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Abstract: This paper conducts a literature review to explore the structure of green consumer research domain and to understand its current state of development. An author co-citation analysis was performed using the SSCI of the Thomson-ISI database. A sample of highly cited authors was identified, and the co-citation frequencies were statistically analysed. The study reveals the present structure of the green consumer research field. Two levels of analysis and eight areas of interest were acknowledged. Although quite rigorous, the paper suffers from limitations of co-citation analysis as a methodology.

Key words: Green consumer, Literature review, Co-citation analysis, Bibliometric method

The intellectual structure of the green consumer field: An author citation/ co-citation analysis

1. Introduction

Green consumer behaviour as a field of enquiry is not new though has gained increasing attention in academic literature over the past two decades. Over decades, marketers have made substantial efforts to understand behavioural aspects of environmentally-conscious (green) consumers so as to develop effective marketing strategies for their green products and organisational practices. Also, policy-makers have had public policy concerns for environmental conservation and have faced challenges in developing environmental policy measures for motivating environmentally-conscious consumer behaviour. Researchers have supported their decision-making by results of their studies on diverse themes of research on green consumer. Anderson and Cunningham (1972) categorised green consumers as one of the socially conscious consumers. And, Kinnear *et al.* (1974) described green consumers as the ones possessing ecological attitude and ecological purchasing behaviour. Though green consumer research originated from marketing domain, it was gradually recognised as an inter-disciplinary field of enquiry. The diversity of the field has raised questions on its boundaries and core subject matters treated within it (e.g. Steg and Vlek, 2009; Hughner *et al.*, 2007; Diamantopoulos *et al.*, 2003). With a certain degree of maturity in green consumer field, it becomes important to understand the way in which clusters of authors and themes shape and interrelate. This study tends to answer these questions by applying a quantitative technique of author co-citation analysis (ACA). Specifically, it explores group of authors influential in shaping green consumer field, delineates the subfields that constitute the intellectual structure of green consumer research, and identifies authors who play a pivotal role in bridging two or more sub-fields of research. Though this study is no substitute for extensive reading and fine-grained content analysis (White and McCain, 1998), it intends to complement qualitative findings of other review studies in the field and contributes as being the first[1], to the best of our knowledge, to apply bibliometric techniques to green consumer research literature.

In sustainability-marketing interface literature, literature reviews over different time periods have covered characteristics of green consumers (Kilboume and Beckmcuin, 1998), and themes and methodologies in studies on green consumers (Chamorro *et al.*, 2009). For the literature reviews, green consumer was one of the categories in classification of sustainability-marketing interface literature (McDonagh and Prothero, 2014; Chamorro *et al.*, 2009). So, to the best of our knowledge, no study has conducted citation analysis on green consumer literature over a long duration. Specific to green consumers, Steg and Vlek (2009) reviewed main factors underlying environmental behaviour of consumers and interventions to change consume behaviour favourable to the environment. Literature review by Diamantopoulos *et al.* (2003) summarised role of socio-demographics in profiling green consumers. Hughner *et al.* (2007) reviewed characteristics of organic food consumers. Verain *et al.* (2012) reviewed segments of green consumers. Leire and Thidell (2005) reviewed how product-related environmental information guide consumer purchases. Brennan *et al.* (2003) provided a critical review of the literature on the consumer interest in the UK in organic food. It shows that the trends captured and analyses made by various researchers are limited by barriers and biases, and hence does not present a complete picture of the research field. This requires minimising subjectivity and selecting an objective method to understand an aerial view of a research field. Bibliometry offers a set of objective methods (White and Griffith, 1981) that are useful in categorising authors and articles for similarity in their school of thoughts, paradigm, or theory.

Use of bibliometric methods in marketing is reasonably popular though the studies are different for their objectives, unit of analysis and selection of bibliometric method. A set of marketing studies have used advanced bibliometric methods (such as co-citation analysis and network analysis) to explore structure and evolution of research fields. Pasadeos *et al.* (1998) used citation and co-citation analysis to identify the most-cited writers, most-cited published works, and co-citation networks for 1982-1985 and 1992-1995 in advertising literature. In business-to-business marketing literature, Backhaus *et al.* (2011) used citation analysis, co-citation analysis and network analysis to explore the structure and evolution of the literature. Similarly, Acedo and Casillas (2005) used author co-citation analysis to determine paradigms in the international management field. Galvagno (2011) applied factor analysis, cluster analysis and multi-dimensional scaling on co-citation matrix of most-cited authors to understand intellectual structure of the anti-consumption and consumer resistance field. In sustainability-marketing literature, Chabowski *et al.* (2011) used social network theory performed an extensive co-citation analysis using multidimensional scaling. Samiee and Chabowski (2011) investigated knowledge structure in international marketing by applying factor analysis, hierarchical cluster analysis and metric multidimensional scaling on co-citation matrix of most-cited research articles. These studies have contributed in providing an objective and aerial view of research fields. Thus, it indicates acceptance of bibliometric methods in marketing domain and their suitability in tracing the development of research fields.

Next section in the article contains a description of the methodology adopted. The article subsequently explains results of the empirical study and summary is presented at the end of the article.

