Model Assisted Statistics and Applications 4 (2009) 159–169
DOI 10.3233/MAS-2009-0121
IOS Press

1-to-1 personalized consumer-product marketing in real-life environment with critical word-of-mouth (WOM) impacts

Dmitri V. Kuznetsov
Intellidyn, 175 Derby St., Suite 40, Hingham, MA 02043, USA
E-mail: dkuznetsov@intellidyn.com

Abstract. Word of mouth (including on-line opinion exchange) is not only one of the key factors for marketing, it is the factor which transforms effects of other (advertising and economic) factors making them less or more significant, or even critical for abrupt transitions to a new market share or product/service demand. Such effects cannot be estimated using typical statistical techniques like, for example, a regression dependency between factors and target value. Using our statistical mediaphysics methodology we were able to uncover many challenging but hidden marketing issues and propose ways how they can be put under control to a better marketing performance. The optimized advertising-amount allocation across marketing of different products including the 1-to-1 personalized consumer-product marketing can appropriately treat many critical phenomena inspired by WOM in a real-life fight between organizing (competitive advertising, WOM, economic, etc.) and disorganizing (entropic) factors. Some of the critical issues that have to be targeted by the marketing are: jumps in population-opinions distributions in response to sometimes even very small changes of advertising factors; hysteresis-type (overheated or overcooled market) effects for strong enough WOM for specific products; and complex non-equilibrium dynamics of opinions.

Keywords: One-to-one marketing, word of mouth, sociophysics, mediaphysics, phase transition

1. Introduction

The present paper discovers and demonstrates critical marketing phenomena and market-share transitions that are crucial for adequate business/political marketing decisions. Such phenomena and transitions are confirmed by real life, but were not grasped yet by any currently available statistical or sociophysical techniques: traditional statistics does not have an appropriate tool and sociophysics is still in its childhood. See, however, Refs. [1,5–7]; and it could be mentioned that deep relationships between physics and sociology was recognized since ancient times: Epicurus (341–270 BC) providentially mentioned that ". . . in order to keep our freedom, it would have been better to remain attached to the belief in gods rather than being slaves to the fate of the physicists: the former gives us the hope. . . ; the latter, on the contrary, brings with it an inviolable necessity". (For more historic facts see [5].) During last two decades, sociophysics and econophysics offered different formalisms to explain mechanics of some hidden social processes including opinion spreading by word of mouth, but usually isolated them from other related and connected phenomena and from their representation in large statistical data sets.

Our recent sociophysical methodology, which we called mediaphysics, has expanded real-life abilities of sociophysics and allowed including in a model a wasted majority of important and crucial real-life phenomena in a consistent and treatable way. As an example of straightforward marketing application of the methodology we can mention the following case study that was analyzed by both (i) different types of traditional statistics and (ii) our sociophysical approach [2]. For a specific type of products we had historical monthly data about sales in a considering company and its competitors, that was accompanied by the corresponding advertising activities, general natural and economic factors. The problem was how to forecast sales as a function of all available factors. This

ISSN 1574-1699/09/$17.00

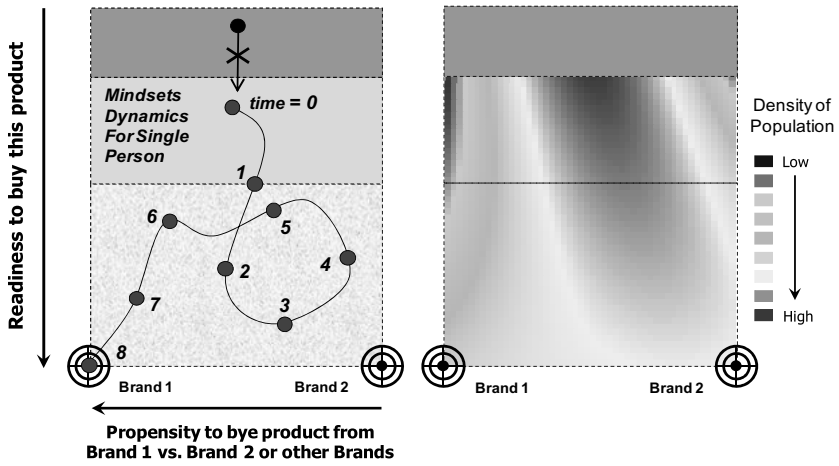

Fig. 1. Left: Mindsets dynamics for a single person in the corresponding metric space approaching or moving away from a choice. Right: A sample of distribution of population mindsets with tone-coded density distribution.

can be considered as a typical statistical problem with, for example, a regression-dependency solution with lags concept or the random-coefficients mixed models, etc. As it was shown in Ref. [2], sociophysical solution cannot be decomposed in a similar way like in the statistical analysis. This is because the sociophysics approach is based on such key points as complex distribution of population in terms of their opinions and WOM interactions between people. These distributions and interactions can be hidden but leading factors for a real media efficiency problem in a large company, as it happened in the case study when forecasting accuracy was increased significantly both quantitatively and qualitatively due to the sociophysics approach.

