

## ePub<sup>WU</sup> Institutional Repository

Nikolaus Franke and Josef Mazanec

The Six Identities of Marketing: A Vector Quantization of Research Approaches

Article (Accepted for Publication)  
(Refereed)

*Original Citation:*

Franke, Nikolaus and Mazanec, Josef (2006) The Six Identities of Marketing: A Vector Quantization of Research Approaches. *European Journal of Marketing*, 40 (5/6). pp. 634-661. ISSN 0309-0566

This version is available at: <http://epub.wu.ac.at/3111/>

Available in ePub<sup>WU</sup>: May 2011

ePub<sup>WU</sup>, the institutional repository of the WU Vienna University of Economics and Business, is provided by the University Library and the IT-Services. The aim is to enable open access to the scholarly output of the WU.

This document is the version accepted for publication and — in case of peer review — incorporates referee comments. There are minor differences between this and the publisher version which could however affect a citation.

## **The Six Identities of Marketing:**

### **A Vector Quantization of Research Approaches**

Nikolaus Franke\* and Josef A. Mazanec\*\*

*A later version of this paper is published in  
European Journal of Marketing, 2006, 40 (5/6): 634-661.*

\* Nikolaus Franke is Professor of Entrepreneurship and Innovation at Vienna University of Economics and Business Administration (Nordbergstrasse 15, A-1090 Vienna/Austria  
Phone: (+43-1) 31336-4582, Fax: (+43-1) 31336-769, [Nikolaus.Franke@wu-wien.ac.at](mailto:Nikolaus.Franke@wu-wien.ac.at)). His research interests are innovation marketing and entrepreneurship.

\*\* Josef A. Mazanec is Professor at the Institute for Tourism and Leisure Studies of the Vienna University of Economics and Business Administration (Augasse 2-6, A-1090 Vienna/Austria, Phone (+43-1) 31336-4586, Fax: (+43-1) 317 12 05, [Josef.Mazanec@wu-wien.ac.at](mailto:Josef.Mazanec@wu-wien.ac.at)). His research interests are hospitality and tourism management, models of consumer & tourist behavior, strategic marketing and strategic planning, multivariate methods and neurocomputing, decision support systems, management science applications to travel & tourism.

# **The Six Identities of Marketing: A Vector Quantization of Research Approaches**

## **Abstract**

*Purpose:* This article provides an empirical identification of groups of marketing scholars who share common beliefs about the role of science and the logic of scientific discovery.

*Design:* We use Topology Representing Network quantization to empirically identify classes of marketing researchers within a representative sample of marketing professors.

*Findings:* We find six distinct classes of marketing scholars. They differ with regard to popularity (size) and productivity (levels of publication output). Comparing the sub-samples of German-speaking and US respondents shows cross-cultural differences.

*Value:* The study enhances our understanding of the current scientific orientation(s) of marketing. It may help to motivate marketing scholars to ponder on their own positions and assist them in judging where they may belong. Future comparisons over time would give us indication about the future of the academic discipline of marketing.

*Keywords:* *marketing research approaches; philosophy of science; partitioning; vector quantization.*

Article type: research paper

## **1. Introduction**

What is the scientific identity of marketing? This question is an old one which can be traced back to the 1950s, when marketing became consolidated as an academic discipline (e.g., Bartels 1951; Hutchinson 1952; and Stainton 1952). To date, several researchers have provided systematic inventories and overviews of the different research approaches to marketing (Arndt 1985; Carman 1980; Day and Wensley 1983; Fisk and Meyers 1982; Hunt 1978; Hunt 1979; Hunt 1991; Kaas 2000; Sheth, Gardner and Garret 1988). They provide invaluable insights into the nature of marketing research. None of them has an quantitative empirical base, however.

In this article, we contribute to this line of research by using Topology Representing Network quantization to empirically identify six classes of marketing researchers within a representative sample of marketing professors. The most important class in terms of sheer size is the “marketing philosopher” class. The most important class regarding publication output, however, is the “marketing missionary” group. We find the classification to be largely culture-invariant, that is, our sub-samples of US and German-speaking marketing professors yield only minor differences.

The paper is organized as follows: In Section 2 we give an overview of the relevant literature. Building on shortcomings identified in our literature research, we then proceed to form research hypotheses in Section 3. In Section 4 we describe the method employed, after which our findings are outlined in Section 5 and discussed in Section 6.

## **2. A brief review of marketing’s struggle for a research identity**

Like many other academic disciplines, marketing has been searching for its scientific identity for a long time. One early example is the long-standing discussion of whether marketing is a science or not, and hence whether it should pursue scientific objectives or predominantly practical goals (Bartels 1951; Hutchinson 1952; Stainton 1952). Other scholars such as Kotler and Levy (1969) discussed the scope of marketing and, on the basis of the idea that marketing should be the discipline that deals with exchanges between institutions and ways in which these exchanges could be triggered in a general sense, argued for a broad scope in the discipline (“generic marketing”). They were opposed by others who favored a more focused scope (e.g., Robin 1979 or Arndt 1978).

Another debate relates to the issue of theory. In earlier years, one issue was whether a “general theory of marketing” was possible, like the Grand Unified Theory contemporary physicists are striving for, or Keynes’s GT of Employment, Interest and Money (e.g., Alderson and Cox 1948; Bartels 1968; Hunt 1971). Later, discussions turned toward a controversy of whether marketing should employ behavioural theories, exemplified in the quotation “Marketing studies those factors which economics assumes away” (Enis 1982, p. 26), or turn its attention to economic theories instead or additionally (e.g., Horsky and Sen 1980; Moorthy 1993).

The last few decades have seen the increasing impact of formal mathematics and methodological rigor. While many have applauded, some researchers (e.g., Sherry 1991; Desphande 1983; Morgan and Smircich 1984) have expressed their discomfort with “measuring giant icebergs in millimeters and using calipers to measure melting marshmallows” (Jacoby 1978, p. 93). The eighties and nineties saw a heated debate on the scientific underpinnings of marketing research, that is, constructivism (e.g., Peter 1992; Zinkham and Hirschheim 1992) versus realism (Hunt 1991).

It is not our purpose (nor would it be possible in a single article) to trace these developments in detail (see Bartels 1988; Hunt 1991; Hunt 2003 or Zaltman et al. 1982 for overviews). Each of the discussions is embedded in a historical context and entails rich sub-discussions and complex arguments. In most of these attempts of specifying the identity of marketing, however, there seems to be a general pattern. Usually they start with a provocative article which builds on an unpublished and informal debate. The article is sharply refuted and rejoinders follow. After a while, the discussions of the few scholars publicly engaged in the debate are exhausted without a clear settlement. The silent majority does not enter the quarrel. We can only assume that there are conflicting positions among many other marketing scholars.

Accordingly, the marketing discipline has been perceived as fragmented and far from having only one identity (Anderson 1983; Bartels 1988). Most of us might have subjective perceptions of certain “groups” among marketing scholars, such as “the modelers”, “the consumer behaviorists”, etc., thus confirming the fragmentation observation. This phenomenon has been addressed by several authors who have delivered overviews of different “paradigms”, “schools of thought”, “approaches” or other forms of clusters within the discipline (Table 1).

Table 1  
Examples for attempts to systemize the marketing discipline

<i>Author</i>	<i>Objective</i>	<i>Method</i>	<i>Identified Groups</i>
Arndt (1985)	Paradigms of Marketing	Logical taxonomy	(1) Logical Empiricist Paradigm, (2) Socio-Political Paradigm, (3) Subjective World Paradigm, (4) Liberating Paradigm
Carman (1980)	Paradigms of Marketing	Literature analysis	(1) Microeconomics Paradigm, (2) Persuasion/Attitude Change Paradigm, (3) Conflict Resolution Paradigm, (4) General Systems Paradigm, (5) Functionalist Paradigm, (6) Social Exchange Paradigm
Day and Wensley (1983)	New Paradigms of Marketing	Identified challenges to marketing	(1) Dyadic Exchange Paradigm, (2) Customer vs. Competitor Orientation, (3) Marketing as Innovation, (4) Constituency-Based Theory of the Firm, (5) Integrative Paradigm
Fisk and Meyers (1982)	Paradigms of Macro-marketing	Literature analysis	(1) Network Flow Paradigm, (2) Market Scarcity Paradigm, (3) Competitive Marketing Management Paradigm, (4) Evolutionary Systems Change Paradigm, (5) General Systems Paradigm, (6) Dissipative Structures Paradigm
Hunt (1978), Hunt (1979), Hunt (1991)	Classification Scheme of Marketing	Logical taxonomy	(1) Positive/profit/micro level, (2) Positive/profit/macro level, (3) Positive/nonprofit/micro level, (4) Positive/nonprofit/macro level, (5) Normative/profit/micro level, (6) Normative/profit/macro level, (7) Normative/nonprofit/micro level, (8) Normative/nonprofit/macro level
Kaas (2000)	Paradigms of Marketing	Subjective Assessment	(1) Neoclassic paradigm, (2) Neo-institutional paradigm, (3) Neo-behaviorist Paradigm
Sheth, Gardner and Garret (1988)	'Schools of Thought' in Marketing	Logical taxonomy, literature analysis	(1) Commodity School of Thought, (2) Functional SOT, (3) Regional SOT, (4) Institutional SOT, (5) Functionalist SOT, (6) Managerial SOT (7) Buyer Behavior SOT, (8) Activist SOT, (9) Macromarketing SOT (10) Organizational Dynamics SOT, (11) Systems SOT, (12) Social Exchange SOT

In this review, we refrain from detailing these attempts any further, although they would deserve such attention. Instead, we confine ourselves to highlighting some interesting patterns within these attempts at systematization: (1) The marketing discipline appears to be rather heterogeneous. All authors distinguish at least three and up to 13 groups. (2) Classification efforts are derived by means of logic, general theoretical frameworks, and subjective appraisals. None of them has a quantitative basis. (3) There is hardly any quantitative information on the actual “importance” of the different groups or on the impact they have on the discipline. The only exception is provided by Sheth, Gardner and Garret (1988) who provide a deliberately subjective evaluation of the achievements of the different schools.