2. Overview of research methodology

This study used author co-citation analysis (ACA) to delineate the intellectual structure of green consumer research. Since co-cited author mapping is found as a valid representation of intellectual structure (McCain, 1986), author as a unit of analysis is selected over articles and other measures. ACA uses a matrix of co-citation frequencies between authors as its input (McCain, 1990a). To cater to the objectives of the study, the matrix was used to perform a number of analyses: (i) factor analysis to extract sub-fields in green consumer research their protagonists and pervasiveness of their influence, (ii) multi-dimensional scaling (MDS) for graphical representation of author proximities, and (iii) cluster analysis to provide insights into the intellectual organisation of green consumer field.

2.1 Author co-citation analysis

Bibliometric methods are found suitable for structuration of an academic field (Ramos-Rodriguez and Ruiz-Navarro, 2004). They involve collection and analysis of quantitative bibliographic data generated from scientific publications (Veerbek *et al.*, 2002). They results into detecting homogeneous areas in research networks (Zitt and Bassecoulard, 1996). Co-citation analysis is one of popular methods in bibliography. It uses co-citation counts that can be statistically analysed and processed to produce maps showing the relative distances between authors. In results, it identifies networks of authors and papers belonging to the same school, paradigm, or theory in a research domain (Acedo *et al.*, 2006).

Author co-citation analysis is one of the popular bibliometric methods to discover underlying relationships among authors contributing to the development of a research field. It uses seminal

authors in a discipline as a unit of analysis. Authors who are frequently co-cited are likely to converge towards a common theme of research is the basic premise behind author co-citation analysis. Moreover, authors working in a stream of research often build upon earlier work of other authors, overcome the limitations of their studies, work on direction of future research proposed by their studies and fill the research gaps. In this process, they draw on common source of knowledge, cite work of each other and build upon conceptualisation. Authors working on intellectually similar themes often cite together works of seminal authors that lead to an "intricate web of relationships between authors established through the creation and dissemination of knowledge" (Nerur *et al.*, 2008). Thus, the co-citation frequency measures the proximity between seminal authors. A matrix of co-citation frequencies between authors serves as input for author co-citation analysis (McCain, 1990a). It is important to note that the intellectual map, an output of author co-citation analysis, represents ideational interactions among seminal authors (McCain, 1990a) in which authors are merely labels for the sub-themes they represent (Culnan, 1986). It is advantageous for quantifiability, objectivity and ability to avoid subjective biases (Nerur *et al.*, 2008). It is popularly employed to identify sub-fields in a research field and relationships among sub-fields (e.g. Pilkington and Meredith, 2009; Ponzi, 2002; Nerur and Mahapatra, 2001; Culnan *et al.*, 1990), to analyse research traditions in a research domain (Cottrill *et al.*, 1989), conceptual differences among seminar authors in a domain (Sircar *et al.*, 2001), and to empirically detect and elucidate paradigms and paradigm shifts (Backhaus *et al.*, 2011; Crane, 1972; Weber, 1987). In consumer research, Hoffman and Holbrook (1993) used author co-citation analysis for articles published in Journal of Consumer Research and explored intellectual structure of consumer research. Thus, this method is found versatile and thus is appropriate for this study.

2.2 Method of analysis

The research process was adapted from the study of McCain (1990a) for the stepwise approach in author co-citation analysis used in this study. First, authors highly cited in green consumer research were identified. Second, co-citation counts for each pair of the seminal authors were retrieved. Third, a matrix of raw co-citations was compiled and then, converted into matrix of Pearson's correlations. Fourth, the matrix of Pearson's correlations was used to perform multivariate techniques (factor analysis, cluster analysis and multi-dimensional scaling). Fifth, interpretation and validation of results was performed.

Factor analysis is a data reduction technique that co-citation matrix as input to produce uncorrelated factors, known as sub-fields in ACA. Authors who work on similar themes and are cited together by other researchers tend to load on same factor (McCain, 1990a). In the output of factor analysis, each extracted factor with acceptable reliability value denotes to a sub-field (McCain, 1990a). Each factor represents an intellectual theme defined by the works of authors loaded highly on the factor (Nerur *et al.*, 2008). The authors loaded highly on more than one factor have a persuasive influence on the field. The factor loadings indicate the degree to which an author belongs to a factor. The contribution of a factor in a research field is construed by the amount of variance explained by the factor in output of factor analysis. Using oblique factor rotation method, inter-factor relationships can also be examined. In ACA, authors with loadings ±0.7 or more are generally used for factor interpretation and those with loadings ±0.4 or more are likely to be reported (McCain, 1990a).

Multi-dimensional scaling (MDS), a data reduction procedure generates a map using similarities (or, dissimilarities) between authors (Wilkinson, 2002). Using correlations between

authors, it creates visual displays (or, two-dimensional maps) from proximity matrices to illustrate underlying structure within a set of objects (McCain, 1990a). The graph represents a visual form of ideational similarity of authors and conceptual distance between various intellectual strands of research. Authors co-cited appear close to each other, those appearing in central position have many links to others and those appearing at periphery have weak ties with others (McCain, 1990a). This also reflects the perception of the overall community of researchers who cite the works of seminal authors used in the study (White and McCain, 1998).

