Measuring the effectiveness of advertising in a positioning context with multi dimensional scaling techniques

Versteijne, M.

Publication date:
1988

Document Version
Publisher's PDF, also known as Version of record

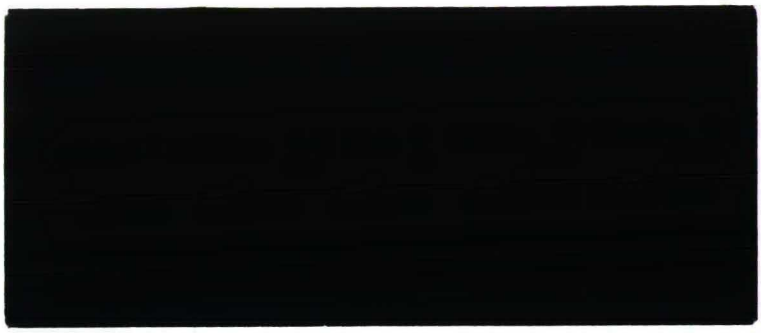
...ERSITY
...LIEKE
UNIVERSITEIT
BRABANT

POSTBOX 90153
5000 LE TILBURG
THE NETHERLANDS

[redacted]

DEPARTMENT OF ECONOMICS

RESEARCH MEMORANDUM



MEASURING THE EFFECTIVENESS OF ADVERTISING IN A POSITIONING CONTEXT WITH MULTI DIMENSIONAL SCALING TECHNIQUES

Marco Versteijne

FEW 352

Dept. of Marketing
and Marketing Research
University of Tilburg
The Netherlands

September 1988

MEASURING THE EFFECTIVENESS OF ADVERTISING WITH MULTI-DIMENSIONAL SCALING TECHNIQUES*

1. Introduction

Measuring the effectiveness of advertising is one of the most difficult problems in marketing management. Over the years, however, many measures and models and methods of measurement have been developed. Measurement of recall and recognition is one of the eldest methods. Lucas, Britt (1963) elaborate on these and many other measures and techniques measuring advertising effectiveness. Especially, in the sixties, models describing the 'working of advertising' have been published. Lavidge, Steiner (1961) and Colley (1961) are famous names in the realm of models of advertising effectiveness. Most models and methods however focus on recall or recognition of the brand name, on the brand preference or on advertising effects on sales (Rao (1970)). It was yet in the seventies and eighties that advertising goals which were stated in terms of brand **positioning** came more into interest (Trout, Ries (1972)).
Trout and Ries argued that because of the tremendous volume of advertising and new brands and products, consumers ran out of their mental ability and brain power. They stressed the importance of the need to position brands

* Parts of this paper have been presented in May 1988 for the University of Cracow (Poland).

in the consumers mind (only in global terms) to assure the brand's position in the evoked set. One of their warnings still is up-to-date: "you can't appeal to everyone".

This paper deals with methods and measurements designed for measuring the effectiveness of an advertising campaign, when (re-)positioning of a particular brand is the campaign's purpose.

As will be presented, the basic idea is the **comparison** of the **brand position** on a **brand map before** and **after** the campaign.

The structure of the rest of the paper is as follows: First we shortly pay attention to the terms "advertising", "effectiveness" and "multidimensional scaling techniques" by **defining** them (section 2). In section three we describe some **procedures** and in section four an explicit **measure** or index is dealed with. In both sections possibilities and problems are mentioned. Section five deals with some **conclusions.**

2. Some definitions

First the basic concept "advertising" has to be defined. For our purpose we take the widely accepted definition of Nickels (1976) which follows the American Marketing Association definition: **Advertising**: "Any paid non-personal communication about the demand for and the supply of persons, places, ideas, goods, services or causes by business, governement agencies, non-profit-organisations and individuals who are identified in the message". So even announcements of the Polish government concerning opening hours of tobacconists-shops are included in this description.

The next concept is that of "**effectiveness**". In general "effectiveness" is seen as "the degree to which stated goals have been reached". It is this point of view that we share in the context of this paper. It is however surprising to see that, despite the existence of this widely accepted simple description of "effectiveness", many articles and papers use "effectiveness" as a measure for 'effect' or productivity. In other words, while "effectiveness" should be a dimensionless figure (e.g. 8 (real percentage marketshare increase) divided by 10 (intended percentage marketshare increase) = 0.8), many authors write about an elasticity or turnover-amount being "effectiveness". See Stevers, Versteijne (1987) for a review of marketing literature on the concepts of effectiveness, efficiency and productivity.

Finally, **multidimensional scaling techniques** -from now on referred to as MDS- is a set of related scaling techniques by which perceptions of consumers about several brands, finally can be displayed **graphically** in a so called "brand map". For an in-depth review of the working of MDS we refer to Backhaus (1987), Green and Rao (1972) and Green, Tull, Albaum, (1988). Here it is sufficient to remark that MDS has some favourable aspects with respect to gathering data, compared with factoranalysis.

3. Procedures

As indicated before, we are looking for both **methods** (procedures) and **measures** to measure the effectiveness of advertising in a (re)positioning context. This section deals with the methods, while section four adresses to the topic of the measure.

Both Dillon, Domzal, Madden (1986) and Lautman, Percy, Kordish (1987) suggested a four-step-method that can be used to select an advantageous advertising theme and for **assessing the impact** of advertising in a brand positioning context.

The method designed by Lautman et al. consists of the following steps:

1. identifying how consumers differentiate among brands,
2. isolate those criteria which seem to be used most by consumers in differentiating brands,
3. make a quantified assessment of the consumers brands perceptions on the identified dimensions,
4. develop a new copy strategy and expose consumers to several alternative ad executions; assess the brand map positions of the alternative executions.