### 3. Research objectives and hypotheses

The logical next step in this line of research is to empirically analyze the phenomenon of different research approaches. We do this by quantitatively exploring research approaches of

marketing scholars. We then analyze their relative importance in terms of size and productivity.

As stated above, we conjecture that marketing scholars differ in their beliefs about the role of science, and that these beliefs occur in symptomatic bundles. This “granularity” may be a result of the different disciplinary origins (ranging from social psychology, sociology and anthropology to political economy, microeconomics and industrial organization), the different types of problems the discipline declares itself responsible for, the different stakeholders in practice and the different objectors to the discipline – ranging from consumer activists who blame marketing as responsible for the decay of mankind to other sciences which look down on such an “unscientific” and applied discipline as they believe marketing to be. We integrate this reasoning in our first hypothesis:

**H1:** Within the field of marketing, meaningful bundles of scholars can be distinguished which internally share similar beliefs about the role of science and the logic of scientific discovery (research approaches).

H1 is a necessary background hypothesis that cannot and need not be tested formally.<sup>1</sup> If we refrained from stating it explicitly, it would be assumed implicitly. Nevertheless, we preferred to formulate it as a hypothesis rather than an assumption, because the reader will be able to judge its face validity on the basis of the empirical results. The attributes “meaningful” and “similar” are ambiguous. In the analysis below, the bundles of scholars are considered to be “meaningful” if they fulfil two conditions. (1) They are stable, as they can be reproduced from the data consistently by means of replication runs. (2) They are plausible, as they do not involve combinations of properties contrary to common sense. “Similarity” clearly depends

on the similarity measure and the classification method used. We shall classify marketing scholars with a quantization tool which does not necessarily require the presence of a spatial cluster structure or an underlying mixture model.

Marketing has been an international discipline for a long time. However, there is evidence that interpretations of the marketing phenomenon vary among different cultures. In this study, we focus on differences between US and German-speaking marketing scholars. Despite the philosophical origins of marketing in the German historical school (Jones and Monieson 1990), several studies suggest that there are considerable differences between these two geographic areas regarding marketing practice (e.g., Piron and Young 1996; Gupta et al. 1992), consumer behaviour (e.g., Mundorf et al. 1996; Campbell et al. 1988), and, accordingly, the scholars' interpretations of marketing (e.g., Kleinaltenkamp and Frank 2002; Backhaus and Koch 1985). These opinions are expressed in the literature without quoting empirical evidence.

We therefore wish to confront them with empirical findings and state the following:

**H2:** The popularity of marketing research approaches (measured as the relative number of scholars belonging to a class which represents such an approach) differs in the US and German-speaking marketing research communities.

Next, it is plausible that the research approaches differ with regard to their relative importance within the marketing discipline. Science is not an egalitarian endeavour and the productivity of scholars varies enormously; an observation first formalized by Lotka (1926) and Price (1963). Empirical analyses of research output concentration in the field of economics (Rupp and McKinney 2002; Cox and Chung 1991), accounting (Chung, Pak and

---

<sup>1</sup> Note that H1 is a universal 'there is' (existential) statement (Popper, 1969, p. 40) not intended for testing. In order to subject it to falsification, one would have to examine an exhaustive set of possible classifications

Cox 1992), and business administration and management (Macharzina and Oesterle 1994) confirm this finding. According to what the sociology of science has taught since Thomas S. Kuhn's inquiry into "The Structure of Scientific Revolutions" (1962), imbalance and discrimination are common characteristics of scientists' lives. Groups of scholars who share a common research paradigm tend to promote the research results consistent with their positions and to suppress those in disagreement. When some groups are more powerful than others, the imbalance in the visible research output of the individual groups becomes more and more pronounced. This leads to the second expectation regarding the consequences of conducting research according to a particular approach:

**H3:** The classes of marketing researchers differ in terms of their research productivity (both on the aggregate and disaggregate levels).

## 4. Method

### *4.1. Specification of variables and measurement*

Before turning to the details, we will have to explain several specifications in our study. First of all, we defined *marketing scholars* as the subjects of our study and excluded practitioners as we suspected that they lack awareness of some of the issues in question. This also means that we surveyed *people* instead of analyzing articles, journals or co-citation patterns as Hoffmann and Holbrook (1993) or Baumgartner and Pieters (2003) did, for example.

Regarding the variables employed, we focused on beliefs about the role of science and the logic of scientific discovery rather than on concrete content (consumer behaviour, innovation marketing, etc.) as Sheth, Gardner and Garret (1988) did. The identity of a

---

derived by all thinkable methods of classification.

discipline is reflected in the underlying positions regarding the philosophy of science as well as in the topics pursued (Arndt 1985, Hunt 1979). The heated debates about these dimensions (as noted in our literature review) illustrate their relevance, too.

In order to conceptualize the abstract notion of ‘the role of science and the logic of scientific discovery’, we drew upon the basic dimensions that structure a scientific discipline, namely (1) the purpose, (2) the types of problems, (3) the ways of solving them, and (4) the philosophical underpinnings of the discipline (see Angelmar and Pinson, 1975, Hunt 1991, Zaltman, LeMasters and Heffring, 1982, Suppe, 1977). Basically, respondents were asked to give a subjective, normative statement on which principles marketing should follow with regard to these dimensions (Table 2).

Table 2  
Measurement

<i>Dimension</i>	<i>Category</i>	<i>Variables</i>
Purpose	Objective: theoretical or pragmatic?	<p>“Theoretical insights (= explaining the world) should be a ...”</p> <p>“Pragmatic insights (= being useful for practice) should be a ...”</p> <p>[very important - not important objective, 5-point rating scale]</p> <p>→ differences for the paired variables on a disaggregate level for further analysis: EXPLANATION/APPLICATION</p>
	Value judgments: make or avoid?	<p>“Explicit value judgments should ... “</p> <p>[should definitely be given - definitely not be given, 5-point rating scale]</p> <p>→ VALUE</p>
Types of problems	Scope: broad or focused?	<p>“Would you favor a focused scope (limitation to commercial firms and their customers) or a broad scope (concept of generic marketing)?”</p> <p>[focused scope - broad scope, 5-point rating scale]</p> <p>→ FOCUS</p>
Ways of solving	Methodological direction: economics or behavioral?	<p>“Formal explanations (microeconomics, neo-institutional theories, game theory, etc.) should play a ...”</p> <p>“Behavioral science explanations (psychology, sociology etc.) should play a ...”</p> <p>[very important role - unimportant role, 5-point rating scale]</p> <p>→ differences for the paired variables on a disaggregate level for further analysis: ECONOMICS/BEHAVIORAL</p>
	Empirical methodology: quantitative or qualitative?	<p>“Quantitative empirical methods (≈ large samples, statistical analysis, etc.) should play a ...”</p> <p>“Qualitative empirical methods (≈ case studies, small number explorations, etc.) should play a ...”</p> <p>[very important role - unimportant role, 5-point rating scale]</p> <p>→ differences for the paired variables on a disaggregate level for further analysis: QUANTITATIVE/QUALITATIVE</p>
Philosophical underpinnings	Realism	<p>“(Marketing) science is in principle able to find universal laws and regularities.”</p> <p>“Cumulative (marketing) theories come closer and closer to the truth.”</p> <p>“The best current (marketing) theories are at least approximately true.”</p> <p>[strongly agree - strongly disagree, 5-point rating scale]</p> <p>→ weighted index: REALISM</p>
	Constructivism	<p>“(Marketing) science is subjective.”</p> <p>“(Marketing) scientific ideas are context-laden, that is, they depend on a specific frame of reference.”</p> <p>“(Marketing) science creates many different realities.”</p> <p>[strongly agree - strongly disagree, 5-point rating scale]</p> <p>→ weighted index: CONSTRUCTIVISM</p>

### (1) The purpose

Scholarly endeavours may have many objectives. The most important goals, however, are considered to be the generation of *theoretical* (“understanding the world”) or *pragmatic* (“being useful for practice”) insights (Arndt 1985; Hunt 1979). These two are not mutually exclusive alternatives but exhibit their full meaning if considered in conjunction with each

other. For instance, giving priority to seeking theoretical explanations (EXPLANATION) very often limits the time a researcher has for serving marketing practice (APPLICATION). We measured these objectives in two direct questions (Table 2). The sign and the amount of the difference of the two scale values reflect the respondents' propensity to lean toward either explanation or application.

