twelve additional DONE leaf-categories do not apply in the present context because they are specific to children and thus they are not within the scope of this paper. Seven DONE leaf-categories were matched here under two umbrella terms due to different wordings in the coded studies (for further details, see Table 2). For example, 'social support', 'family structure', 'family food culture', and 'household socio-economic status' (DONE framework) were merged into one broader category that we labeled as 'social influence'. In addition, five leaf-categories from the DONE main levels environment and interpersonal have so far been neglected in the food decision making literature (these leaf-categories are provided in Table 2 for transparency, but they are not further discussed in this article). Finally, based on the literature screening, two leaf-categories were added (see Table 2).

The analysis revealed a wide range of research disciplines dealing with food decision making. In total, 320 journals (with 885 articles and 63 other types of publications) are assigned to a single discipline, 145 journals (797 articles and 14 other types of publications) to two disciplines, and 20 journals (55 articles and 6 other types of publications) to three disciplines. This means that more than half of the research on food decision making comes in what we denote as single-discipline journals (320 of 485 journals), whereas fewer journals have a cross-disciplinary scope or even a broader interdisciplinary focus. When considering the primary discipline only, the analysis revealed a dominance of medicine/health science (125 journals with 221 articles and 11 other types of publications = 232), psychology (53 journals with 100 articles and 17 other types of publications = 117), and nutritional science (30 journals with 277 articles and 12 other types of publications = 289; Fig. 3). Within the publications in two-discipline journals, nutritional science (34 journals with 539 articles and 4 other types of publications = 543), medicine/health science (38 journals with 67 articles and 6 other types of publications = 73), and psychology (26 journals with 68 articles and 4 other types of publications = 72) dominate. Although food science and technology (55 journals with 283 articles and 10 other types of publications = 293) and behavioral science (16 journals with 257 articles and 1 other type of publication = 258) have strong relations to a second discipline, they have weaker ties to a third discipline. The same is true for publications in marketing/consumer research, social psychology, and sociology.

4.2. Predictors of food decision making (RQ 2)

The analysis of the 1,820 publications with 2,996 codings revealed that the majority of the studies investigate predictors of food decision making at the individual level (61.8%) (Fig. 4). Approximately one third of the predictors include environmental aspects (30.8%). Studies dealing with interpersonal relations represent 6.6%, while it appears that policy-related studies are rare in food decision making research (0.8%).

The main level predictors were further differentiated with

Table 2
Predictors of the DONE framework with the number of entries.

Predictors main level[a]	Predictors stem-category	Predictors leaf-category
Individual (1,853)	**Biological** (385, 20.8%)	Brain Function (23)
		Oral Function (15)
		Food-related Physiology (74)
		Anthropometrics (81)
		Sensory Perception (78)
		Physical Health (100)
		Sleep Characteristics (14)
	Demographic (440, 23.7%)	Biological Demographics (213)
		Cultural Characteristics (143)
		Situational Demographics (0)†
		Personal Socio-Economic Status (84)
	Psychological (905, 48.8%)	Personality (145)
		Mood and Emotions (53)
		Self-Regulation (27)
		Health Cognitions (60)
		Food Knowledge, Skills and Abilities (114)
		Food Beliefs (247)
		Food Habits (43)
		Eating Regulation (43)
		Weight Control Cognitions and Behaviors (89)
		Intervention (84)*
	Situational (123, 6.6%)	Hunger (23)
		Related Health Behaviors (51)
		Situational and Time Constraints (49)
Interpersonal (197)	**Social** (178, 90.4%)**	Social Influence (178)
	Cultural (19, 9.6%)***	Cultural Cognitions, Cultural Behaviors (19)
Environment (922)	**Product** (768, 83.3%)	Intrinsic Product Attributes (265)
		Extrinsic Product Attributes (388)
		Food Type (115)*
	Micro (70, 7.6%)	Portion Size (6)
		Home Food Availability and Accessibility (16)
		Eating Environment (48)
	Meso/Macro (84, 9.1%)	Natural Conditions (0)†
		Characteristics of Living Area (13)
		Environment Food Availability and Accessibility (40)
		Food Outlet Density (4)
		Exposure to Food Promotion (22)
		Market Prices (0)†
		Societal Initiatives (5)
Policy (24)	**Industry** (1, 4.2%)	Industry Regulations (1)
		Industry Influence (0)†
	Government (23, 95.8%)	Governmental Regulations (4)
		Campaigns (19)
		Broader Governmental Policies (0)†