In step 3, Multidimensional Scaling procedures can be applied to assess the consumers multi-dimensional perceptions.

Dillon, Domzal and Madden suggested also a (slighty different) four-step-method:

1. obtain a brand map,
2. expose consumers to the repositioning campaign,
3. obtain a new brand map, and
4. evaluate the new position of the brand in relation to the 'desired' position, by using some sort of 'index'.

Section 4 will elaborate on these indices.

When we evaluate both methods we can say that the procedures mentioned are in essence very comprehensible and theoretically easy-to-use; the idea is simple. When your goal is to change your brand in the consumer's perception, then just assess a brand map before exposure, expose, and measure after exposure, and in order to make an explicit evaluation, apply some evaluation index on the brand map change.

However, basically simple, these methods suffer from several problems:

1. Stochastic brand map positions; because the brand maps will be generated with the help of a sample of respondents, the (mean) score of a brand on the dimension axes are in fact estimates, subject to estimating errors. In evaluating changes one should take into account a (multinormal) distribution around these means. Tests of significance should be applied.
2. Changes in the position of a brand on a brandmap could also be initialized by other marketinstruments or by contingency variables. E.g. a change in the brand's price could influence the perception of consumers of the quality of the product, which in turn could be reflected in a change in brand map position.
   The same reasoning applies for actions of competitions or other institutions in the core market system.
   So, when applying these methods one should assure the absence of other influencing factors. In a pretest situation this will be easier than in a real 'on-air' situation.
3. Which time period to take into account?

This is another traditional problem in the area of testing advertising effectiveness. Should we assess the 'after-exposure-map' one week, one month or one year after exposure?

This problem can easily overcome by stating the advertising goals for a specific moment point in time.

4. Applicability for **low-involvement** goods?

   Low-involvement buying processes typically are **not** based on extensive problem solving behavior (Engel, Blackwell, Miniard, (1986). One may hypothesize that such processes are based on habit, routinized or automatic processes, in which real brand perceptions do not anymore play a role. So, what's the reason in measuring brand perceptions. In fact for most productcategories, advertising, goals, will not sound in perceptionterms, but in terms of mere brandname or sales.

5. **Importance** of the relevant dimensions.

   Despite stating positioning goals in terms of **belief**changes, one could argue that severe changes in the **weights** of the criteria dimensions, substantially could influence the perception of or even preference towards the brand.

6. **Number of stimuli**. MDS typically generates bad or unrealistic solutions for a very low or high number of stimuli (brands). Use of few brands leads to non-unique solutions, while to many brands could badly influence the task of the respondent while filling in his inquiry-form. The 'ideal number of stimuli' is between 8 and 15.

7. **Methodology artifact**. Applying standard scaling methods before and after exposure will "undoubtedly produce a perceptual space map in which all of the brands have been displaced; that is, given a change in

one's brand position in the perceptual joint space (i.e., the referent brand), the distances among the other brands will most likely have to change in order to maintain a satisfactory goodness-of-fit value" (Dillon, Domzal, Madden (1986, p. 30)). These displacements of the non-referents complicate the assessment of the effectiveness of the campaign. Dillon, Domzal, Madden describe a methodology to cope with this problem. This methodology where configural invariance of the non-referent brands is assumed to hold is called ASCID.

The number of problems that could be mentioned can easily be enlarged by looking at the 'normal' problems which are inherent to application and interpretation of multidimensional scaling techniques (homogeneous perceptions, knowledge of brands etc.). In fact, this remark does apply also to the most common known problems in advertising research.

An important preliminary conclusion thus is, that measuring advertising effectiveness with MDS, suffers from both the common well-known problems in measuring advertising effectiveness and the problems with applying MDS.

4. Measurement

In this section we suppose that already a method à là Dillon et al. or Lautman et al. has been used to assess before- and after-exposure brand map positions.

We now focus on indices that can be used to assess more explicitly and quantitatively advertising effectiveness. With respect to this purpose we examine the measure proposed by Seggev (1982).

Seggev proposes the following three steps in deriving a measure:

1. Determine the a priori position of the brand in a perceptual map; this is called the 'bench mark position' or current position (CP). See figure 1.
2. Assess a desired position (DP) in this brand map (figure 2); expose people to a number of alternative advertisements or commercials; then construct a new brand map in which graphically the 'psychological positions' of the brand, resulting from all the different strategies (commercials, ads) are described. Figure 3 shows the results of testing three strategic approaches. However, graphic representations of results do not go far enough. It would be nice to know if e.g. S_2 is 'better' than S_3, and if so, how much. In order to say more about the relative success of the different strategies Seggev introduced the "Persuasion Index".