Another important aspect of marketing's purpose relates to value judgments. Value judgments are propositions that assert how things should be (e.g., "It would be desirable for American companies to deliver better service."). Such propositions can not be falsified or tested as they are not based on logic or empirical insights – they involve an ethical judgment or subjective preference (e.g., Fraedrich, Thorne and Ferrell 1994).<sup>2</sup> Obviously, marketing scholars have different perspectives on whether making value judgments is beyond the purpose of the discipline or not. We measured the position of the respective scholar in a singleton variable (VALUE).

## (2) The types of problems

The dispute on the scope of marketing comprises a wide variety of details. In our study, however, we confined ourselves to the classic controversy sketched in our literature review, that is, whether marketing should be "*generic*" or *focused* on commercial firms and their customers. Again, the position of the respective scholar was measured in a singleton variable (FOCUS).

## (3) The ways of solving them

Generally, problems can be solved by means of theoretical reasoning and empirical study. As mentioned in our literature review, two fundamentally different forms of *theory* are common

in marketing: A strongly formal style of research which emphasizes (micro-) *economics*, and a *behavioural* type which prefers sciences such as social psychology, sociology, etc., for the purpose of providing basic theories. It must be noted, however, that strictly speaking the differences are rather a difference in language and emphasis than in substance (Akerlof and Dickens 1982). We measured them in two variables (ECONOMICS and BEHAVIORAL; Table 2). Again, the respondents were not forced to choose an alternative and could assign equal importance to both styles. The sign and the amount of the difference of the two scale values reflect the respondent's propensity to lean toward either an economic or a behavioural perspective.

When it comes to *empirical methods*, two paradigms can again be identified in the case of *qualitative* and *quantitative* approaches. These two are certainly complementary and there is a huge overlap, which even leads some researchers to conclude that differentiating qualitative and quantitative methods is becoming obsolete. It is our conviction, however, that most scholars have a tendency toward one of these directions. We measured the strength of approval of either method in two variables (QUANTITATIVE and QUALITATIVE; Table 2).

#### (4) Philosophical underpinnings

There are numerous philosophies regarding the role of science (Hunt 1991). Again, two mainstream schools of thought exist in the form of realism and constructivism. *Realistic* approaches emphasize objectivity, rationality, and the existence of laws and patterns which can be detected by science, albeit imperfectly. The counterpart, *constructivism*, stresses subjectivity, questions the possibility of progress, and even suggests discarding the concept of

---

<sup>2</sup> These should not be confused with propositions that predict what managerial actions will lead to desired outcomes, often denoted as 'norms' (Hunt, 1991); this aspect is covered under Dimension 1 (purpose).

truth. As pointed out in our literature review, marketing has also seen conflicts between those two interpretations of the world, as has been the case in other social sciences.

A pilot study clearly showed that, unlike the other dimensions, these two concepts can not be measured directly, as the understanding of these two directions differed greatly among the scholars surveyed. Thus we operationalised them as latent constructs. We collected 24 (12+12) characteristic items from the literature (Hunt 1991; Leong 1985; Feyerabend 1993) and selected the best-fitting items in a pilot study of 61 marketing professors, employing the methods suggested by Bagozzi (1994), namely exploratory factor analysis and Cronbach's alpha. We ended up with three items for each construct. A confirmatory factor analysis showed them to be of sufficient reliability and validity (Appendix 2). The items were condensed into two indices (REALIST and CONSTRUCTIVIST) and weighted on the basis of the path coefficients. Their range spans the same scale interval as the rest of the items.

Using these items, we assembled an electronic questionnaire (see Appendix 5) and successfully pre-tested it on 10 marketing professors. It should be noted that for our analysis we generally computed scale differences for the paired variables on the disaggregate level, thus enhancing the discriminating strength of the items. One convenient side-effect is that it also greatly improves the multivariate normality properties of the set of variables. After these pre-processing measures, six attitudinal items remained for further analysis.

#### *4.3. Sample*

Two samples were drawn: a random sample of 500 US marketing professors and a full census of 192 German-speaking marketing professors (assistant, associate, and full professors are represented in both samples). The samples were scaled down by neutral losses (due to incorrect e-mail addresses) to 451 and 175 scholars, respectively. After three reminders, 161

and 80 scholars completed the questionnaire, resulting in a response rate of 38.5%. Careful analyses showed no sign of a non-response bias (see Appendix 1 for sample characteristics).

#### *4.4. Classification procedure*

Converting the six attitudinal variables into belief *systems* requires a data compression step. The attitudes observed are to be replaced by one new feature variable which is categorical and associates each respondent with one of the research approaches. This is considered an exploratory step leading to the definition of the research approaches. The new feature variable “approach” represents symptomatic combinations of beliefs and thus provides a more realistic view than each of the individual belief variables.

A simple projection pursuit visualizing the attitude points in a reduced principal components space reveals that one cannot expect a number of nicely separated clusters. Nevertheless, an attempt was made with conventional parametric methodology in order to emphasize the feasibility of an alternative classification approach. Fitting a probabilistic model to the researchers’ attitude data failed. Neither for 2 nor for 3, 4, or 5 classes does a mixture clustering approach (Wedel and Kamakura 2001) yield a-posteriori probabilities significantly different from .5, .33, .25, or .2.<sup>3</sup> Therefore, “typical” attitudes cannot be separated under the assumption that the data is a mixture of various multivariate Gaussians. However, this does not in any way imply that the sample is actually homogeneous in terms of normative beliefs about science.

Considering the intricacy or possible absence of a cluster structure, an unconventional approach was needed. We chose a data condensing method known as Vector Quantization (VQ). It generates a minimum-variance partition representing the data points with centroids in a way similar to the K-means method well known in clustering (Linde, Buzo and Gray 1980).

---

<sup>3</sup> Michel Wedel’s Glimmix 2.0 was used (<http://www.assess.com/Software/GLIMMIX.htm>).

However, VQ differs from cluster analysis as it does not depend on subsets of the data being fairly separated in a spatial sense. The term “class” is preferred over the term “cluster” to underline this distinction. Partitioning data with VQ is always possible, but sometimes the solution may not be unique. Therefore, we shall have to test the reproducibility of the results very thoroughly. VQ methods already proved to be useful analytical tools for marketing research. For example, they were integrated into the concept of Perceptions-Based Market Segmentation (Mazanec and Strasser 2000) and served in its applications to service and retail marketing (Buchta, Dolnicar and Reutterer 2000).

The partitioning of the marketing professors according to their epistemological attitudes was achieved with a special variant of VQ termed the Topology Representing Network (TRN).<sup>4</sup> It combines the K-means objective function with stochastic approximation (“training” in neural network parlance). As in K-means each centroid (“prototype”) is moved into the centre of a densely populated region of the data space where it becomes a representative of its surrounding data points. Unlike the popular K-means procedure, the TRN tries to preserve the topological properties of the data by exploiting the adjacency structure among the centroids. In non-technical terms, this means that not just one centroid but the whole system of prototypes gets updated in each training iteration. Thus a larger amount of information is used for the stepwise improvement. As a practical consequence, the analyst is provided with a measure of “statistical neighbourhood” among the class centres. This measure assists in deciding on which classes to merge if a more parsimonious representation of the data is sought. The TRN developed by Martinetz and Schulten (1994) was demonstrated to reproduce intricate data structures with non-convex subsets and successfully applied to market segmentation problems (Mazanec 1999; Elrod et al. 2002). A more rigorous outline of the TRN procedure is given in Appendix 3 for the reader interested in technicalities.

---

<sup>4</sup> The TRN32 software obtainable at <http://tourism.wu-wien.ac.at/cgi-bin/ift.pl?charly/http/software/trn32.html> (Mazanec 1997) was used.

To determine the number of classes in the partition and to check the uniqueness of the solution, three heuristics were consulted: the “weighted simple structure index” (*wSSI*), the “statistical neighbourhood matrix”, and the “percentage of uncertainty reduction” (*%UR*). These criteria gave conclusive indication of how many classes should be accepted.

The *wSSI* proposed in Mazanec and Strasser (2000) is a heuristic measure for the distinctive quality of class profiles (see the “silhouette coefficient” in Kaufman and Rousseeuw 1990 for a related concept). In a recent comparison (Dimitriadou et al. 2002), it proved to be a useful instrument for improving the identification of cluster profiles. The *SSI* considers the amount of contrast between the prototypes representing the classes; the *wSSI* also penalizes exuberance in the number of classes (see the *wSSI* formula in Appendix 4).