[a] Numbers in parentheses indicate how often the predictor was analyzed (n = 2,996, resulting from a total of 1,820 publications). The category scheme is adopted from the DONE framework (Stok et al., 2016) and slightly adapted. Two new leaf-categories were inductively found in the literature screening and are not part of the conceptual DONE framework (*). Leaf-categories that have to do with parents (e. g., parental attitudes, parental behaviors) apply exclusively to children. They are thus by definition not applicable to our article. The leaf-categories family structure, family food culture, household socio-economic status, social support and social influence were merged to 'social influence' (**). The leaf-categories cultural cognitions and cultural behaviors were merged into one leaf-category (***). Predictors from five leaf-categories from the DONE framework have not yet been researched in the food decision making literature. These leaf-categories are included in this table for completeness' sake, but not discussed in the remainder of the article (†).

respect to the stem-categories of the DONE framework. As regards individual predictors, psychological factors received the greatest interest (48.8% of the individual predictors), with food beliefs (247) being the most important leaf-category (see Table 2). One fifth of the studies investigate biological factors (20.8%). The relatively large number of anthropometric indicators, brain function, oral function, sleep characteristics, and physical health must be attributed to the fact that medicine/health science emerged as one of the dominant disciplines. Sensory and food-related physiology characteristics, e. g., food preferences and taste sensitivity, constitute vital biological predictors, and the situational predictors include hunger, health-related behavior and situational and time constraints. Demographics (23.7%) also play an important role, presumably because age, sex or ethnicity as cultural characteristics, and different socioeconomic predictors such as educational level and personal income, are often used as independent or moderating variables.

With regard to environmental predictors, product is the most widely studied factor of food choice (83.3%; see Table 2). This factor can be distinguished into extrinsic product attributes, intrinsic product attributes, and food type. Further predictors are included at the micro-level (e. g., the eating environment), whereas the meso/macro predictors reflect the surroundings of a consumer that (s)he is unable to change, such as food availability and accessibility. The by far smallest stem-category within the DONE framework is the policy predictor with a total of 24 studies.

The analysis shows that there are large differences between well- and under-researched predictors in food research; the median equals 49 (Fig. 5). While 20 of the 39 leaf-category predictors jointly account for 2,611 entries, the remaining 19 predictors jointly sum up to only 385 entries. Among the well-researched predictors are mainly psychological and biological predictors at the individual level, and product characteristics at the environment level. Other environmental predictors and policy-related predictors that may

Primary discipline	Secondary discipline											
	NS	MH	FT	BS	B	P	MC	SP	BA	S	None	Total
NS	–	8	3	1	30	0	0	0	8	0	289	339
MH	58	–	1	11	6	21	0	1	2	5	232	337
FT	150	1	–	1	1	3	10	0	33	0	94	293
BS	225	5	8	–	11	4	0	0	0	0	5	258
B	69	15	3	0	–	35	0	0	1	0	73	196
P	12	23	0	4	2	–	3	0	6	0	117	167
MC	1	1	0	0	0	9	–	0	17	0	80	108
SP	28	17	0	0	0	0	0	–	0	1	32	78
BA	0	3	6	0	0	0	4	0	–	0	22	35
S	0	0	0	5	0	0	0	0	0	–	4	9
None	0	0	0	0	0	0	0	0	0	0	–	0
Total	**543**	**73**	**21**	**22**	**50**	**72**	**17**	**1**	**67**	**6**	**948**	**1820**