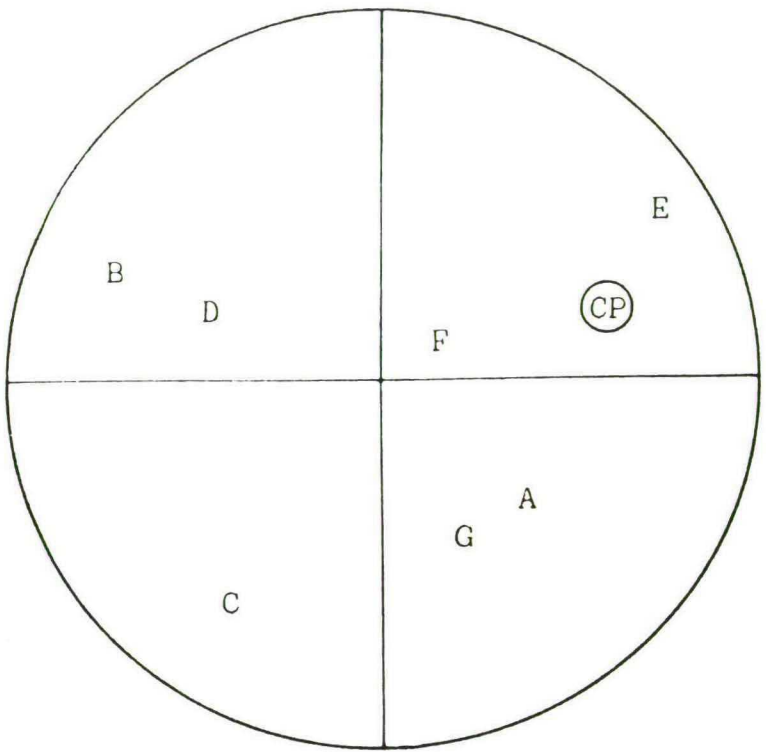
3. For every strategy (copy/ad) the following expression is computed

$$PI = \left[1.00 - \frac{\hat{S}_i}{90^o} \right] \cdot \left[\frac{\overline{CP\ S_i}}{R} .100 \right] \qquad (1)$$

where PI = Persuasion Index; a quantitative expression for the effectiveness of the advertisement.

Figure 1

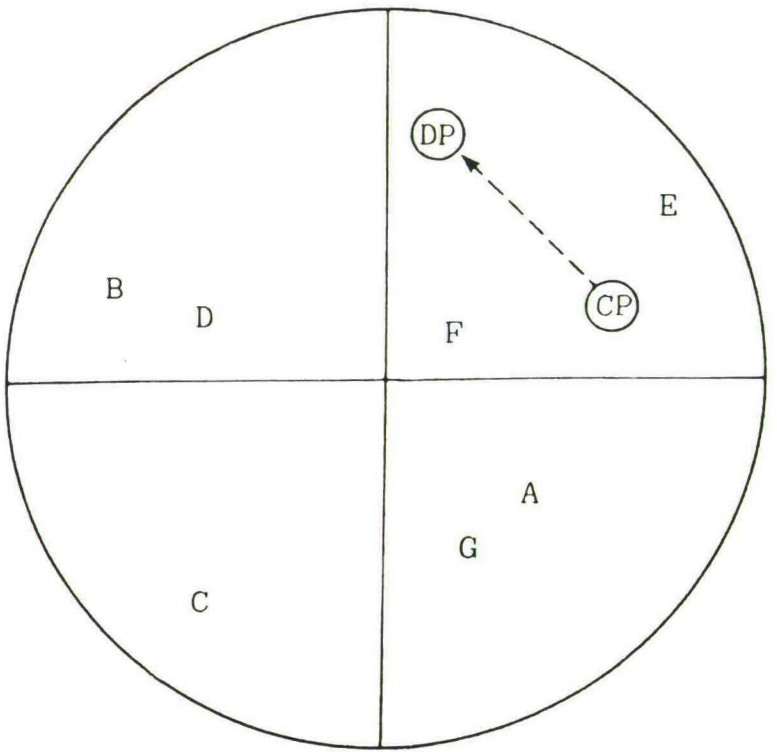
Bench-Mark Positioning



CP: current positioning
A through G: competitive ads/products

Figure 2

Setting Positioning Objectives



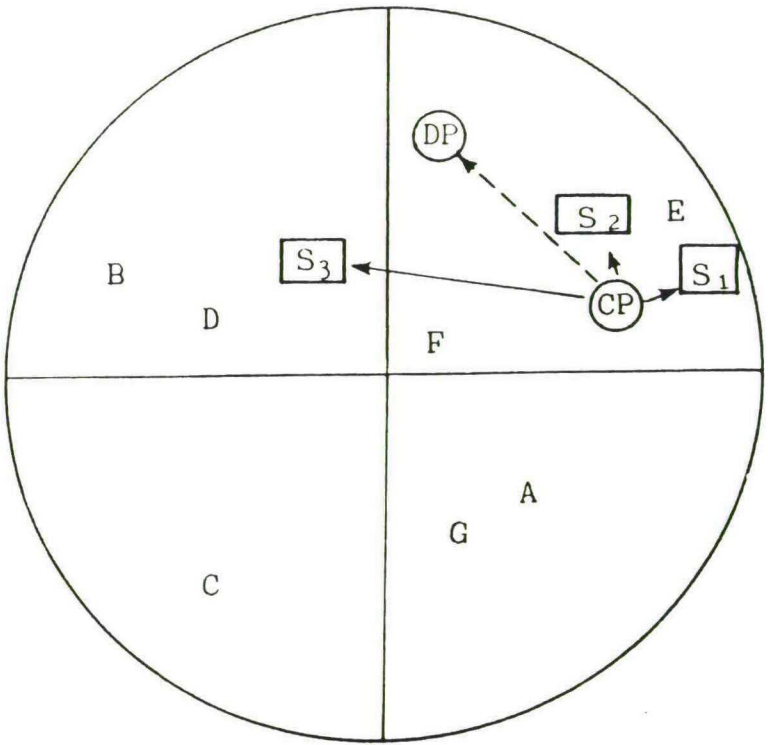
DP: desired positioning

CP: current positioning

A through G: competitive ads/products

Figure 3

Test of 3 Strategies



CP: current positioning
DP: desired positioning

S_1, S_2, S_3 : alternative strategies
A through G: competitive ads/products

$\hat{S}_i$ = the angle formed by the vector $\overline{CP\ DP}$ and the line extended from CP through S_i.