McCain (1990a) described about application of MDS in ACA in detail. For MDS, main output is a table of spatial coordinates for the author set and a two-dimensional map. In the process, distortion is created in the original data and is summarised with "stress" statistics. The stress measure also represents best fit between the original input matrix "distances" and estimated distances in the map. The acceptable value of stress measure is usually less than 0.2. R^2 is another indicator of goodness-of-fit and is directly proportional to the number of dimensions in the solution. In co-citation analysis, a two-dimensional solution is generally preferred over three-dimensional solution as three-dimensional solution is complex for interpretation and generally adds little explanatory power compared to two-dimensional solution.

In ACA, cluster analysis groups authors into sub-groups to provide insights into the intellectual organisation of a given field. Hierarchical agglomerative methods use correlation matrix as similarity measures among the authors and fuse clusters based on their similarity. McCain (1990a) found Ward's method for ACA more appropriate for interpretable results on a given data set. Since the goal of ACA is to inform a more general discussion over determining exact number of clusters, it is recommended to choose a single cluster level for detailed analysis and later, referring to sub-clusters to higher-level aggregations where useful (McCain, 1990a).

3. Results and discussion

This section has four parts that individually describe each stage of our analysis and their results. Adapting methodology from McCain (1990), steps used in the study include identification of green consumer articles published from 1970s to 2014, preparation of authors ranking based on 200 total citations as minimum, retrieval of co-citation counts for each pair of authors, compilation of matrix of co-citations and matrix of Pearson's correlations, perform multi-dimensional scaling, cluster analysis and factor analysis, and interpretation of results.

3.1 Selection of authors

First step of ACA is identification of its intellectual core that serves as a unit of analysis in the study (McCain, 1990). For selection of influential authors who had a significant impact on the green consumer research field, we started searching articles (excluding notes, book reviews, etc.) and their authors in a wide range of leading marketing, psychology and sustainability journals (Table 1). For the time period, the articles were collected from early 1970s to 2014. Over this time period, researchers began to develop consumer research with an environmental perspective in early 1970s and the green consumer field is towards its growth over the last decade. A wide range of journals and a long time-period of about 40 years reduce the possibility of biasness of any kind in this context. Establishing a diversified list of authors from a variety of sources is critical for an overall examination of the intellectual structure of an area of scholarship (McCain, 1990).

The search process was facilitated by a set of keywords related to green consumer research such as "green consumer", "environmentally-conscious consumer", "sustainable consumption", "green consumerism" and so on in titles, abstracts or as one of the keywords in the articles. The articles in the included journals were searched in Institute for Scientific Information (ISI) databases as well as manually in Google scholar for journals not found in ISI databases (and, for those journals with time period unavailable in ISI). A database of 677 articles was prepared for their article names, author names, year of publication and number of citations as per July 2015. For ensuring reliability, all the data was recorded twice and double-checked the entire data set, as suggested by Pasadeos *et al.* (1989).

Table 1
Journals included in the study

Advances in Consumer Research	*Journal of International Marketing*
Business Strategy and the Environment	*Journal of Marketing Research*
Ecological Economics	*Journal of Marketing Theory and Practice*
Energy Policy	*Journal of Personality and Social Psychology*
European Journal of Marketing	*Journal of Public Policy and Marketing*
International Journal of Advertising	*Journal of Retailing*
International Journal of Consumer Studies	*Journal of Services Marketing*
International Journal of Research in Marketing	*Journal of Services Research*
International Marketing Review	*Journal of Strategic Marketing*
Journal of Advertising	*Journal of the Academy of Marketing Science*
Journal of Business Research	*Journal of Business Ethics*
Journal of Cleaner Production	*Journal of Consumer Affairs*
Journal of Consumer Behaviour	*Journal of Consumer Marketing*
Journal of Consumer Psychology	*Journal of Macromarketing*
Journal of Consumer Research	*Journal of Marketing*
Journal of Environmental Psychology	*Journal of Marketing Management*
Journal of International Consumer Marketing	*Psychology and Marketing*

From the database, a rank-ordered list of first authors for their total number of citations was prepared that produced a list of 1357 authors in green consumer field. From the list, authors with 200 or more number of citations were selected for further analysis. Thus, a total of 60 authors were used for developing co-citation matrix to perform multivariate analysis. An alphabetical listing of authors in provided in table 2.