As shown in Figure 1 the *wSSI* recommends a seven-class solution, while six are still more feasible than eight or even nine. The “statistical neighbourhood” matrix is examined next. It reveals information about the similarity of the classes in a partition. Unlike the similarity measures popular in clustering, it does not rely on distances alone. Instead, it describes the number of data points belonging to a pair of prototypes where one is either the best (“winner”) or the second-best (“co-winner”) representative. In spatial terms, the “statistical neighbourhood<sup>2</sup> shows the number of data points lying between each of two class centres. Table 3 exhibits the statistical neighbourhood matrix for the seven-class solution. Prototypes #3 and #7 are co-winners for 23.8 percent of the data points. This is almost twice as much as the values for the next pairs, 1-2 or 6-7, and suggests a potential for merging two classes. Therefore, a closer look at the six-class solution is advisable.

Figure 1  
Simple structure index

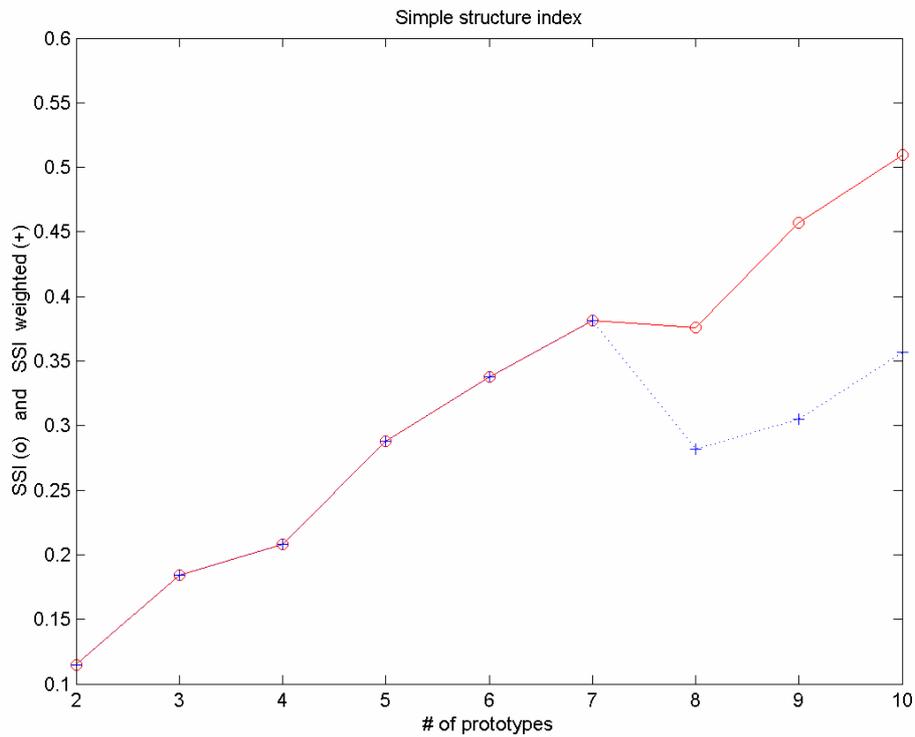


Table 3  
Statistical neighborhood matrix (percent of points)

Class #	2	3	4	5	6	7
1	12.7	2.0	9.8	.0	.0	9.0
2		1.2	.4	.0	.0	2.0
3			.0	.0	2.5	23.8
4				11.1	5.7	.0
5					5.7	1.2
6						12.7

The six-class solution lacks a single dominant pair with a large statistical neighbourhood percentage. Pair 2-6 amounts to 20.5%, 2-4 to 19.7%, 5-6 to 15.6%, 1-5 to 10.7%, and then the values level off. The size of the classes ranges from 25% for #2 to 11% for #1.

Finally, we perform a rigorous check of the reproducibility of the partition. This is necessary as the TRN (like all procedures descending from K-means) requires an initialization that may influence the final result. The %UR heuristic (Mazanec and Strasser 2000) is based

on the number of misplaced pairs of data points that occur in repetitive partitioning with different random starting configurations. We conducted 30 replication runs. Consider now one particular pair of data points. If the two data points emerge in different classes 15 times, the analyst is faced with the maximum level of uncertainty and least reproducibility. In the case of six misplacements instead of 15, the uncertainty drops by 60 percent. With zero misplacements the reproducibility is perfect and  $\%UR = 100$ . The  $\%UR$  is calculated across all pairs of data points. The six-class solution attained an excellent  $\%UR$  of 96.2, in contrast to 89.3, 88.3, and 87.6 for 5, 7, and 8 classes. Given this almost perfect reproducibility, we decided in favour of six classes. The almost perfect reproducibility does, of course, not prove the out-of-sample validity of the six classes attained. But it gives assurance that the sample data exhibit a stable structure which can be reliably reproduced.

#### *4.5. Operationalising the scholars' productivity*

Without a doubt, publication output is a meaningful measure in expressing scholarly productivity. Publications in scientific journals are most relevant as they highlight the scholars' contribution to progress at the research frontier. The list of admissible journals was limited to the 40 titles which appeared in the ranking published by Theoharakis and Hirst (2002). A researcher's journal articles published during his/her lifetime would be heavily influenced by age, thus we restricted the time span to the period of the last five years prior to this study. German-speaking researchers are (with a few notable exceptions) notoriously underrepresented in the dominating US journals, a fact that is often bemoaned in Germany. In order to avoid bias resulting from potentially different fractions within the different classes, we decided to concentrate on US scholars only.

In the US sample, 61 scholars (or 37.8%) provided us with the data necessary to measure their productivity. Their characteristics showed no obvious bias compared to the total sample (Table 4).

Table 4  
Sub-sample characteristics

<i>Age</i>	<i>Total sample %</i>	<i>Sub-sample %</i>	<i>Status</i>	<i>Total sample %</i>	<i>Sub-sample %</i>	<i>Country</i>	<i>Total sample %</i>	<i>Sub-sample %</i>
20-30	3.4	6.5	Assistant Professor	25.2	19.8	USA	67.2	100.0
31-40	29.2	17.7	Associate Professor	18.3	16.4	Germany	32.8	.0
41-50	25.8	25.8	Full Professor	52.6	54.1			
51-60	31.8	33.9	Other (e.g., Emeritus)	3.9	9.8			
61+	9.9	16.1						

## 5. Results

### 5.1. Classification of approaches

A major lesson derived from the quantization exercise relates to the high degree of variability in the combinations of the class-defining dimensions (Table 5). It is never a single dimension that determines a scholar's assignment to one of the classes. The research paradigms are highly diversified but nevertheless indicative of symptomatic bundles of beliefs. Note that the class-generating dimensions in Table 5 were not measured as dichotomies. A respondent could, of course, assign equal importance to "explanation" and "application". In the case of equal importance, a "↔" symbol appears in Table 5. A slant in importance in either direction, however, leads to a "↑" or "↓" marker; the number of arrows denotes the strength of preference.

Regarding size or "popularity" the classification generates neither genuine outsiders nor a predominant majority. This clear profile makes the classes relatively easy to interpret. We

have tried to capture their peculiarities in a summarizing name. It should be noted, however, that such labels are necessarily simplifying and subjective to some degree.

Members of Class 1 have a pronounced quantitative orientation. They show very clear preferences both for formal economic theory and quantitative empirical methods. They also show a clear preference for explanation (as opposed to application), thus they are rather research than practice-oriented. It appears to follow that they clearly refrain from value judgments and strongly favour the “classical” research focus of commercial exchange relationships. We term this the “*marketing scientist*” approach. With only 9% of all respondents this class is the smallest. The full professors are underrepresented (by 5 percentage points) and the share of assistant professors exceeds its marginal frequency by 8 points, but given the small number of “scientists” these tendencies must not be overrated.

The second class stands in sharp contrast to the “marketing scientists”. Its members strongly prefer a generic marketing perspective (a “wide focus”), opening the discipline to many applications, problems and phenomena beyond the traditional commercial realm. They also very clearly embrace value judgments – marketing should “barge in” and favour a constructionist interpretation of science. They are well balanced with regard to methods and objectives, and they are obviously not exclusively practice-oriented. In conclusion, one gets the general impression of a very active group – marketing scholars with a mission. We think it is justified to label this group the “*marketing missionary*” approach constituting a medium-sized group (16%).

With the highest value for application orientation of all six classes Class 3 is clearly practice-oriented. Consequently, members of this group wish to focus on commercial applications, that is, the traditional scope of marketing. They do not seem to care too much for the ethical and value-driven aspects of the discipline, and they apply behavioural as well as economic concepts. The share of full professors is smaller than on average (by about 7

percentage points). We believe that the term “*marketing manager*” approach captures the essence of this group quite well. This class is also of medium size (16%).

The fourth class is the second-smallest. It strongly favours value judgments and thus the ethical and philosophical aspect of the discipline – within its traditional limits. They appreciate behavioural as well as economic theory. Qualitative methods are preferred, and there is a general tendency towards constructivism. Full professors are slightly overrepresented by about 5 percentage points and the opposite is true for associate and assistant professors. We term this the “*marketing philosopher*” approach.