$\overline{CP\ S_i}$ = the absolute length of the line connecting CP and S_i.

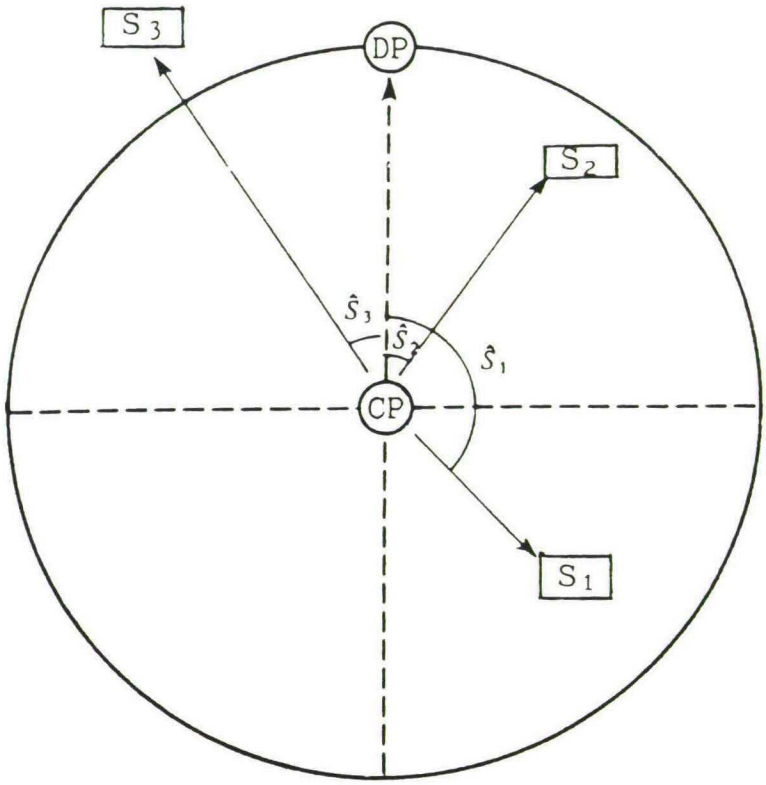
R = the length of the radius of the circle around CP; in fact, this is the absolute length of the line connecting CP and DP.

See figure 4; In figure 4 the circle is drawn with CP as center. With this formula one can capture in one single numerical expression the degree to which an ad has brought the brand closest to its desired position. As can be seen in equation (1), the effectiveness of alternative strategies (or 1 strategy) can be assessed as a function of two factors; first, the **direction** to which the ad 'brought' the brand to, and second, the **intensity** or strength of 'transportation' of the brand from the 'current position' to the new position.
So the index Seggev proposes is a "measure of closeness of the tested strategy to the positioning objective as expressed by the relative length of the line from the current positioning to the desired positioning, weighted by the degree to which the strategy matches the direction of the objective relative to the current situation (Seggev (1982), p. 41).

Despite its simplicity and justification to the term 'effectiveness' Seggev's index suffers from some problems.

Figure 4

Derivation of Persuasion Index



CP: current positioning
DP: desired positioning

$S_1, S_2, S_3,$: alternative strategies

First of all, we can question the metric properties of the PI, and especially the 'direction-factor'. In figure 5 we have a current position CP and a desired position DP, and also we see the effects on the positioning of the brand from two alternative strategies, A_1 and A_2. The vectors $\overline{CP\ A_1}$ and $\overline{CP\ A_2}$ have the same length. The only difference is the direction to which the two strategies 'moved' the brand. $\hat{S}_i$ for A_1 is 0; $\overline{CP\ A_1}$ is pointing in the same direction as $\overline{CP\ DP}$. The angle between $\overline{CP\ DP}$ and $\overline{CP\ A_2}$ however is 45^o. So, the expression $(1.00 - \frac{\hat{S}_i}{90^o})$ for A_1 equals 0 and for A_2 equals 0.5.

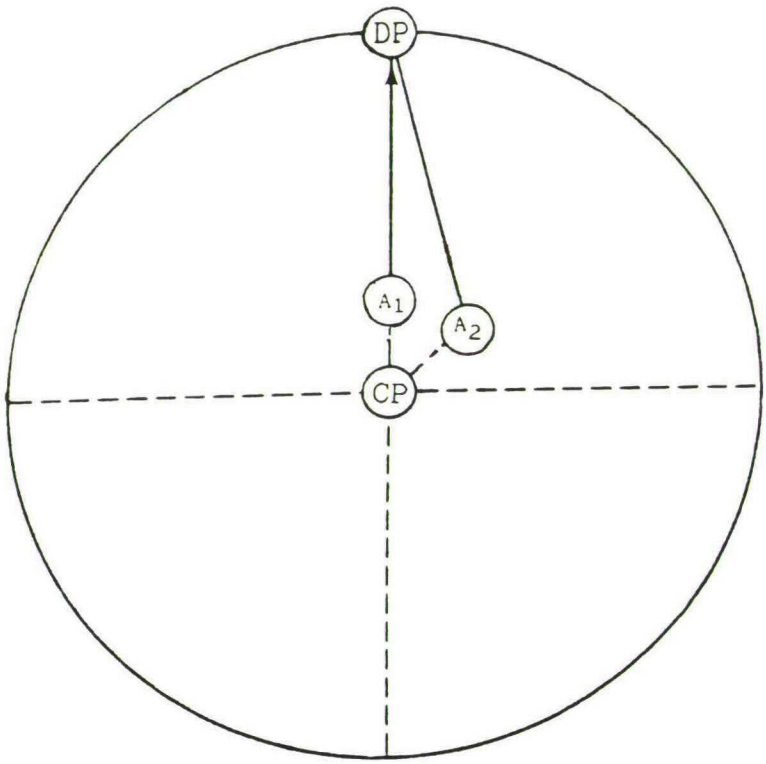
If we look at the second factor of the PI, the intension, or distance-factor, we can see that $\overline{DP\ A_1}$ has almost the same length as $\overline{DP\ A_2}$. These two factors combined will result in an effectiveness, a PI which for A_1 is more than twice as high as for A_2. This significantly depends on the difference in **direction** for both strategies.