Table 2
An alphabetical list of authors with more than 200 citations

Adamantios Diamantopoulos (ADiamantopoulos)	Johan Jansson (JJansson)	P Wesley Schultz (PWSchultz)
Andrea Prothero (AProthero)	Johanna Moisander (JMoisander)	Pam Scholder Ellen (PSEllen)
Ann P Minton (APMinton)	John A McCarty (JAMcCarty)	Pat Auger (PAuger)
Bas Verplanken (BVerplanken)	John H Antil (JHAntil)	Patrick de Pelsmacker (PdePelsmacker)
Bodo B Schlegelmilch (BBSchlegelmilch)	John Thøgersen (JThøgersen)	Pirjo Honkanen (PHonkanen)
Brian Roe (BRoe)	Josephine Pickett-Baker (JPickettBaker)	Renee Shaw Hughner (RSHughner)

Carmen Tanner (CTanner)	Ken Peattie (KPeattie)	Ricky Y K Chan (RYKChan)
Charles H Schwepker Jr (CHSchwepkerJr)	Kent L Granzin (KLGranzin)	Ritsuko Ozaki (ROzaki)
Christoph Weber (CWeber)	Linda Steg (LSteg)	Robert D Straughan (RDStraughan)
Deborah J Webb (DJWebb)	L J Shrum (LJShrum)	Ryan H Wiser (RHWiser)
Deirdre Shaw (DShaw)	Lois A Mohr (LAMohr)	Scott B Follows (SBFollows)
Elena Fraj-Andrés (EFrajAndrés)	Lorraine Whitmarsh (LWhitmarsh)	Sebastian Bamberg (SBamberg)
Helene Cherrier (HCherrier)	Maria L Loureiro (MLLoureiro)	Seonaidh McDonald (SMcDonald)
Ian H Rowlands (IHRowlands)	Mary R Zimmer (MRZimmer)	Stavros P Kalafatis (SPKalafatis)
Ida E Berger (IEBerger)	Marylyn Carrigan (MCarrigan)	Thomas L Osterhus (TLOsterhus)
Iris Vermeir (IVermeir)	Melody E Schuhwerk (MESchuhwerk)	Tom Hargreaves (THargreaves)
James A Roberts (JARoberts)	Michal J Carrington (MJCarrington)	Vladas Griskevicius (VGriskevicius)
Jay Zarnikau (JZarnikau)	Michel Laroche (MLaroche)	William E Kilbourne (WEKilbourne)
Jeff B Murray (JBMurray)	Mohamed M Mostafa (MMMostafa)	Wokje Abrahamse (WAbrahamse)
Joe Hinds (JHinds)	Nina Michaelidou (NMichaelidou)	Yeonshin Kim (YKim)

3.2 Retrieval of co-citation data

After the retrieving of seminal authors, a co-citation matrix based on the seminal authors was formed next. From ISI, a total of 14637 articles (the master set of citing authors) were retrieved that cited the above 60 seminal authors. Next, for each of the authors in table 1, a co-citation frequency matrix of 60 by 60 was creating by pairing authors with each other and by obtaining frequency of co-citations for each pair of authors. These counts then formed a 60×60 square co-citation matrix. For values in diagonals, different authors have proposed different approaches. Some authors (McCain, 1990a; White and McCain, 1998) have treated diagonal values as missing values while others (Culnan, 1986; Culnan, 1987; White and Griffith, 1981) have used an artificial value obtained by dividing the sum of the three highest values for that row (or column) by two. McCain (1990a) found that neither of the approaches has significantly affected the results. Following White and Griffith (1981a), this study substituted diagonal values by a value based on the highest off-diagonal co-citation count for each author. Further, the raw co-citation matrix was standardised converting from raw co-citation matrix into a matrix of Pearson's correlation coefficients so as to nullify scaling effect. The creation of correlation matrix is useful in many ways (McCain, 1990a). First, correlation coefficient function measures similarity in co-citation profiles for any given pair of authors. Second, it removes differences in "scale" between highly cited authors and less frequently cited authors if they have similar profiles.

3.3 Factor analysis

As a data reduction technique, factor analysis produces factors with the factor loadings of their authors. In the study, factor analysis was applied to matrix of Pearson's correlation coefficients using Principal component analysis and Oblique rotation in SPSS package version 20.0. Factors with a minimum eigenvalue of 1 were extracted. Eigenvalue indicates of the amount of variance explained by a factor (Hair *et al.*, 1998). The extracted factors correspond to sub-fields (also known as intellectual themes) in a research field. Authors loaded highly (more than ±0.4) on a factor define an intellectual theme and contribution of the theme is expressed by the amount of variance explained by the factor. The authors who appear in more than one sub-field (factor) have persuasive influence on the field of research (Nerur *et al.*, 2008).

For results of factor analysis, factors with minimum eigenvalue of 1 and Cronbach's Alpha value more than 0.7 were retained in the analysis. Eight statistically reliable factors (Table 1) were retrieved from the analysis that all together accounted for 93.52 per cent of the total variance. First factor seems most relevant within the field as it explains 45.75 per cent of the total variance and first four factors together explain about 82.45 per cent of the total variance. This revealed specialised area or approaches that characterise and define green consumer field. The results of factor analysis were interpreted to understand intellectual connections among authors. 54 authors (out of 60) loaded on at least one of the factors that were found statistically reliable. Out of the 54 authors, nine author (Adamantios Diamantopoulos, Ann P Minton, Bodo B Schlegelmilch, Brian Roe, Carmen Tanner, Elena Fraj-Andrés, Lorraine Whitmarsh, Mohamed M Mostafa and Stavros P Kalafatis) loaded heavily (greater than 0.402) on more than one factor. These authors are recognised as bridge authors who influence two or more research approaches. Based on interpretation of the factors and their structure, the factors were named as: factor 1 – behavioural modelling, factor 2 – ethical consumerism, factor 3 – green consumer experience, factor 4 – pro-social consumer behaviour, factor 5 – pro-environmental self-identity studies, factor 6 – consumers' willingness-to-pay studies, factor 7 – green product adoption and factor 8 – pro-environmental lifestyle studies. The Cronbach's Alpha value for these factors varied between 0.993 and 0.718.