Secondary discipline	Tertiary discipline											
	NS	MH	FT	BS	B	P	MC	SP	BA	S	None	Total
NS	–	1	0	0	2	1	1	0	1	0	537	**543**
MH	6	–	1	0	2	3	0	0	0	0	61	**73**
FT	1	0	–	0	8	0	0	0	0	0	12	**21**
BS	4	0	0	–	0	0	0	0	0	0	18	**22**
B	0	12	0	0	–	0	0	0	0	0	38	**50**
P	0	0	0	0	0	–	0	0	1	0	71	**72**
MC	0	0	0	0	0	0	–	0	4	0	13	**17**
SP	0	0	0	0	0	0	0	–	0	0	1	**1**
BA	0	3	0	2	0	0	8	0	–	0	54	**67**
S	0	0	0	0	0	0	0	0	0	–	6	**6**
None	0	0	0	0	0	0	0	0	0	0	948	**948**
Total	**11**	**16**	**1**	**2**	**12**	**4**	**9**	**0**	**6**	**0**	**1759**	**1820**

Fig. 3. Relationship between primary, secondary and tertiary discipline. NS, nutritional science; MH, medicine/health science; FT, food science and technology; BS, behavioral science; B, biology; P, psychology; MC, marketing/consumer research; SP, social psychology; BA, business administration/economics; S, sociology.

both influence food decision making suffer from a lack of research.

4.3. Domain-specific predictors (RQ 3)

In almost all disciplines, published research mainly addresses predictors from an individual perspective (Table 3), whereas research in business administration/economics puts emphasis on environmental predictors (highest number of the main level predictors). This can be explained with the fact that widely studied extrinsic product attributes (e. g., price and food labeling) are assigned to the environment level of the DONE framework. In the business literature, purchase intentions are analyzed in the context of food price, manipulated food labels, and other intrinsic or extrinsic cues (Kiesel & Villas-Boas, 2013; Lin, Ver Ploeg, Kasteridis, & Yen, 2014).

The importance of individual predictors at the DONE main level mainly results from the large number of research on biological, psychological, and demographic predictors at the DONE stem-category (see Table 3). In behavioral science, the most examined psychological predictors are weight control cognition and behavior, personality, mood and emotions, and knowledge, skills and abilities. This is also true for psychology and social psychology. Nutritional science and medicine/health science are two of the most active domains working on the examination of almost all predictors of food decision making, but also have a certain focus on psychological predictors.

Biological predictors, such as food-related physiology and anthropometrics, dominate in biology. In addition, predictors such as physical health, oral function or sleep characteristics are becoming more prevalent. In sociology, research is determined by demographics but, in contrast to other disciplines, the contribution of sociology to analyzing predictors of food choice is small. Business administration/economics, food science and technology, and marketing/consumer research predominantly examine product-related attributes. In total, only three clusters of main research activities across all disciplines were identified, and the domain-specific examination of predictors is limited. All disciplines concentrate on few predictors, whereas the remaining predictors received far less attention in prior research.

4.4. Timeline of publications and research trends (RQ 4)

The earliest publication identified in this study was published in 1954, a book section dealing with food preferences and menu planning. While between 1954 and 1989, the quota was one to eleven publications per year (Table 4), a steady increase in publication number is noticeable since 1990, with currently almost 200 publications per year. Compared to the most recent quinquennium with 883 publications, only 21 of the sampled studies were published between 1980 and 1984. In Web of Science, the ratio of total entries in these two periods is 22.1 million *vs.* 8.8 million, which clearly shows that the topic of food decision making became considerably more important to the research community during the last years.