However the 'new' distances from A_1 to DP and from A_2 to DP are almost equal. So, with the PI-formula A_1 will be 'punished' to strongly. Therefore, one could argue that comparison of the length of $\overline{A_i DP}$ to the length of $\overline{CP\ DP}$ results in a better measure to determine the **effectiveness** (the degree to which the Desired Position has been reached with an advertisement.) The index of effectiveness in my opinion should measure the relative decrease in distance from the current position to the desired position. In figure 6 we find the basis for this index.

CP is the 'current' position (position before exposure); DP stands for desired position, and AP means actual position (the new positioning after the commercial/campaign).

Figure 5

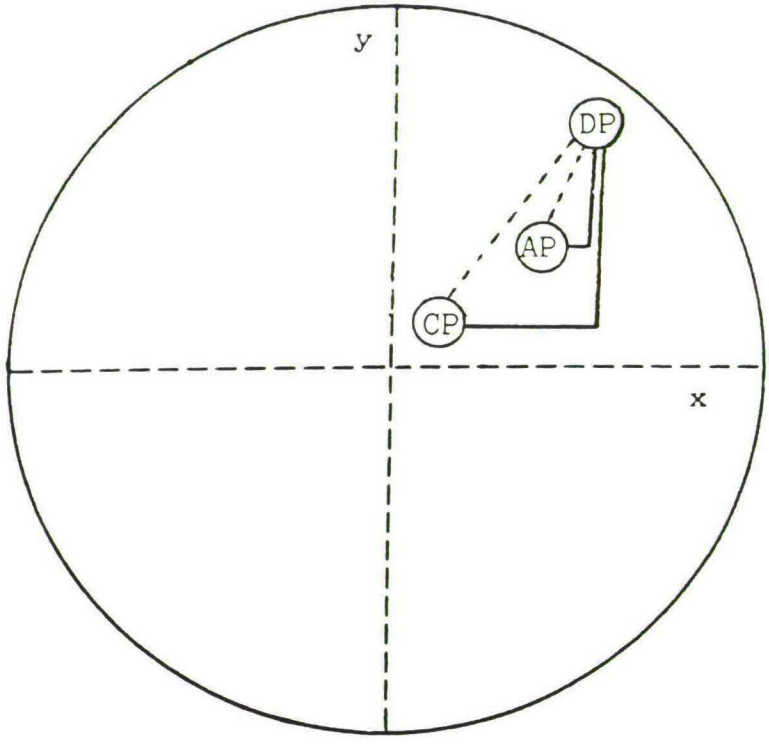
The Effects of 2 Alternatives



A_1, A_2 : 2 alternatives
DP: desired positioning
CP: current positioning

Figure 6

Derivation of the Index of Effectiveness



DP: desired positioning
AP: actual positioning
CP: current positioning

The 'old' distance from CP to DP can be derived via Pythagoras; this Euclidean distance is: $((DP_x - CP_x)^2 + (DP_y - CP_y)^2)^{\frac{1}{2}}$.

The 'new' distance can be derived via:

$((DP_x - AP_x)^2 + (DP_y - AP_y)^2)^{\frac{1}{2}}$.

We can the index in this case compute as:

$$100\ (1 - ((DP_x-CP_x)^2 + (DP_y-CP_y)^2)^{\frac{1}{2}}) \ /\ ((DP_x-AP_x)^2 + (DP_y-AP_y)^2)^{\frac{1}{2}}) \qquad (2)$$

A general formula for the Index of Effectiveness (IE) then is:

$$IE = 100. \left[1.00 - \left(\frac{\sum_{i=1}^{N} (D_i-A_i)^2}{\sum_{i=1}^{N} (D_i-C_i)^2} \right)^{\frac{1}{2}} \right] \qquad (3)$$

where D_i, A_i and C_i are the (quantitative) positions of the desired, actual and current, respectively, position on the i-th dimension. Total number of dimensions is N.

A **second** comment on Seggev's PI is attached to the fact that the 'perceptual' length of the vector $\overline{CP\ S_i}$ is based on an 'unweighted' euclidean distance. If dimensions (attributes) are not equal in importance to the consumer, the PI will 'weight' the less important dimension(s) too high.

These weights can be derived from a conjoint measurement analysis or directly from the MDS-program PREFMAP. With respect to this weighting/importance-issue the IE however can easily be adapted:

$$IE^{w} = 100. \left[1- \left[\frac{\sum_{i=1}^{N} w_i .(D_i - A_i)^2}{\sum_{i=1}^{N} w_i . (D_i - C_i)^2} \right]^{\frac{1}{2}} \right] \qquad (4)$$

A third comment concerns the simplicity of the graphical base of the PI. In many instances perceptions of consumers are not two-dimensional; In cases where consumers differentiate among brand by means of 5 attributes Seggev's flat 'pancake' can't be used to assess the total impact of advertising.
His formula however, then still is applicable; the PI is based on computations of directions and lengths of vectors.
The IE-measure which we proposed in this article only uses lengths of vectors. Therefore, because of its applicability we prefer the use of the IE.