The fifth class is dominated by a marked tendency towards the philosophical underpinnings of realism, which emphasizes objectivity and the concept of truth and believes in the possibility of finding universal regularities. The attitudes in favour of quantitative methods and explanation are not distinctly different from the grand mean, and the preference for value judgments is rather low in this group. The “*realist*” approach is most popular, among full professors and associate/assistant professors as well, and comprises 25% of all respondents.

The last group is the second-largest (21%). It emphasizes a wide and generic interpretation of marketing which is much more pronounced than in the class discussed above. They also clearly reject value judgments. We interpret this as an indicator of a predominantly scientific orientation and thus label this group the “*all-around researcher*” approach.

Table 5  
Six classes of marketing research approaches<sup>\*)</sup>

↑	<i>Application</i>	<i>Narrow</i>	<i>Value judgments desired</i>	<i>Behavioral</i>	<i>Qualitative</i>	<i>Construc-tionist</i>	
	<i>more important than</i>						
↓	<i>Explanation</i>	<i>Wide focus</i>	<i>Undesired</i>	<i>Economic view</i>	<i>Quantitative</i>	<i>Realist</i>	
9%	↓ -.86 (1.25)	↑↑↑ 2.20 (.98)	↓ -.67 (1.28)	↓↓↓ -1.32 (1.04)	↓↓ -1.73 (1.01)	↔ .13 (1.08)	“Marketing scientist”
16%	↔ .00 (1.18)	↓↓↓ -2.51 (.75)	↑↑↑ 1.84 (1.07)	↔ .67 (1.24)	↔ .18 (1.05)	↑↑ 1.75 (1.04)	“Marketing missionary”
16%	↑ .73 (1.04)	↑↑↑ 1.40 (1.19)	↓↓↓ -1.81 (.99)	↔ .70 (1.04)	↔ .10 (1.25)	↔ .78 (1.18)	“Marketing manager”
13%	↔ .01 (.96)	↑↑↑ 1.18 (1.07)	↑↑↑ 1.69 (1.17)	↔ .74 (1.03)	↑ .42 (1.03)	↔ .47 (.83)	“Marketing philosopher”
25%	↔ -.38 (.84)	↓ -1.40 (1.03)	↑ .88 (1.02)	↔ .32 (.84)	↔ -.66 (1.01)	↓↓ -0.60 (.99)	“Realist”
21%	↔ -.24 (.86)	↓↓↓ -2.20 (.83)	↓↓↓ -1.94 (1.81)	↔ .76 (1.34)	↔ -.24 (1.16)	↔ .59 (1.13)	“All-around researcher”
overall means (std. dev.)	-.10 (1.08)	-.63 (2.0)	-.03 (1.87)	.44 (1.23)	-.27 (1.23)	.45 (1.29)	

<sup>\*)</sup>The arrows illustrate the direction and relative strength of the preference within each column; note that ‘↔’ denotes neutrality or no distinct bias for either direction.

Table 6  
Fictitious strings of ideas stimulated by reading this article

“Marketing scientist”	“Becoming part of a research paradigm generates costs (learning new methods) and benefits (publication output), so it might be possible to devise a utility function and choice model.”
“Marketing missionary”	“This is far too terse an instrument to understand the contemporary research communities and to judge their usefulness and desirability.”
“Marketing manager”	“This doesn’t tell me precisely how I might be able to increase my own publication output.”
“Marketing philosopher”	“Junior marketing researchers should be advised on becoming aware of these research approaches and given guidance in making a deliberate choice.”
“Realist”	“A much more thoroughly validated measuring instrument is required for a comprehensive analysis of the belief systems of empirical researchers.”
“All-around researcher”	“It is worthwhile to conduct such a survey among other communities of economists, business researchers, and social scientists of all disciplines.”

There are several ways of illustrating the nature of the classes and their approaches to research in a less abstract manner. Typical research projects may be one, real scholarly personalities (as exposed in Hirschman 1985) may be another. We exemplify the identity of the six researcher types by providing imaginary reactions to this article (Table 6).

The reader is now in a position to evaluate the background hypothesis H1. Are there meaningful bundles of scholars who share a similar interpretation of the marketing discipline?

The condition of reproducibility is certainly met. The contextual interpretation depending on the belief systems seems highly consistent and plausible (though this is a subjective assessment). The class centroids (“prototypes”) provide the approaches with contrasting profiles. They appear to capture the range of marketing scholars encountered in publication outlets and at conferences reasonably well. Next we will consider how stable the approaches are in a cross-cultural comparison and what follows from an affiliation with a particular class.

### 5.2. Testing for German / US specificities

In order to test whether the classes are culture-specific, we split the sample into two subsamples. Differences in the distributions become visible immediately. For example, the “marketing managers” are much more prevalent in the US than in Germany. On the other hand, the “marketing scientist” group is three times more frequent in the German-speaking countries than in the US. Furthermore, the “marketing philosopher” appears to be rather a peculiarity of the German-speaking marketing research community.

Table 7  
Relative frequencies of researcher classes in Germany and the US

	<i>USA</i>	<i>Germany</i>
“Marketing scientist”	5.5	16.3
“Marketing missionary”	14.6	18.7
“Marketing manager”	19.5	10.0
“Marketing philosopher”	9.8	18.7
“Realist”	27.4	20.0
“All-around researcher”	23.2	16.3
<i>(n=244)</i>	100% (164)	100% (80)

The  $\chi^2$  value of 16.3 indicates that the assumption of independence for the entire contingency table has to be rejected ( $p < .006$ ). Hence there should be cross-cultural

differences as expected in H2. However, the sample is rather small and a precise additional test is appropriate. Moreover, a chi-square test does not disclose the significance of the individual cell frequencies  $f_{ij}$ . To test our hypothesis of country-specific frequencies of each individual class of researchers, Strasser's permutational test statistic  ${}_hT_2$  for heterogeneity (Mazanec and Strasser 2000) is employed here. As a nonparametric (exact) test it does not rely on large sample approximation and exactly determines the significant values of the standardized deviations  $z_{ij}$ . These are equivalent to the deviations used in the  $\chi^2$  statistic and calculated from the cell and marginal frequencies of Table 7 (“.” denotes summation over an index in a  $p \times q$  table of frequencies  $f_{ij}$ ). Note, however, that unlike  $\chi^2$  the maximum instead of the sum of (squared) deviations is required:<sup>5</sup>

$${}_hT_2 := \max \{ |\hat{z}_{ij}| : 1 \leq i \leq p; 1 \leq j \leq q \}$$

$$|\hat{z}_{ij}| := \sqrt{n} \left| \frac{f_{ij} - f_{i\cdot} \cdot f_{\cdot j}}{\sqrt{f_{i\cdot} \cdot f_{\cdot j}}} \right|$$

Sampling 1,000 values from the set of admissible permutations of the 6×2 table leads to the exact critical value ( $p < .05$ ) of |1.94|, which is only exceeded by the row-column combination 1-2. After this more rigorous testing, the “marketing scientist” turns out to be the only researcher class significantly over-represented among German-speaking marketing scholars.<sup>6</sup> With one exception, the marketing research communities of these two countries seem to have evolved into fairly similar landscapes of marketing research paradigms. Thus H2 gains partial support.

---

<sup>5</sup> The `ct_dt2h.m` Matlab function in the `Permut.cb` toolbox programmed by Christian Buchta ([christian.buchta@wu-wien.ac.at](mailto:christian.buchta@wu-wien.ac.at)) was used to sample the cumulative distribution of Strasser's  $T_2$ .

<sup>6</sup> Age and academic position do not exert a significant influence.

### 5.3. The classes' differences in productivity

The publication output measure outlined in Section 4.5 complements the picture at least for the situation in the US (Table 8). The distribution of respondents with known publication output resembles the overall frequencies of the classes in the sample fairly well (columns 2 and 3). A comparison with the productivity distribution (each class's share of journal publications) reveals that the "marketing manager" and the "marketing philosopher" achieve less than half the importance of their popularity value. This finding does not come as a surprise and confirms our interpretation of these approaches. The most productive class follows the "marketing missionary" approach, which doubles its contribution in the productivity ranking. Despite the small sample size, these are significant differences in the percentages as the  $p < .05$  confidence interval approximates  $\pm 5$  percentage points. On an aggregate level H3 is confirmed.

Table 8  
Productivity of classes

	<i>Share of respondents (US sample)</i>	<i>Share of respondents with known publications</i>	<i>Classes' share of journal publications</i>	<i>Mean number of articles</i>	<i>Std. dev.</i>
"Marketing scientist"	5.5	3.2	2.6	1.00	1.41
"Marketing missionary"	14.6	16.4	32.0	2.40	2.46
"Marketing manager"	19.5	23.0	10.7	.57	1.16
"Marketing philosopher"	9.8	11.5	4.0	.43	.79
"Realist"	27.4	26.2	34.7	1.63	1.82
"All-around researcher"	23.2	19.7	16.0	1.00	1.00
	100% (n=162)	100% (n=61)	100%		

On a disaggregate level, the difference in productivity is reflected in the number of journal articles published by the individual researchers in each class. The "marketing

missionary” approach again outstrips the other approaches, although intra-class variation is enormous (columns 5 and 6 in Table 8).