Table 4 also shows the time-based number of publications in the respective research disciplines. Evidently, the increasing trend is mirrored by all disciplines. For half of the disciplines (biology, marketing/consumer research, medicine/health science, nutritional science, and sociology), the research interest peaked in the last quinquennium. Nutritional science started to gain focus in the early 1990s and currently stands for approximately one third of all publications. With a slight delay, research in food science and technology, medicine/health science, behavioral science, biology, and psychology rose gradually, without reaching the amount of nutrition publications. Contrarily, the number of publications in business administration/economics, marketing/consumer research and social psychology remains stable at a relatively low level. Publications dealing with sociological aspects are scarce.

A similar development in the number of publications emerged when distinguishing the levels of the DONE framework over time (Fig. 6). The number of publications on individual predictors exceeds the other predictors at DONE main levels since 1981. With a delay of about 13 years, the number of publications on environmental predictors also started to increase and, since 2004, a continuous increase in publications targeting the interpersonal impact on food choice is evident. Far behind, policy-related

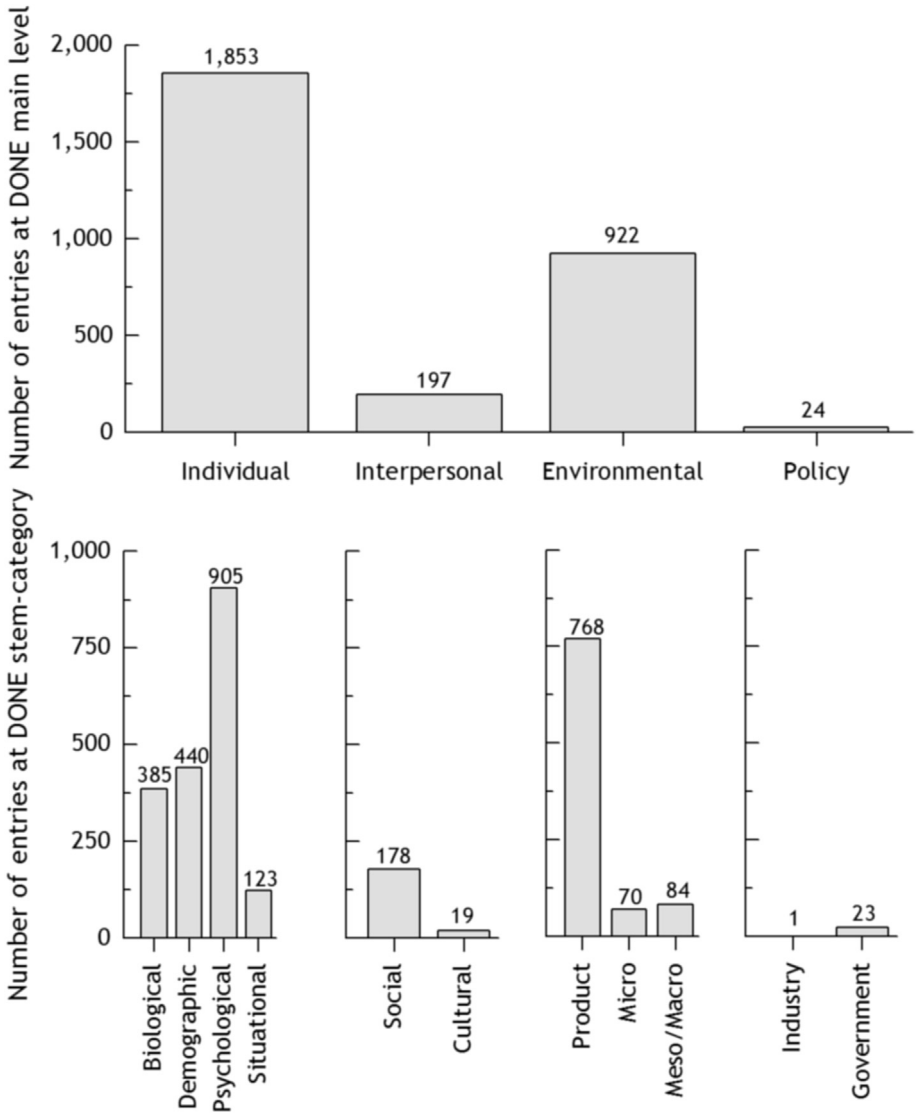

Fig. 4. Number of entries at DONE main level and stem-category (n = 2,996 entries).

publications have been published continuously since 2010 with a small annual number from two to seven publications per year.