The last remark about the PI-index is about the effects of perceptual changes longer or shorter than the desired change. Seggev states: "whether the line CP/S_i extends beyond the radius (i.e., outside the circle), the Persuasion Index should reflect the fact that a given distance, longer or shorter than the length of the radius, is interpreted as the same degree of accomplishment of the objective".
With this respect we agree with Seggev; the IE therefore is based on the distance from the actual position to the desired position, disregarding extension or falling short the objective.

5. Conclusion

Measuring the effectiveness of advertising in the context of positioning can easily be accomplished by MDS-procedures and the Index of Effectiveness (IE). However, many problems have to be eliminated. Most problems arise from the MDS-procedures. All the traditional pitfalls accompanying the use of MDS in general appear in the proposed specific application. Further research should direct to the scaling techniques underlying the brand maps. Some other problems are inherent in measuring advertising effectiveness in general; this are the ones also present in measuring advertising effectiveness when sales or recall-measures are used: "was advertising the only influencing factor?" and "how long do we have to wait till total effect has worked out". Further research in this area should adress to the use of controlled experiments. The presence of cable-t.v. and scanning-mechanisms in the stores will enable improvements in the future.

References

* Backhaus, K. and B. Erichson, W. Plinke, Chr. Schuchard-Ficher, R. Weiber (1987), Multivariate Analysemethoden; Eine anwendungsorientierte Einfurung, 4th ed. Berlin: Springer-Verlag (in German).
* Colley, R.H. (1961), "Defining Advertising Goals for Measured Advertising Results", Association of National Advertisers, Inc., New York.
* Dillon, W.R. and T. Domzal, Th.J. Madden (1986), "Evaluating alternative product positioning strategies", Journal of advertising research, aug./sept.
* Engel, J.F. and R.D. Blackwell, P.W. Miniard (1986), Consumer behavior, 5th ed. Eastbourne: Holt-Saunders.
* Green, P.E. and V.R. Rao (1972), Applied Multidimensional Scaling: A Comparison of Approaches and Algorithms. New York: Holt, Rinehart, and Winston, Inc.
* Green,P.E. and D.S. Tull, G. Albaum (1988), Research for Marketing Decisions, 5th. ed. Englewood Cliffs, N.J.: Prentice-Hall, Inc.
* Lautman, M.R. and L.H. Percy, G.R. Kordish (1978), Campaigns from Multidimensional Scaling, Journal of advertising research, Vol.18, nr.3, june 1978.
* Lavidge, R.J. and G.A. Steiner (1961), "A Model for Predicting Measurements of Advertising Effectiveness", Journal of Marketing, Vol. 25, pp.59-62.
* Lingoes, J. and E.E. Roskam (1973), "A Mathematical and Empirical Study of two Multidimensional Scaling Algorithms", Psychometrika, Monograph 19 (Vol.38, 4, Pt.2).
* Lucas, D.B. and S.H. Britt (1963), Measuring Advertising Effectiveness. New York: McGraw-Hill.
* Nickels, W.G. (1976), Marketing Communications and Promotion, Grid, Inc. Columbus, Ohio.
* Rao, A.G. (1970), Quantitative Theories in Advertising. New York: John Wiley and Sons, Inc.
* Seggev, E. (1982), "A new method for...Testing Persuasion by Strategic Positioning", Journal of advertising research, Vol.22, no 1, Feb./March

* Stevers, P.H. and P.A.M. Versteijne (1987), "Evaluatie van Marketing-activiteiten", Research Memorandum. Tilburg: University of Tilburg (in Dutch).

* Trout, J. and A. Ries (1972), "Positioning Cuts through Chaos in Marketplace", Advertising Age, May 1.

IN 1987 REEDS VERSCHENEN

242 Gerard van den Berg
Nonstationarity in job search theory

243 Annie Cuyt, Brigitte Verdonk
Block-tridiagonal linear systems and branched continued fractions

244 J.C. de Vos, W. Vervaat
Local Times of Bernoulli Walk

245 Arie Kapteyn, Peter Kooreman, Rob Willemse
Some methodological issues in the implementation of subjective poverty definitions

246 J.P.C. Kleijnen, J. Kriens, M.C.H.M. Lafleur, J.H.F. Pardoel
Sampling for Quality Inspection and Correction: AOQL Performance Criteria

247 D.B.J. Schouten
Algemene theorie van de internationale conjuncturele en strukturele afhankelijkheden

248 F.C. Bussemaker, W.H. Haemers, J.J. Seidel, E. Spence
On (v,k,λ) graphs and designs with trivial automorphism group

249 Peter M. Kort
The Influence of a Stochastic Environment on the Firm's Optimal Dynamic Investment Policy

250 R.H.J.M. Gradus
Preliminary version
The reaction of the firm on governmental policy: a game-theoretical approach

251 J.G. de Gooijer, R.M.J. Heuts
Higher order moments of bilinear time series processes with symmetrically distributed errors