Factor 1 includes 22 authors who are split up in all the clusters and who have contributed in behavioural modelling of green consumers. In particular, behavioural modelling has concentrated on factors related to internal locus of control (e.g. John A McCarty, L J Shrum, Michel Laroche, Yeonshin Kim) and external locus of control (e.g. Melody E Schuhwerk, Ricky Y K Chan). Authors Rowlands, Roberts and Antil such as have worked on profiling of green consumers. John H Antil and James A Roberts have written on general profiling, Robert D Straughan has developed segments of green consumers, and Mohamed M Mostafa has explored gender-based profiling.

Factor 2 has 10 authors who have written on ethical consumerism. The specialised areas in this factor are voluntary simplicity (e.g. Deirdre Shaw), anti-consumption discourses (e.g. H Cherrier), and modelling for fair-trade buying behaviour (e.g. P de Pelsmacker). Specifically, Michal J Carrington developed a framework to understand gaps between the ethical purchase intentions and actual buying behaviour of ethically minded consumers and Marylyn Carrigan described myths of the ethical consumer.

Factor 3 has 8 authors who worked on green consumer experience. The specialised areas in this factor have studied evolutionary bases for sustainable behavior (e.g. V Griskevicius), and

how environmentally-harmful behaviour can be changed (e.g. S Bamberg). Authors in this factor have explored consumer-product interactions and have predicted green consumer behaviour. Factor 4 has 5 authors who worked on socially-responsible consumption. Specifically, the authors explained socially-responsible consumption, examined what motivates it and described pro-social consumer influence strategies. Factor 5 has 3 authors who examined effect of self-identity on green consumer behaviour.

Factor 6 has 3 authors who studied consumers' willingness to pay for green products and what affect it. Factor 7 has 9 authors who studied on factors determining green product adoption. For example, Johan Jansson studied involvement levels, attitudinal factors and perceived product characteristics, Josephine Pickett-Baker and Ritsuko Ozaki studied marketing factors, Mohamed M Mostafa studied environmental knowledge, personal norms and attitude, and Ann P Minton studied consumers' ecological concern and consumer perceptions on corporate environmental initiatives. Factor 8 has 3 authors who focused on pro-environmental lifestyle of consumers.

Table 1. Factor extracted for the period 1975-2014: Author factor loadings at 0.40 or higher

	1	2	3	4	5	6	7	8
	Environmental locus-of-control studies	Ethical consumerism	Green consumer experience	Pro-social consumer behaviour	Pro-environmental self-identity studies	Consumers' willingness-to-pay studies	Green product adoption	Pro-environmental lifestyle studies
	John A McCarty	*Michal J Carrington*	*Vladas Griskevicius*	*Thomas L Osterhus*	*Bas Verplanken*	*Maria L Loureiro*	*Johan Jansson*	*Joe Hinds*
	L J Shrum	*Pat Auger*	*P Wesley Schultz*	*Lois A Mohr*	*Pirjo Honkanen*	*Brian Roe*$_2$	*Josephine Pickett-Baker*	*Charles H Schwepker Jr*
	Melody E Schuhwerk	*Deirdre Shaw*	*Tom Hargreaves*	*Pam Scholder Ellen*	Lorraine Whitmarsh$_2$	Renee Shaw Hughner	*Ritsuko Ozaki*	Elena Fraj-Andrés$_2$
	Ian H Rowlands	*Helene Cherrier*	*Sebastian Bamberg*	*Deborah J Webb*			Mohamed M Mostafa$_2$	
	Yeonshin Kim	*Marylyn Carrigan*	*John Thøgersen*	*Ida E Berger*			Carmen Tanner$_2$	
	Michel Laroche	*Patrick de Pelsmacker*	*Linda Steg*				Adamantios Diamantopoulos$_2$	
	Ricky Y K Chan	Iris Vermeir	Wokje Abrahamse				Ann P Minton$_2$	
	James A Roberts	Johanna Moisander	Lorraine Whitmarsh$_1$				Bodo B Schlegelmilch$_2$	
	Scott B Follows	Brian Roe$_1$					Stavros P Kalafatis$_2$	
	Stavros P Kalafatis$_1$	Elena Fraj-Andrés$_1$						
	Nina Michaelidou							
	Adamantios Diamantopoulos$_1$							
	John H Antil							
	Bodo B Schlegelmilch$_1$							
	Ken Peattie							
	Mary R Zimmer							
	Robert D Straughan							
	Seonaidh McDonald							
	William E Kilbourne							
	Ann P Minton$_1$							
	Mohamed M Mostafa$_1$							
	Carmen Tanner$_1$							
Per cent of variance explained	45.75	18.06	11.82	6.83	4.28	2.84	2.04	1.91