The increase in the total number of publications since 1991 is strongly connected to the steady increase of mainly three stem-category predictors of the DONE framework: biological, psychological, and product-related predictors. In accordance with Fig. 5, the other predictors hardly attract the interest of the research communities.

5. Interpretation of the findings

This study is the first that systematically reviews quantitative studies in the field of food decision making. The analysis provides new insights into the research topics, the examined predictors of food choice, and current trends. As indicated by the increasing number of publications, the interest in food decision making was continuously growing in the last three decades. Although food decision making is in the scope of many domains, a vast majority of this research is conducted in medicine/health science, and in nutritional science. From a conceptual perspective, biological, psychological, and product-related aspects are hot topics that attract most interest, whereas policy-related factors and other environmental predictors play a less important role in research. In the DONE framework, many researchers attested the policy-related predictors a very high overall research priority (Stok et al., 2016). Yet, according to the present mapping study, these variables are dramatically under-researched in the field of food decision making.

Researchers may use the results of this study as a state-of-the-art reference and starting point for future projects. It might be helpful to address other predictors to fill some of the identified voids in the research landscape. This overview of past research interests is also important to improve the quality and relevance of new publications, and to avoid unnecessary development expenditures. Given the limited amount of existing research in policy-related and environmental predictors of food decision making, there is much left to explore this topic. Furthermore, undertaking meta-analyses to verify relationships between predictors and food decision making in a quantitative way might be promising.

The categorization of 1,820 different publications into 39 DONE leaf-categories underlines the broad and general applicability of this study. Consequently, practitioners can refer to a broad classification scheme and they may compare the context of a given study