252 P.H. Stevers, P.A.M. Versteijne
Evaluatie van marketing-activiteiten

253 H.P.A. Mulders, A.J. van Reeken
DATAAL - een hulpmiddel voor onderhoud van gegevensverzamelingen

254 P. Kooreman, A. Kapteyn
On the identifiability of household production functions with joint products: A comment

255 B. van Riel
Was er een profit-squeeze in de Nederlandse industrie?

256 R.P. Gilles
Economies with coalitional structures and core-like equilibrium concepts

257 P.H.M. Ruys, G. van der Laan
Computation of an industrial equilibrium

258 W.H. Haemers, A.E. Brouwer
Association schemes

259 G.J.M. van den Boom
Some modifications and applications of Rubinstein's perfect equilibrium model of bargaining

260 A.W.A. Boot, A.V. Thakor, G.F. Udell
Competition, Risk Neutrality and Loan Commitments

261 A.W.A. Boot, A.V. Thakor, G.F. Udell
Collateral and Borrower Risk

262 A. Kapteyn, I. Woittiez
Preference Interdependence and Habit Formation in Family Labor Supply

263 B. Bettonvil
A formal description of discrete event dynamic systems including perturbation analysis

264 Sylvester C.W. Eijffinger
A monthly model for the monetary policy in the Netherlands

265 F. van der Ploeg, A.J. de Zeeuw
Conflict over arms accumulation in market and command economies

266 F. van der Ploeg, A.J. de Zeeuw
Perfect equilibrium in a model of competitive arms accumulation

267 Aart de Zeeuw
Inflation and reputation: comment

268 A.J. de Zeeuw, F. van der Ploeg
Difference games and policy evaluation: a conceptual framework

269 Frederick van der Ploeg
Rationing in open economy and dynamic macroeconomics: a survey

270 G. van der Laan and A.J.J. Talman
Computing economic equilibria by variable dimension algorithms: state of the art

271 C.A.J.M. Dirven and A.J.J. Talman
A simplicial algorithm for finding equilibria in economies with linear production technologies

272 Th.E. Nijman and F.C. Palm
Consistent estimation of regression models with incompletely observed exogenous variables

273 Th.E. Nijman and F.C. Palm
Predictive accuracy gain from disaggregate sampling in arima - models

274 Raymond H.J.M. Gradus
The net present value of governmental policy: a possible way to find the Stackelberg solutions

275 Jack P.C. Kleijnen
A DSS for production planning: a case study including simulation and optimization

276 A.M.H. Gerards
A short proof of Tutte's characterization of totally unimodular matrices

277 Th. van de Klundert and F. van der Ploeg
Wage rigidity and capital mobility in an optimizing model of a small open economy

278 Peter M. Kort
The net present value in dynamic models of the firm

279 Th. van de Klundert
A Macroeconomic Two-Country Model with Price-Discriminating Monopolists

280 Arnoud Boot and Anjan V. Thakor
Dynamic equilibrium in a competitive credit market: intertemporal contracting as insurance against rationing

281 Arnoud Boot and Anjan V. Thakor
Appendix: "Dynamic equilibrium in a competitive credit market: intertemporal contracting as insurance against rationing

282 Arnoud Boot, Anjan V. Thakor and Gregory F. Udell
Credible commitments, contract enforcement problems and banks: intermediation as credibility assurance

283 Eduard Ponds
Wage bargaining and business cycles a Goodwin-Nash model

284 Prof.Dr. hab. Stefan Mynarski
The mechanism of restoring equilibrium and stability in polish market

285 P. Meulendijks
An exercise in welfare economics (II)

286 S. Jørgensen, P.M. Kort, G.J.C.Th. van Schijndel
Optimal investment, financing and dividends: a Stackelberg differential game

287 E. Nijssen, W. Reijnders
Privatisering en commercialisering; een oriëntatie ten aanzien van verzelfstandiging

288 C.B. Mulder
Inefficiency of automatically linking unemployment benefits to private sector wage rates

289 M.H.C. Paardekooper
A Quadratically convergent parallel Jacobi process for almost diagonal matrices with distinct eigenvalues

290 Pieter H.M. Ruys
Industries with private and public enterprises

291 J.J.A. Moors & J.C. van Houwelingen
Estimation of linear models with inequality restrictions

292 Arthur van Soest, Peter Kooreman
Vakantiebestemming en -bestedingen

293 Rob Alessie, Raymond Gradus, Bertrand Melenberg
The problem of not observing small expenditures in a consumer expenditure survey

294 F. Boekema, L. Oerlemans, A.J. Hendriks
Kansrijkheid en economische potentie: Top-down en bottom-up analyses

295 Rob Alessie, Bertrand Melenberg, Guglielmo Weber
Consumption, Leisure and Earnings-Related Liquidity Constraints: A Note

296 Arthur van Soest, Peter Kooreman
Estimation of the indirect translog demand system with binding non-negativity constraints

IN 1988 REEDS VERSCHENEN

297 Bert Bettonvil
Factor screening by sequential bifurcation

298 Robert P. Gilles
On perfect competition in an economy with a coalitional structure

299 Willem Selen, Ruud M. Heuts
Capacitated Lot-Size Production Planning in Process Industry

300 J. Kriens, J.Th. van Lieshout
Notes on the Markowitz portfolio selection method

301 Bert Bettonvil, Jack P.C. Kleijnen
Measurement scales and resolution IV designs: a note

302 Theo Nijman, Marno Verbeek
Estimation of time dependent parameters in lineair models
using cross sections, panels or both

303 Raymond H.J.M. Gradus
A differential game between government and firms: a non-cooperative approach

304 Leo W.G. Strijbosch, Ronald J.M.M. Does
Comparison of bias-reducing methods for estimating the parameter in dilution series