Considering a small sample, unequal intra-class variances and the non-normal productivity variable, ANOVA results may not be trustworthy. The Kruskal-Wallis test was used instead, and it led us to reject H3 on the disaggregate level ( $p=.54$ ). Our data does not allow us to state that a scholar’s individual productivity significantly varies with his/her affiliation with a particular class.

In order to learn more about each of the six classes, we discretized the productivity variable into four groups in which respondents with 3+ articles are grouped in one reasonably sized category. The nonparametric test with  $H_2$  is conducted for the class-productivity contingencies in Table 8. Again, the permutational test computes the exact probabilities for each cell in Table 9. All of them may occur randomly with  $p > .95$ , with the notable exception of the “marketing missionary” producing two or more articles ( $p=.17$ ). In relative terms, the aggregate results for the “missionaries” come closest to being reflected in their per-capita productivity.

Table 9  
Cross-tabulation of classes vs. productivity<sup>7</sup>

	<i># of respondents with ... journal articles:</i>				
	<i>0</i>	<i>1</i>	<i>2</i>	<i>&gt;2</i>	<i>Σ</i>
“Marketing scientist”	1	0	1	0	2
“Marketing missionary”	4	0	1	5	10
“Marketing manager”	10	2	1	1	14
“Marketing philosopher”	5	1	1	0	7
“Realist”	7	1	4	4	16
“All-around researcher”	6	2	3	1	12
Σ	33	6	11	11	61

The support for H3 on the aggregate level means that we face a discrepancy between the size (or popularity) of an approach and its visibility in the scientific journals. We cannot claim that H3 has been confirmed in the sense that each marketing research paradigm entails a composition of scholars with a typical productivity level. There is evidence, however, that some attitudes combined in the researchers’ belief systems are related to their publication output. Apparently, for the “marketing missionary” this is a combination of a broad research focus and the ambition to make value judgments. A narrow focus of one’s research domain seems to inhibit productive publication efforts. FOCUS is also a predictor that survives in a stepwise regression procedure with productivity as the dependent variable. The “marketing scientist” is surprisingly popular among German scholars. Unfortunately, we do not have comparative data on their publication activity. For the imaginative reader, there is ample room

---

<sup>7</sup> At first glance, it may be puzzling that the number of articles per capita in the top 40 journals seems so small. A simple calculation, however, lends credibility to these results. Assume that the top 40 journals publish about 1,000 articles each year, and compare 5,000 (5 years\*1000 articles) to the number of marketing scholars at US business schools. There should be roughly 5,000 marketing scholars in the US (500 business schools \* 10 professors per school). Multi-author articles would increase the per capita output while the fact that a growing proportion of articles are published by non-US scholars decreases the number of articles in the top 40 journals. In sum, a mean number of one per in five years in the sample corresponds to the normal publication rate among US marketing scholars. If some researchers are highly productive, then many others must remain without a single publication in these media. Also, the fact that more than 50% of the respondents are (tenured) full professors who no longer face the “publish or perish” threat makes the numbers plausible. However, we cannot fully preclude a sampling bias.

for further speculation on the relationships between class membership, popularity and publication success.

## **6. Discussion**

This study advances our understanding of research approaches underling marketing by providing quantitative information of extant classes of scholars. It has been demonstrated that the marketing scholars' normative belief systems about science are heterogeneous.

Nevertheless, they are captured in distinct classes. These classes, which represent the marketing research paradigms that have arisen in the US and German research communities, are relatively similar. A researcher's association with such an approach appears to be indicative of scholarly productivity measured in terms of publication output. This shows that approaches are not of equal importance. Comparisons with future studies might show if the currently prevailing classes of "realists" (in terms of size) or "marketing missionaries" (in terms of productivity) will oust the other classes or if, on the contrary, there will be a counter-movement towards more diversity.

Of course, several limitations of the study must be noted. First of all, there are methodological issues. "Research approaches" were restricted to fundamental beliefs about research. They are not meant to relate to specific research contents. Such matters are better analyzed using citation and co-citation patterns. Also, a classification method generally involves decisions (e.g., the number and labels of the classes) which are to a certain extent arbitrary. Beyond these restrictions, there is another caveat. We tried to measure the importance of a research paradigm in two ways. First, it was judged by the number of subjects belonging to it. This "popularity approach" is sufficient for comparing country-specific frequency distributions. However, it does not take into account the fact that scientists from

one approach are more productive and have a greater impact on the marketing discipline than those from others. Therefore, the publication effort of each approach's members was examined as a second criterion and actually lends credit to the assumption that being associated with a research approach, particularly in the case of the "marketing missionaries", may be linked to a higher level of productivity. Still, these are relatively simple criteria and more refined measures for larger samples may reveal deeper results. For instance, citation figures (capturing the effect of publishing seminal articles) or the respondents' functions as editors and reviewers of influential journals would be more sophisticated indicators.

We would suggest continually monitoring the evolution of marketing thought as well as classifying and profiling its major threads. Empirical studies with larger samples, the participation of more countries and a longitudinal perspective would also be desirable. The empirical analysis of marketing identities may help to motivate many marketing scholars to ponder on their own positions and assist them in judging where they may belong.

Comparisons over time would give us indication about the future of the academic discipline of marketing. If we, for example, observe an *increasing* tendency to separate into distinct research approaches (visible by a higher number of classes or sharper inter-class contrasts) this might be interpreted as an early indicator of an imminent split into sub-disciplines. While this sounds unlikely at present, it is in fact what happened to several academic disciplines in their history. For hundreds of years the disciplines of economics, psychology, anthropology and several others were bundled under the label "philosophy" – it is only decades ago that this "super-discipline" was divided into the disciplines we are familiar with nowadays.

If such comparisons yield a *decreasing* heterogeneity, this might be interpreted as an indicator of the marketing discipline's academic maturity. Again, this is exemplified by older disciplines. E.g., one would hardly find a physicist, who does not value experiments and

formal mathematics. Some hundred years ago this might have been different. If the quarrels on research approaches are settled in marketing as well and agreement is increasing, marketing might be one step closer to being an established discipline with a joint identity.

## Appendix 1: Sample characteristics

Table A-1  
Sample characteristics

<i>Age</i>	<i>%</i>	<i>Status</i>	<i>%</i>	<i>Country</i>	<i>%</i>
20-30	3.4	Assistant Professor	25.2	USA	67.2
31-40	29.2	Associate Professor	18.3	Germany	32.8
41-50	25.8	Full Professor	52.6		
51-60	31.8	Else (e.g., Emeritus)	3.9		
61+	9.9				

## Appendix 2: Confirmatory factor analysis

Table A-2  
Confirmatory factor analysis

<i>Construct</i>	<i>Indicator</i>	<i>Indicator Reliability</i>	<i>t-value</i>	<i>Item-to-total correlation</i>	<i>Cronbach's <math>\alpha</math></i>	<i>Variance explained by 1st factor</i>	<i>Reliability of factor</i>	<i>Mean variance</i>
Realism	1	.61	-	.70	.80	72.3%	.81	.60
	2	.76	5.33	.57				
	3	.40	4.60	.70				
Construc- tivism	4	.53	-	.37	.54	52.9%	.69	.43
	5	.40	3.32	.43				
	6	.36	3.27	.30				
Global fit	$\chi^2 = 11.71$ df = 8 $p = .165$ $\chi^2/df = 1.46$	GFI = .94 AGFI = .85 RMSEA = .08 CFI = .96	<i>Fornell-Larcker criterion: .60</i> .43 > (.48) <sup>2</sup> $n = 60$					

### Appendix 3: Outline of the TRN

The TRN encodes a data manifold  $X$  with probability distribution  $P(x)$  into a finite set of reference vectors ('prototypes', centroids) with respect to the topological properties of the data observed. The similarity between the data points and the prototypes is measured by the Euclidean distance  $d$  between the  $i$ -th prototype's coordinates ('weights'), vector  $w_i$ , and an input data vector  $x$  with values  $x_{1, \dots, M}$ :

$$(4) \quad d_i = \|x - w_i\| = \left( \sum_{j=1}^M (x_j - w_{ij})^2 \right)^{\frac{1}{2}}.$$

Unlike the more widely known and conceptually related Self-Organizing Map (SOM; Kohonen, 1982), the TRN optimizes an explicit objective function

$$(5) \quad \int d^M x P(x) (x - w_i)^2 \rightarrow \text{Min}.$$

Optimization occurs via stochastic approximation ('training'). During training, the system of prototypes is repeatedly exposed to input vectors randomly selected from the data set. It adapts its weight structure according to the distribution pattern of the input data. Each of the prototypes learns to take responsibility for a homogeneous subset of data vectors. This weight update follows the learning rule (Martinetz, Berkowitz and Schulten, 1993):

$$(6) \quad \Delta w_i = \varepsilon h_\lambda(k_i(x, w_1, \dots, w_K)) (x - w_i), \quad i = 1, \dots, K$$

$0 < \varepsilon < 1$  is a learning constant.  $k = 0, 1, \dots, K-1$  and  $k_i(x, w_1, \dots, w_K)$  indicates the rank number  $k$  associated with each prototype. Thus rank 0 is attached to the winning prototype  $i'$ , rank 1 to the second-closest node  $i''$  (the co-winner), and so on. As in the SOM, the prototypes compete with each other and only the winner  $i''$  with

$$(7) \quad \|x - w_{i'}\| < \|x - w_i\|, \quad \forall i,$$

is fully updated. The units in its neighborhood are allowed to improve their fit by means of a weight update with

$$(8) \quad h_\lambda(k_i(x, w_i)) = \exp(-k_i(x, w_i) / \lambda)$$

where  $\lambda$  is a decay constant that decreases during the training. For  $\lambda = 0$ , the process is equivalent to the online version of the popular K-means algorithm. The update rules outlined above have been shown to optimize an explicit cost function (Martinetz, Berkowitz and Schulten, 1993). The co-updating of adjacent prototypes resembles the fuzzy version of the K-means algorithm (Bezdek, 1974; Dunn, 1974) by determining a ‘fuzzy’ assignment of the data points to the best, second-best, third-best, etc. prototype. The “neural gas” algorithm was shown to outstrip K-means as well as the SOM and the maximum-entropy clustering procedures in terms of distortion error (Martinetz, Berkowitz and Schulten, 1993, p. 561).