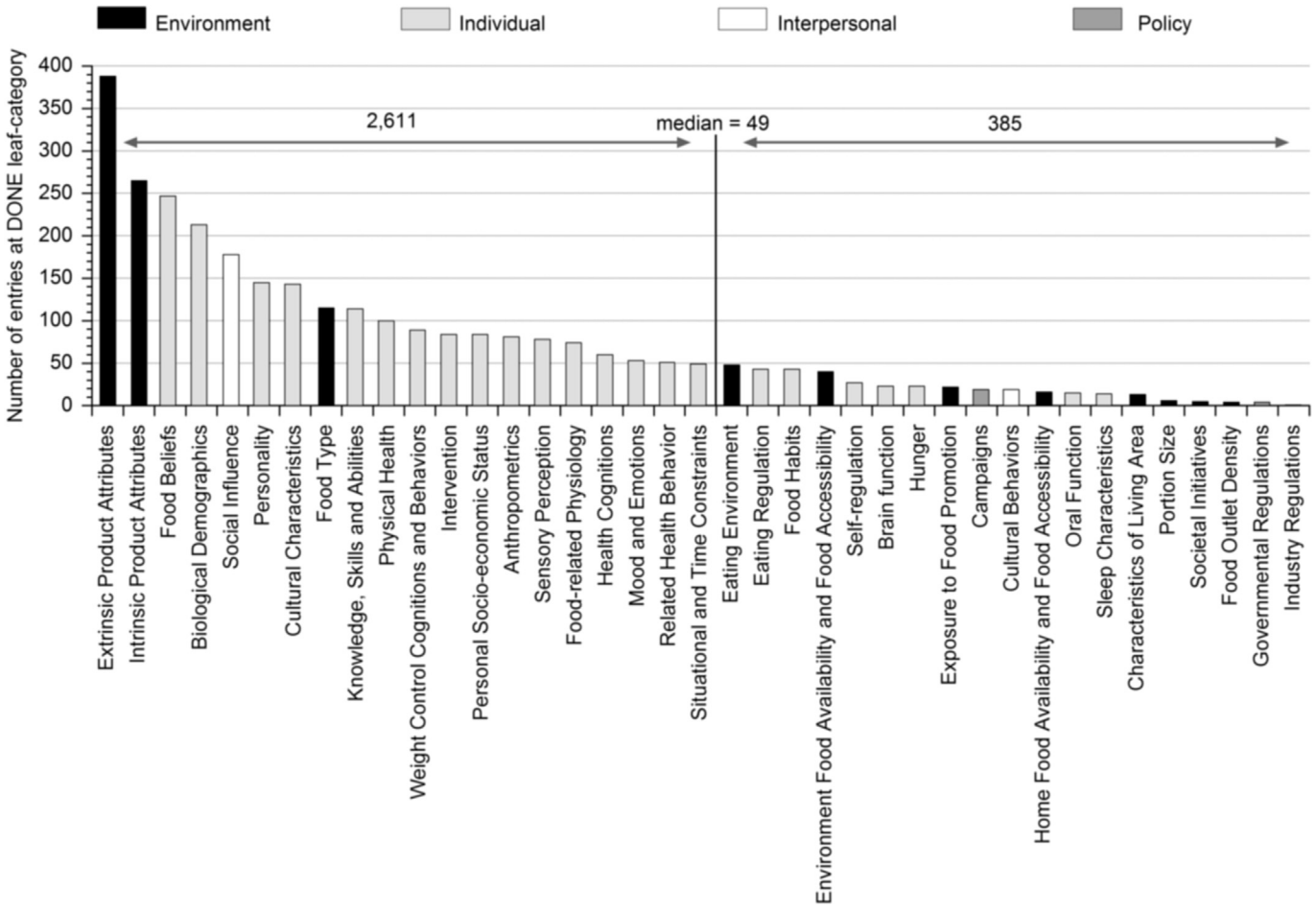

Fig. 5. Number of entries at DONE leaf-category in descending order (n = 2,996 entries).

Table 3
Number of publications at DONE main level and stem-category per discipline.

Disci-pline[a]	Individual					Interpersonal			Environment				Policy		
	Total	Biological	Demographic	Psychological	Situational	Total	Social	Cultural	Total	Product	Micro	Meso/Macro	Total	Government	Industry
NS	**1,015**	200	247	497	71	**115**	106	9	**494**	410	42	42	**10**	10	0
MH	**389**	104	119	137	29	**47**	44	3	**153**	117	12	24	**11**	10	1
FT	**435**	75	86	262	12	**41**	36	5	**337**	298	23	16	**1**	1	0
BS	**300**	54	7	165	21	**31**	28	16	**128**	111	13	4	**2**	2	0
B	**264**	103	66	66	29	**9**	9	0	**67**	51	6	10	**4**	4	0
P	**193**	51	15	103	24	**10**	10	0	**55**	45	5	5	**0**	0	0
MC	**97**	2	23	68	4	**16**	14	2	**80**	71	2	7	**1**	1	0
SP	**82**	9	17	53	3	**14**	13	1	**31**	17	5	9	**1**	1	0
BA	**73**	1	19	52	1	**12**	12	0	**89**	79	3	7	**3**	2	1
S	**14**	0	9	3	2	**1**	1	0	**3**	3	0	0	**0**	0	0

[a] Based on n = 1,820 publications in 485 journals; one to three disciplines could be assigned to one journal. NS, nutritional science; MH, medicine/health science; FT, food science and technology; BS, behavioral science; B, biology; P, psychology; MC, marketing/consumer research; SP, social psychology; BA, business administration/economics; S, sociology. Bold numbers are DONE main level predictors.

with their own situation, therefore ensuring the suitability of the chosen solution. However, practitioners must be aware of the fact that the quality of the considered primary studies differs across the 1,820 studies. So, on the one hand, they have to pay attention to the individual context when referring to a study but, on the other hand, they may contribute to ongoing research by providing new cases for empirical validation.