305 Drs. W.J. Reijnders, Drs. W.F. Verstappen
Strategische bespiegelingen betreffende het Nederlandse kwaliteits-concept

306 J.P.C. Kleijnen, J. Kriens, H. Timmermans and H. Van den Wildenberg
Regression sampling in statistical auditing

307 Isolde Woittiez, Arie Kapteyn
A Model of Job Choice, Labour Supply and Wages

308 Jack P.C. Kleijnen
Simulation and optimization in production planning: A case study

309 Robert P. Gilles and Pieter H.M. Ruys
Relational constraints in coalition formation

310 Drs. H. Leo Theuns
Determinanten van de vraag naar vakantiereizen: een verkenning van materiële en immateriële factoren

311 Peter M. Kort
Dynamic Firm Behaviour within an Uncertain Environment

312 J.P.C. Blanc
A numerical approach to cyclic-service queueing models

313 Drs. N.J. de Beer, Drs. A.M. van Nunen, Drs. M.O. Nijkamp
Does Morkmon Matter?

314 Th. van de Klundert
Wage differentials and employment in a two-sector model with a dual labour market

315 Aart de Zeeuw, Fons Groot, Cees Withagen
On Credible Optimal Tax Rate Policies

316 Christian B. Mulder
Wage moderating effects of corporatism
Decentralized versus centralized wage setting in a union, firm, government context

317 Jörg Glombowski, Michael Krüger
A short-period Goodwin growth cycle

318 Theo Nijman, Marno Verbeek, Arthur van Soest
The optimal design of rotating panels in a simple analysis of variance model

319 Drs. S.V. Hannema, Drs. P.A.M. Versteijne
De toepassing en toekomst van public private partnership's bij de grote en middelgrote Nederlandse gemeenten

320 Th. van de Klundert
Wage Rigidity, Capital Accumulation and Unemployment in a Small Open Economy

321 M.H.C. Paardekooper
An upper and a lower bound for the distance of a manifold to a nearby point

322 Th. ten Raa, F. van der Ploeg
A statistical approach to the problem of negatives in input-output analysis

323 P. Kooreman
Household Labor Force Participation as a Cooperative Game; an Empirical Model

324 A.B.T.M. van Schaik
Persistent Unemployment and Long Run Growth

325 Dr. F.W.M. Boekema, Drs. L.A.G. Oerlemans
De lokale produktiestructuur doorgelicht.
Bedrijfstakverkenningen ten behoeve van regionaal-economisch onderzoek

326 J.P.C. Kleijnen, J. Kriens, M.C.H.M. Lafleur, J.H.F. Pardoel
Sampling for quality inspection and correction: AOQL performance criteria

327 Theo E. Nijman, Mark F.J. Steel
Exclusion restrictions in instrumental variables equations

328 B.B. van der Genugten
Estimation in linear regression under the presence of heteroskedasticity of a completely unknown form

329 Raymond H.J.M. Gradus
The employment policy of government: to create jobs or to let them create?

330 Hans Kremers, Dolf Talman
Solving the nonlinear complementarity problem with lower and upper bounds

331 Antoon van den Elzen
Interpretation and generalization of the Lemke-Howson algorithm

332 Jack P.C. Kleijnen
Analyzing simulation experiments with common random numbers, part II: Rao's approach

333 Jacek Osiewalski
Posterior and Predictive Densities for Nonlinear Regression.
A Partly Linear Model Case

334 A.H. van den Elzen, A.J.J. Talman
A procedure for finding Nash equilibria in bi-matrix games

335 Arthur van Soest
Minimum wage rates and unemployment in The Netherlands

336 Arthur van Soest, Peter Kooreman, Arie Kapteyn
Coherent specification of demand systems with corner solutions and endogenous regimes

337 Dr. F.W.M. Boekema, Drs. L.A.G. Oerlemans
De lokale produktiestruktuur doorgelicht II. Bedrijfstakverkenningen ten behoeve van regionaal-economisch onderzoek. De zeescheepsnieuwbouwindustrie

338 Gerard J. van den Berg
Search behaviour, transitions to nonparticipation and the duration of unemployment

339 W.J.H. Groenendaal and J.W.A. Vingerhoets
The new cocoa-agreement analysed

340 Drs. F.G. van den Heuvel, Drs. M.P.H. de Vor
Kwantificering van ombuigen en bezuinigen op collectieve uitgaven 1977-1990

341 Pieter J.F.G. Meulendijks
An exercise in welfare economics (III)

342 W.J. Selen and R.M. Heuts
A modified priority index for Günther's lot-sizing heuristic under capacitated single stage production

343 Linda J. Mittermaier, Willem J. Selen, Jeri B. Waggoner, Wallace R. Wood
Accounting estimates as cost inputs to logistics models

344 Remy L. de Jong, Rashid I. Al Layla, Willem J. Selen
Alternative water management scenarios for Saudi Arabia

345 W.J. Selen and R.M. Heuts
Capacitated Single Stage Production Planning with Storage Constraints and Sequence-Dependent Setup Times

346 Peter Kort
The Flexible Accelerator Mechanism in a Financial Adjustment Cost Model

347 W.J. Reijnders en W.F. Verstappen
De toenemende importantie van het verticale marketing systeem

348 P.C. van Batenburg en J. Kriens
E.O.Q.L. - A revised and improved version of A.O.Q.L.

349 Drs. W.P.C. van den Nieuwenhof
Multinationalisatie en coördinatie
De internationale strategie van Nederlandse ondernemingen nader beschouwd

350 K.A. Bubshait, W.J. Selen
Estimation of the relationship between project attributes and the implementation of engineering management tools

351 M.P. Tummers, I. Woittiez
A simultaneous wage and labour supply model with hours restrictions