Thus far the training process does not enforce a topographic mapping of the data points into a set of prototypes subject to a learned adjacency structure. This step was added by Martinetz and Schulten (1994). Adjacency is conceived as a dichotomous concept in the Topology Representing Network. The adjacency learning and unlearning process is based on the pair of prototypes with rank  $k_{i'} = 0$  and  $k_{i''} = 1$ . Each data point arouses a winner/co-winner pair for which it either confirms or establishes the adjacency relation in  $A = (a_{pq})$ . Therefore, for the following assume that  $p$  is a winning prototype  $i'$  and  $q$  may become its co-winner  $i''$  in one updating iteration. The more data points support a winner/co-winner pair, the stronger the adjacency becomes. If the procedure is to function online by processing each data point one at a time, the strength of adjacency connections needs to have a ‘memory’. The TRN achieves this by refreshing the ‘age’ value  $t$  (*new* and *old* indicate current and previous iterations):

$$(9) \quad a_{pq}^{new} = \begin{cases} 1, & \text{if } q = i'' \\ a_{pq}^{old}, & \text{else} \end{cases}$$

$$(10) \quad t_{pq}^{new} = \begin{cases} 0, & \text{if } a_{pq}^{new} = 1 \\ t_{pq}^{old}, & \text{else} \end{cases}$$

Adjacency connections for pairs that are not confirmed for a number of successive updates (the maximum lifetime  $\tau$ ) die out but may emerge again later on. The ‘age’ matrix  $T = (t_{pq})$  monitors the number of iterations passed since the connections were refreshed by a winner/co-winner arousal. Thus

there are further adjustments as the  $t^{new}$ -value has to be incremented for all active connections and the obsolete connections in  $A$  must be removed:

$$(11) \quad t_{pq}^{new} = \begin{cases} t_{pq}^{new} + 1, & \text{if } a_{pq}^{new} = 1 \\ t_{pq}^{new}, & \text{else} \end{cases}$$

$$(12) \quad a_{pq}^{new} = \begin{cases} 0, & \text{if } t_{pq}^{new} > \tau \\ a_{pq}^{new}, & \text{else} \end{cases}$$

The learning ( $\varepsilon$ ) and the adjacency update ( $\lambda$ ) parameters in this process are subject to exponential decay to a lower bound during the training. The lifetime parameter  $\tau$  increases towards an upper bound (see Martinetz and Schulten, 1994, for recommendations on setting these (non-critical) limits). In a simulation experiment, these authors demonstrate that the TRN is capable of preserving rather complicated topological structures.

#### Appendix 4: The Weighted Simple Structure Index

$$(1) \quad SSI = \sum_{j=1}^M (w_{i^{\max} j} - w_{i^{\min} j})$$

$$(2) \quad wSSI = \frac{SSI}{SSI_{\max}} \frac{N_{\max \vee \min}}{N}, \quad 0 < wSSI < 1,$$

where

$SSI_{\max}$ : maximum value attainable by the  $SSI$

$w_{i^{\max} j}$ : highest value for weight  $j$  found in a profile of the classes  $i=1, \dots, N$

$N_{\max \vee \min}$ : number of classes contributing either a maximum or minimum weight value at least once

$N$ : total number of classes.

## Appendix 5: Questionnaire

### 1. Objectives of marketing science

Which objectives should be pursued by marketing science? In your personal opinion, how important are the objectives of gaining theoretical insights (=explaining the world) and pragmatic insights (=being useful for practice). Please answer spontaneously.

Theoretical insights (=explaining the world) [very important - not important objective, 5-point rating scale]

Pragmatic insights (=being useful for practice) [very important - not important objective, 5-point rating scale]

### 2. The scope of marketing science

Which scope, in your opinion, is appropriate for research in marketing? Would you favor a focused scope (limitation to commercial firms and their customers) or a broad scope (concept of generic marketing)? Please answer spontaneously.

[focused scope - broad scope, 5-point rating scale]

### 3. Value judgements in marketing science

Should marketing science give explicit value judgements (e.g. “comparative advertising is reprehensible” or “it would be desirable for American companies to deliver a better service”). Please do not consider the content of these examples of value judgements. Please answer spontaneously.

Explicit value judgments should ...

[definitely be given - definitely not be given, 5-point rating scale]

### 4. Methodology of marketing science

Which methods of research should in your opinion mainly be utilized in marketing science? Please answer spontaneously.

#### a) Basic methodological direction

Formal explanations (microeconomics, neo-institutional theories, game theory, etc.) should play a ... [very important role - unimportant role, 5-point rating scale]

Behavioral science explanations (psychology, sociology etc.) should play a ... [very important role - unimportant role, 5-point rating scale]

#### b) Empirical methodology

Quantitative empirical methods (=large samples, statistical analysis, etc.) should play a ... [very important role - unimportant role, 5-point rating scale]

Qualitative empirical methods (=case studies, small number explorations, etc.) should play a ... [very important role - unimportant role, 5-point rating scale]

### 5. Opinions about marketing science

How far do these statements correspond with your opinion? Please answer spontaneously.

“(Marketing) science is in principle able to find universal laws and regularities.”

“Cumulative (marketing) theories come closer and closer to the truth.”

“The best current (marketing) theories are at least approximately true.”

“(Marketing) science is subjective.”

“(Marketing) scientific ideas are context-laden, that is, they depend on a specific frame of reference.”

“(Marketing) science creates many different realities.”

[strongly agree - strongly disagree, 5-point rating scale]

### Particulars

Age [20-30 years, 31-40, 41-50, 51-60, 61+]

Occupational status [full professor, associate professor, assistant professor, other – please indicate]

## References

- Akerlof, George A. and William T. Dickens (1982), "The economic consequences of cognitive dissonance", *American Economic Review*, 72 (3), 307-319.
- Alderson, Wroe and Reavis Cox (1948), "Towards a theory of marketing", *Journal of Marketing*, 13 (October), 137-152.
- Angelmar, Reinhard and Pinson, Christian (1975): "The meaning of 'marketing'", in: *Philosophy of Science* (June), S. 208-214.
- Arndt, Johan (1978), "How broad should the marketing concept be?", *Journal of Marketing*, 42 (January), 101-103.
- Arndt, Johan (1985), "On making marketing science more scientific: role of orientations, paradigms, metaphors, and puzzle solving", *Journal of Marketing*, 49 (3), 11-23.
- Backhaus, Klaus and Franz-Karl Koch (1985), "Behavioral industrial marketing research in Germany and the United States - A comparison", *Journal of Business Research*, 13 (5), 375-383.
- Bagozzi, Richard P. (ed.), (1994), *Principles of marketing research*, Cambridge: Blackwell Publishers.
- Bartels, Robert (1968), "The general theory of marketing", *Journal of Marketing*, 32 (January), 29-33.
- Bartels, Robert (1988), *The history of marketing thought*, Columbus: Holcomb Hathaway.
- Baumgartner, Hans and Rik Pieters (2003), "The structural influence of marketing journals: A citation analysis of the discipline and its subareas over time," *Journal of Marketing*, 67, 123-139.

Bezdek, James C. (1974), "Numerical Taxonomy with Fuzzy Sets", *Journal of Mathematical Biology*, 1, 57-71.

Buchta, Christian, Sara Dolnicar and Thomas Reutterer (2000), *A Nonparametric Approach to Perceptions-Based Market Segmentation: Applications*, Vienna-New York: Springer.

Campbell, Nigel C. G., John L. Graham, Alain Jolibert and Hans Gunther Meissner (1988), "Marketing Negotiations in France Germany, The United Kingdom", *Journal of Marketing*, 52 (2), 49-53.

Chung, Kee H., Hong S. Pak and Raymond A. K. Cox (1992), "Patterns of Research Output in the Accounting Literature: A Study of the Bibliometric Distributions," *Abacus*, 28 (2), 168-186.