Limitations must however be mentioned. Firstly, qualitative studies were excluded from the selection process because we primarily focused on determinants suggested in the DONE framework. Secondly, studies on food choice of children or infants were also excluded, and there still may be literature that is not referred to in the databases that were screened with our iterative stepwise approach. Thirdly, we used the journal as a proxy to code the disciplines. Future studies could code previous research efforts according to the discipline of the study itself or according to the affiliation of the authors. This might be helpful to gain new insights into the cross-disciplinary collaboration of researchers.

Table 4
Assignments of publications to disciplines.

Time period	Number of publications[a]	Assignments of publications to disciplines[b]										
		NS	FT	BS	MH	P	B	MC	BA	SP	S	Total
before 1960	8	1	2	0	0	5	0	1	4	0	0	13
1960–1964	3	0	2	0	0	1	0	0	0	0	0	3
1965–1969	6	0	0	0	2	4	0	1	0	0	0	7
1970–1974	3	0	0	0	1	3	0	0	0	0	0	4
1975–1979	13	6	2	0	0	5	3	0	0	0	0	16
1980–1984	21	5	1	1	1	9	2	1	0	2	0	22
1985–1989	32	11	2	7	5	8	7	2	1	3	0	46
1990–1994	67	37	2	13	14	14	10	1	4	2	0	97
1995–1999	162	91	12	24	38	26	12	5	7	8	2	225
2000–2004	201	118	26	38	66	20	13	15	14	12	1	323
2005–2009	405	174	86	57	90	44	58	43	22	19	5	598
2010–2014	883	438	172	138	208	103	153	63	56	33	7	1,371
Total	**1,804**	881	307	278	425	242	258	132	108	79	15	**2,725**

[a] n = 1,804 publications (1,721 articles in 484 journals and 83 other types of publications, 1954–2014).
[b] One to three disciplines could be assigned to one journal. NS, nutritional science; FT, food science and technology; BS, behavioral science; MH, medicine/health science; P, psychology; B, biology; MC, marketing/consumer research; BA, business administration/economics; SP, social psychology; S, sociology.