Total variance explained: 93.53%.
Authors with loading ≥ ±0.7 are shown in italics.
Significant factor correlations: factors 1 and 7: 0.607; factors 1 and 8: 0.475; factors 3 and 4: 0.308; factors 7 and 8: 0.439.
Subscripts: 1= First appearance; 2 = Second appearance

3.4 Hierarchical cluster analysis and multi-dimensional scaling

A hierarchical cluster analysis with Ward's method and multi-dimensional scaling (MDS) were used to graphically delimit the groups and sub-groups in green consumer field. Non-metric multi-dimensional scaling (MDS) mapped relationships among authors. ALSCAL routine of SPSS package version 20.0 was used for MDS that projected the authors on a two-dimensional map. The stress value (0.079, lower than an acceptable value 0.2) and R^2 (0.95 for two-dimensions) showed a good fit for the data. The map depicts spatial separation of authors in two-dimensional space used to interpret conceptual distance between various intellectual strands of research (Nerur *et al.*, 2008). More is the ideational similarity among authors, more proximity they will have with each other. The map reflects the perceptions of researchers who have cited work of authors under consideration in the study (White and McCain, 1998). For example, JA Roberts and MA Mohr appear at considerable distance from each other and indicate that there is very little in common between these authors. In other words, those who cite JA Roberts are unlikely to be citing MA Mohr.

MDS graph has two axes and four quadrants. The authors placed close to each other have high correlation profiles and are cited together often. An interpretation of axes based on authors and their positioning suggests that vertical axis refers to "nature of consumption" and horizontal axis refers to "nature of consumer".
The authors in second quadrant (upper left) focus on universal behaviour of individual consumers and those in first quadrant (upper right) on product-related behaviour of individual consumers. In these two quadrants, locus of behavioural control is consumer. The authors in third quadrant (lower left) concentrate their attention on how green consumer behaviour is influenced by universal behaviour of corporate consumers and authors in forth quadrant (lower right) study how green consumer behaviour is influenced by product-related behaviour of corporate consumers. In these two quadrants, behaviours of consumers change with corporate behaviour.

The distribution of authors in four quadrants shows that none of the quadrants clearly contains any of the three kinds of scholars in green consumer behaviour field (i.e. marketing scholars, psychologist and environmentalist).

Next, Ward's hierarchical method in SPSS package version 20.0 was used for cluster analysis of the 60 authors and the results of cluster analysis were superimposed on MDS graph. Cluster analysis grouped authors for similarities. Results of cluster analysis superimposed on MDS graph is shown in figure 1. The distance between individual authors in the MDS graph can be interpreted as the possibility of being cited together.

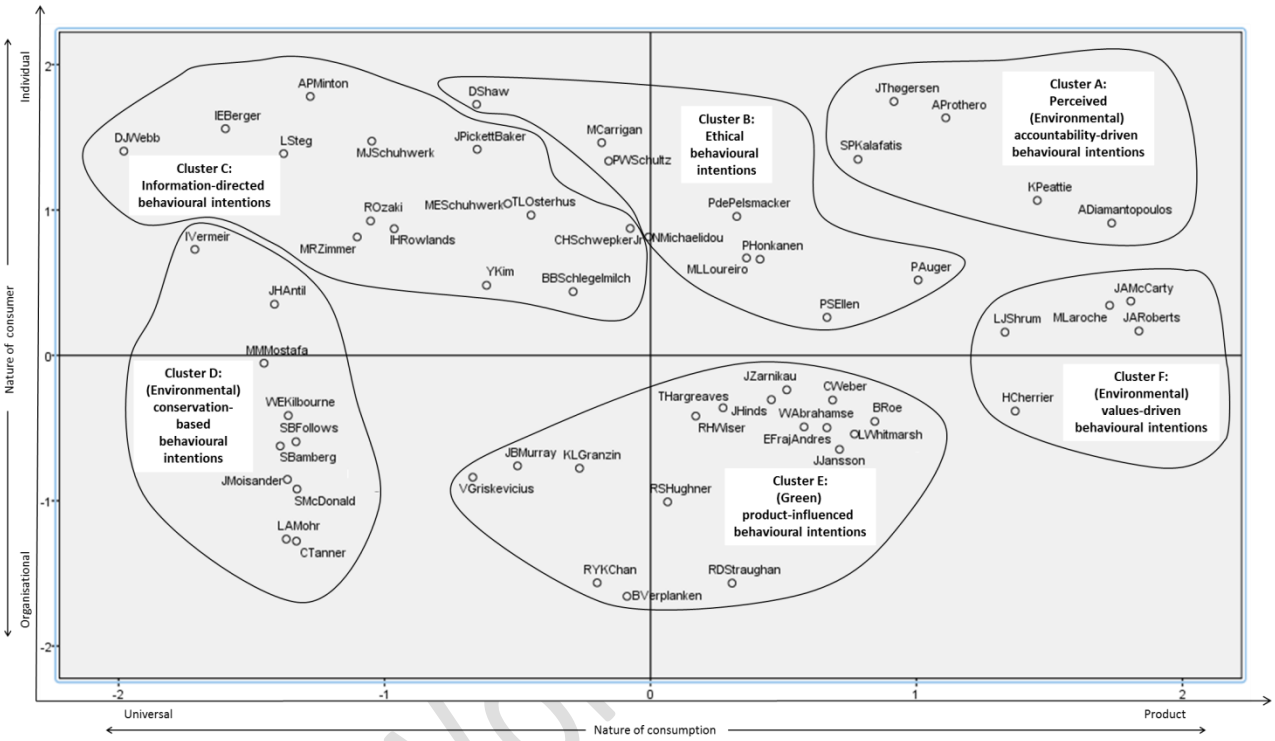
Cluster analysis grouped the authors in six author groups. In particular, authors within a cluster share similar research interests in green consumer field. This means that authors in a particular cluster address similar themes of green consumer research, their research questions originate from a common theme, the inferences from their studies converge to a macro understanding of the theme and thus contribute in theoretical development of the theme. Six clusters identified as the following:

- ⇨ Cluster A: Perceived (environmental) accountability-driven behavioural intentions

Authors in this cluster have focused on how consumers' ecological concern and perceived responsibility affect their behavioural intentions. Authors such as Adamantios Diamantopoulos have conceptualised and measured consumers' ecological concerns as a construct while others

such as Andrea Prothero, John Thøgersen and Ken Peattiehave investigated the relationships of environmental concern and environmental responsibility with consumers' behavioural intentions.

Figure 1
Multidimensional scaling



Note: Stress index of final configuration is 0.079.
Proportion of variance (R^2) is 0.95.

⇨ Cluster B: Ethical behavioural intentions

Authors in this cluster have modelled green consumer behavioural intentions affected by consumption ethics. Authors in this cluster have addressed research themes such as reasons for ethical consumption (e.g. Pelsmacker), concern for ethical consumption (e.g. Loureiro, Carrigan), willingness to pay for fair-trade products (e.g. Auger) and consumer choice (e.g. Shaw).

⇨ Cluster C: Information-directed behavioural intentions

These authors have explored how information possessed by the consumers shapes consumer behaviour. Authors studied information in forms of consumer knowledge about companies' actions and consumer knowledge on environmental issues, and relating companies' actions with consumers' decision making. Specifically, Schlegelmilch explored how consumers' perceptions about corporate actions influence their consumption decisions. Some authors such as Webb, Steg and Ozaki studied what kind of (and, how) knowledge motivates consumers for environmentally-conscious behaviour and demand companies for environmentally-conscious products. Authors like Steg and Schuhwerk related advertising, tailored information and goal setting with behavioural intentions.

⇨ Cluster D: Environmental conservation-based behavioural intentions

This cluster comprises of authors who have theorised on green consumer behavioural intentions influenced by the motive of environmental conservation. Authors such as Mohr have related corporate responsibility of environmental conservation with green consumer behavioural intentions. Others have explored how dominant social paradigm and materialism (Kilbourne), and self-regulated behavioral change (Bamberg) lead to environmental conservation-based behavioural intentions.

⇨ Cluster E: (Green) product-influenced behavioural intentions

This cluster has maximum number of authors and it comprises of authors who investigated how several aspects of green products influence behavioural intentions of green consumers. Some of the aspects are related to marketing of green products such as recycling attributes (e.g. Granzin), advertising and environmental claims related to products (e.g. Chan), in-store environmental cues (e.g. Chan), relevance of products with consumer lifestyle (e.g. Fraj-Andrés and Weber), consumer involvement (e.g. Jansson), consumer knowledge (e.g. Fraj-Andrés) and consumers' willingness to pay more for green products (e.g. Roe).

⇨ Cluster F: Environmental value-driven behavioural intentions

Authors in this cluster have theorised on green consumer behavioural intentions influenced by their consumers' environmental values. They have written on topics such as roles of intrinsic and extrinsic values, culture, lifestyles and personality in shaping green consumer behavioural intentions. In particular, Laroche and McCarty, who are placed at extreme right in the cluster, have linked environmental locus of control with green consumer behavioural intentions. Among others, Cherrier explored anti-consumption discourses, Shrum explored personal values, and Roberts identified consuemr segments based on values.

Out of the clusters identified in the study, one or more clusters are mentioned by literature review articles in green consumer field. Brennan et al. (2003) insisted upon need of clear, accurate and reliable information to influence consumer behaviour that resembles with information-directed behavioural intentions in this study. Similarly, a literature review by Leire and Thidell (2005) explained how product-related environmental information guided consumer purchases in Nordic market. The clusters have similarity with findings of Hughner *et al.* (2007) who classified determinants of consumers' buying decisions for organic food under ten themes. The clusters, in total, partially resemble with the findings of Steg and Vlek (2009) who reviewed factors influencing environmental behaviour and identified weighing cost and benefits, moral and normative concerns, and affect as three lines of research. Contrary to findings of Steg and Vlek (2009), this study did not retrieve any cluster based on financial motivations.