Cox, Raymond A. K. and Kee H. Chung (1991), "Patterns of Research Output and Author Concentration in the Economics Literature", *The Review of Economics and Statistics*, 73 (4), 740-748.

Desphande, Rohit (1983), "Paradigms lost: On theory and method in research in marketing", *Journal of Marketing*, 47 (3), 101-110.

Dimitriadou, Evgenia, Sara Dolnicar and Andreas Weingessel (2002), "An Examination of Indexes for Determining the Number of Clusters in Binary Data Sets", *Psychometrika*, 67, 137-160.

Dunn, Joseph C. (1974), "A Fuzzy Relative of the ISODATA Process and Its Use in Detecting Compact Well-Separated Clusters", *Journal of Cybernetics*, 3, 32-57.

Elrod, Terry, Gary J. Russell, Allan D. Shocker, Rick L. Andrews, Barry L. Bayus, J. Douglas Carroll, Richard M. Johnson, Wagner A. Kamakura, Peter Lenk, Josef A. Mazanec, Vithala R. Rao and Venkatesh Shankar (2002), "Inferring Market Structure from Customer Response to Competing and Complementary Products", *Marketing Letters*, 13 (3), Special Issue on Choice Modeling, 219-230.

Enis, Ben M. (1982), "Toward a taxonomy of marketing terms", in *Marketing theory, philosophy of science perspectives*, Bush, Ronald F. and Shelby D. Hunt, eds. San Antonio: American Marketing Association, 26-29.

Feyerabend, Paul K. (1993), *Against method: outline of an anarchistic theory of knowledge*, Verso Books.

Fraedrich, John, Debbie M. Thorne and O.C. Ferrell (1994), "Assessing the application of cognitive moral development theory to business ethics", *Journal of Business Ethics* 13(10), 829-838.

Gupta, Ashok K., Klaus Brockhoff and Ursula Weisenfeld (1992), "Making Trade-Offs in the New Product Development Process: A German/US Comparison", *The Journal of Product Innovation Management*, 9 (1), 11-19.

Hirschman, Elizabeth C. (1985), "Scientific Style and the Conduct of Consumer Research", *Journal of Consumer Research*, 12 (Sept.), 225-239.

Hoffman, Donna L. and Morris B. Holbrook (1993), "The Intellectual Structure of Consumer Research: a Bibliometric Study of Author Cocitations of the First 15 Years of the Journal of Consumer Research", *Journal of Consumer Research*, 19 (4), 505-517.

Horsky, Dan and Subrata K. Sen (1980), "Interfaces between marketing and economics: an overview", *Journal of Business*, 53 (3, part 2), 5-12.

Hunt, Shelby D. (1971), "The morphology of theory and the general theory of marketing", *Journal of Marketing*, 35 (April), 65-68.

Hunt, Shelby D. (1979), "Positive vs. normative theory in marketing: the three dichotomies model as a general paradigm for marketing", in: *Conceptual and theoretical developments in marketing*, Ferrell, O. C., Stephen W. Brown and Charles W. Lamb, eds. Phoenix: 567-576.

Hunt, Shelby D. (1991) "*Modern marketing theory. Critical issues in the philosophy of marketing science*", Cincinnati: South-Western Publishing Co.

Hunt, Shelby D. (1991): "*Controversy in Marketing Theory: For Reason, Realism, Truth, and Objectivity*", Armonk, NY: M.E. Sharpe

Jacoby, Jacob (1978), "Consumer research: a state of the art review", *Journal of Marketing*, 42 (2), 87-96.

Jones, D.G. Brian and David D. Monieson (1990), "Early development of the philosophy of marketing thought", *Journal of Marketing*, 54 (1), 102-113.

Kleinaltenkamp, Michael and Jacob Frank (2002), "German approaches to business-to-business marketing theory origins and structure", *Journal of Business Research*, 55 (2), 149-155.

Kohonen, Teuvo (1988), "Self-organized Formation of Topologically Correct Feature Maps", *Biological Cybernetics* (1982), 43, 59-69; reprinted in *Neurocomputing: Foundations of Research*, Andersen James A. and Edward Rosenfeld, eds. 511-521, Cambridge: MIT Press.

Leong, Siew Meng (1985), "Metatheory and metamethodology in marketing: A Lakatosian reconstruction", *Journal of Marketing*, 49 (3), 23-40.

Lilien, Gary L. and Arvind Rangaswamy (2001), *Marketing Engineering: Computer-Assisted Marketing Analysis and Planning*, 2nd ed. Englewood Cliffs: Prentice Hall.

Linde, Yoseph, Andres Buzo and Robert M. Gray (1980), "An Algorithm for Vector Quantizer Designs", *IEEE Transactions on Communications*, Vol. Com-28, 84-95.

Lotka, Alfred J. (1926), "The Frequency Distribution of Scientific Productivity", *Journal of the Washington Academy of Sciences*, 19, 317-323.

Macharzina, Klaus and Michael-J. Oesterle (1994), "International comparative evaluation of North-American and German research output in business and management", *Management International Review*, 34 (3), 255ff.

Mangiameli, Paul, Shaw H. Chen and David West (1996), "A Comparison of SOM Neural Network and Hierarchical Clustering Methods", *European Journal of Operational Research*, 93, 402-417.

Martinetz, Thomas, Stanislav G. Berkovich and Klaus Schulten (1993), "'Neural Gas' Network for Vector Quantization and its Application to Time-Series Prediction", *IEEE Transactions of Neural Networks*, 4, 558-569.

Martinetz, Thomas and Klaus Schulten (1994), "Topology Representing Networks", *Neural Networks*, 7, 507-522.

Mazanec, Josef A. (1997), "TRN32" (accessed November 30, 2003, available from <http://charly.wu-wien.ac.at/software/>).

Mazanec, Josef A. (1999), "Simultaneous Positioning and Segmentation Analysis with Topologically Ordered Feature Maps: A Tour Operator Example", *Journal of Retailing and Consumer Services*, 6, 219-235.

Mazanec, Josef A. and Helmut Strasser (2000), *A Nonparametric Approach to Perceptions-Based Market Segmentation: Foundations*, Vienna-New York: Springer.

Milligan, Glen W. and Martha C. Cooper (1985), "An Examination of Procedures for Determining the Number of Clusters in a Data Set", *Psychometrika*, 50 (2), 159-179.

Moorthy, Sridhar (1993), "Theoretical modelling in marketing", *Journal of Marketing*, 57 (2), 92-106.

Morgan, Gareth and Linda Smircich (1984), "The case for qualitative research", in *Marketing Theory*, Brown, Stephen W. and Raymond P. Fisk, eds. New York: American Marketing Association, 273-284.

Mundorf, Norbert, Ruby Roy Dholakia, Nikhilesh Dholakia and Stuart Westin (1996), "German and American consumer orientations to information technologies: Implications for marketing and public policy", *Journal of International Consumer Marketing*, 8 (3,4), 125.

Nicholas G. Rupp and Carl Nicholas McKinney, Jr. (2002), "The publication patterns of the elite economics departments", *Eastern Economic Journal*; 28 (4), 523-538.

Nicholls, Paul Travis (1986), "Price's Square Root Law: Empirical Validity and Relation to Lotka's Law", *Information Processing & Management*, 24 (4), 469-477.

Peter, Paul (1992), "Realism or relativism for marketing theory and research: a comment on Hunt's 'Scientific Realism'", *Journal of Marketing*, 56 (2), 72-79.

Piron, Francis and Murray Young (1996), "Consumer advertising in Germany and the United States: A study of sexual explicitness and cross-gender contact", *Journal of International Consumer Marketing*, 8 (3,4), 211.

Popper, Karl R. (1969), *Logik der Forschung*, 3rd ed., Tübingen: J.C.B. Mohr.

Price, Derek J. de Solla (1963), *Little science, big science ... and beyond*, New York: Columbia University Press.

Robin, D. (1977), "Comment on the nature and scope of marketing", *Journal of Marketing*, 41 (1), 136-138.

Sherry, John F. (1991), "Postmodern alternatives: the interpretative turn in consumer research", in *Handbook of consumer behavior*, Robertson, Thomas S. and Harold H. Kassarian, eds. Englewood Cliffs: 548-591.

Sheth, Jagdish N., Gardner, David M., Garrett, Dennis E. (1988): "*Marketing theory: evolution and evaluation*", New York: Wiley.

Suppe, F. (1977): "*The structure of scientific theories*", Chicago: University of Illinois.

Theoharakis, Vasilis and Andrew Hirst (2002), "Perceptual Differences of Marketing Journals: A Worldwide Perspective", *Marketing Letters*, 13 (4), 389-402.

Wedel, Michel and Wagner Kamakura, (2001), *Market Segmentation, Conceptual and Methodological Foundations*, 2nd ed., Boston: Kluwer.

Zaltman, Gerold, Karen LeMasters and Michael Heffring (1982), *Theory construction in marketing: some thoughts on thinking*, New York: John Wiley & Sons.

Zinkhan, George and Rudy Hirschheim (1992), "Truth in marketing theory and research: an alternative perspective", *Journal of Marketing*, 56 (2), 80-88.