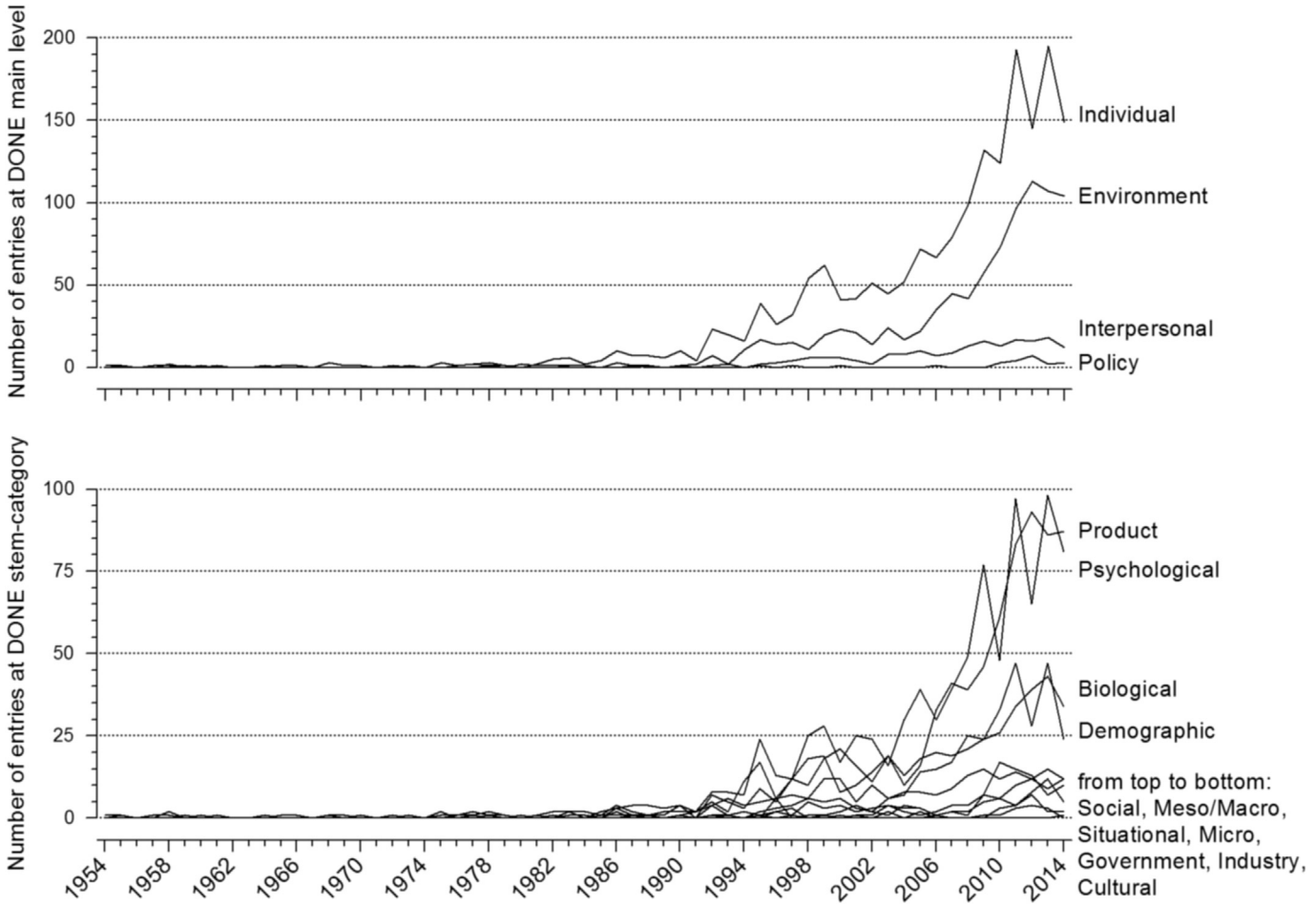

Fig. 6. Timeline of entries at DONE main level and stem-category (1954–2014, n = 2,974).

6. Conclusions

The present study analyzed the field of food decision making research. Out of 10,380 initially identified and screened publications, 1,820 studies (published between 1954 and January 2015) were finally included in this investigation. As a conceptual basis, the DONE framework allowed a systematic and reproducible mapping of the publications. It is the first comprehensive interdisciplinary representation of food research and builds a reference and starting point for further research activities.

The study revealed an ongoing and rising interest in the field of food decision making. The findings have shown which publication channels are used, how the number of publications has changed over time, and which scientific disciplines deal with the food choice

process. The study also takes a closer look on which predictors dominate previous research and what current research trends are being explored. Beyond mapping the state-of-the-art, the analysis has discovered several research gaps, such as the lack of quantitative research on the policy-related predictors (e. g., systematic examination of the implications of policy initiatives or specific prevention campaigns for food decision making). Furthermore, implications were derived for further research and practical applications, including the need for more scientific work about the environmental predictors of the DONE framework.

This study provides a systematic approach to guiding research in the field of food decision making. It enables the inclusion of further studies because the DONE framework as a classification scheme can easily be applied to new publications. The field covered in the present study was highly interdisciplinary. This implies that the relevant knowledge on the mechanisms that guide food decision making is spread across publications from very different domains and with several (highly diverse) mental paradigms represented in domain-specific theories, study designs, and data. Therefore, future studies should try to link and integrate the perspectives of the different disciplines to paint a more realistic picture of the food decision making of individuals.

Conflict of interest

The authors have no relevant interests to declare.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.appet.2016.11.023

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