4 Conclusion

Green consumer is one of the highly sought after fields of research and in practice at present. Although various authors have offered reviews of the green consumer literature (McDonagh and Prothero, 2014; Verain *et al.*, 2012; Leonidou and Leonidou, 2011; Chamorro *et al.*, 2009; Steg and Vlek, 2009; Hughner *et al.*, 2007; Leire and Thidell, 2005; Brennan *et al.*, 2003; Diamantopoulos *et al.*, 2003; Kilboume and Beckmcuin, 1998), these reviews are subjective, qualitative in nature and suffer from biases of the researchers performing analyses for their reviews. The study in this paper used ACA to overcome these limitations by performing an

objective review of the main contribution in green consumer field. Moreover, no study has used co-citation analysis to study intellectual structure and to identify current main trends in green consumer field. The study differs from other review studies in this regard.

The objective of this paper was to identify groups of authors influential in shaping green consumer field and to delineate the subfields that constitute the intellectual structure of green consumer research. We attempted to accomplish these objectives by conducting an objective review of main contributions to green consumer field and revealing its latent structure for different themes of research in the field. The study prepared a list of 60 most contributing authors in green consumer field over 40 years based on total number of citations and performed multivariate analysis using co-citation frequencies of the 60 most-cited authors. Consideration of a large duration of 40 years was aimed at reducing the possibility of static representation of the field.

A major clarification is needed for the three methods used in the study: factor analysis, MDS and cluster analysis. Though all the three methods result into groups of authors, factor analysis identifies underlying sub-themes in the domain, multi-dimensional scaling presents similarities/ dissimilarities among authors and cluster analysis reveals groups of authors who are often cited together. Factor analysis reveals sub-fields in a domain reflected by groups of authors in each sub-field. Authors in a sub-field may have conceptual similarities or dissimilarities amongst them which are reflected by MDS map and the results of cluster analysis are superimposed on the MDS map to separate closely placed authors on the map but belonging to different sub-fields.

The first contribution of the study is the identification of eight research approaches that uncover the "invisible colleges". Results of factor analysis reflected upon specialised research areas and approaches for intellectual connections among authors. In particular, four of these are quite relevant: behavioural modelling, ethical consumerism, green consumer experience and pro-social consumer behaviour. The eight factors are not mutually exclusive as some authors are found involved with more than one factor. These authors are perceived to be experts in more than one sub-field. For example, studies of Brian Roe focused upon ethical consumption as well as consumers' willingness to pay for green products. Such studies facilitate learning for different faces of green consumer research.

Second contribution of the study is the identification and visual representation of the six groups of authors. For this, the study used MDS to map the authors on a two-dimensional graph and used hierarchical cluster analysis to explore six groups (clusters) of influential authors in green consumer research field that represented relevant investigation issues in the field. Thus, we believe that our analysis offered an aerial view of the field and reflected subjective views of its authors that could suggest "both opportunities for closure and brokerage" (Nerur *et al.*, 2008) for future development of the field. The results of the study will help researchers to be introduced to the field and to locate their work within the field. In our great expectations, this study may serve as a reference to investigate changes in green consumer field for emergence of new areas, contributing authors and development in the field over time.

5 Limitations

Acedo *et al.* (2006) described homogeneity, immediacy and stability as limitations of co-citation analysis. The study has a possibility of excluding significant authors who entered the field relatively recently and have not yet built up a substantial citation history (Holsapple *et al.*, 1994). Ranking authors based on their adjusted citations per year could have been a better measure in this case. To avoid treating all citations alike, threshold citation analysis could have been used. An important caveat of the study is the preparation of authors' list from journal articles only. However, this may be seen as a more concentrated approach as a book is generally not focused on one theme of research and hence may be difficult to categorise under one cluster or factor. Another important limitation of co-citation analysis is that co-citation data may be noisy (e.g. an author's name used in multiple disciplines of research) but in the aggregate it is understood to be a robust measure of citers' opinion on the intellectual linkages in a research domain (Galvagno, 2011). Moreover, it is dynamic in nature (co-citation frequency changes with time and thus, may change the results over time) and is more biased towards 'the past' of a research domain (Vogel and Güttel, 2013; Gregoire *et al*. 2006). Nonetheless, it is less likely that two authors from extremely different disciplines (such as medicine or chemistry) are cited together. Also, author ranking based on total number of citations may be misleading as new researchers might have been ignored for their less number of citations. This could be avoided by ranking authors based on total citations per year rather than total number of citations. And, the study was biased towards first authors of the articles which might have been removed by taking into account all the authors and by ranking the authors based weighted number of citations. Co-citation also takes into account bad citations which do not considerably contribute to an article (Galvagno, 2011). Despite these limitations, ACA is widely accepted as a methodology to study evolution of a research field. Nonetheless, future researchers may study evolution of the field by understand patterns across suitable time-periods from 1970s to 2014. This work can also be extended by co-word and co-author analyses. Interesting insights can be explored by a detailed analysis of inter-factor relations to understand converting and diverging thoughts and thus, existing gaps in the literature.

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