We put this methodology in the base of marketing analysis in the present article. To use appropriately our marketing recommendations it is desirable to understand what is going on with the target population through snapshots of our sociophysics "camera", that is described in the next two sections. Then, we analyze some critical phenomena in marketing and their appropriate treatment using marketing optimization and 1-to-1 personalization.

2. A big picture made by sociophysics "camera"

Typical marketing objective is to attract people's opinions to the choices (brands, products, political affiliations, etc.), that are desirable for the marketed company, and to make the attraction stronger than it is from competitors. It is easier to say than to make it real, because of so many different factors included and especially people that are so different and required different approaches for different products. Let us try to see what is going on in real life using sociophysics [2]. The starting point of the approach is current position of an individual's mindset (his/her opinion and thoughts about what he/she likes better) when this person is thinking about the available and marketed choices (e.g. brands) in a specific category. The closer the mindset to a choice versus other choices, the higher propensity to accept this choice (e.g. to buy a product of a specific brand) with respect to other available choices (brands). Here, we can mention a rough analogy of the above with fish and fishermen (individual's mindset and brands) where fishermen (brands) compete with each other trying to catch the fish. (See this analogy in our first publication on mediaphysics [3].) Strictly speaking, the mediaphysics methodology is based on the concept of a metric space of personal mindsets between two or many choices. Any metric space requires defining a notion of distance (a metric) between its elements. We define distance between a mindset position and a choice as a measure of relative propensity to accept the choice with respect to other available choices. In general, this space can be non-Euclidean with a complicated topology.

Changes in a personal mindset are reflected in the mindset motion (circles at time moments from initial $t = 0$ to 8 in the left part of Fig. 1) between choices (different brads along horizontal line). Vertical position of the mindset characterizes the readiness to buy the product from any brand in the category. In the vertical direction we can

conditionally separate three areas: (1) unmarketable (top) area (a person belongs to it if he/she cannot buy any product in the category by objective reason), (2) product-awareness (middle) area (a person belongs to it if he/she in general can buy a product in the category but does not consider to buy), and (3) brand-awareness (bottom) area (a person belongs to it if he/she can and consider to buy a product in the category). Application of motivations makes the mindset dynamics similar to real life thoughts, doubts and decisions under competitive advertising, economic, word-of-mouth and many other factors. During the motion a mindset can closely approach a choice, where the person is finally ready to make a positive decision about the choice. In other words, if the distance between a mindset position and a choice equals zero, then an acceptance event (sale, vote, etc.) takes place (the circle at time = 8).

Accumulating many personal mindsets we can talk about a distribution of population mindsets (see the right part of Fig. 1 with a sample of tone-coded density) and accumulating motion of the mindsets we can talk about dynamics of the mindset distribution. These population mindsets distributions (not a mindset of single person) and their transformations are subject of the sociophysics analysis. The dynamics of mindsets distributions typically reflects hidden phenomena in a society, while observable phenomena (like sale amounts, numbers of votes, etc.) are different derivatives of the usually hidden facts.

The readers who are interested in the math background of the methodology can see our manuscripts published in Ref. [2–5]. Here, we provide only a short description of the basic equations. The Markovian character of the system makes possible to model it using Green's function technique for the Brownian motion under action of different fields that represent motivations applied to population mindsets. For the Gaussian model, equation for time-dependent mindsets density distribution G_t can be reduced to the Schrödinger-type diffusion equation like

$$\frac{\partial G_t}{\partial t} = -W_t \cdot G_t + \frac{a^2}{2D} \cdot \Delta_{\vec{z}} G_t.$$

Here, $\Delta_{\vec{z}}$ is the Laplacian operator in the D-dimensional mindsets location space $\vec{z}$, a^2 is the mean-square distance between two neighboring mindset states during time t if there are no external fields (motivations) applied, and $W_t(\vec{z})$ stands for a total field (combined motivations) applied to the mindset in the position $\vec{z}$ at time t. Problem-adequate normalization (to reflect changes in total population number) and boundary conditions for the mindsets density G_t have to be applied [2]. Then, the observed outcomes (e.g., sales for the choices "0" and "1") at the moment t can be derived from G_t at the corresponding points of choices ($z = Z_0$ and $z = Z_1$, respectively): $S_0(t) = \lambda \cdot G_t(Z_0)$ and $S_1(t) = \lambda \cdot G_t(Z_1)$, where λ is the scaling factor. In social life, the total motivation field

$$W(\vec{z},t) = f\left[W_0(\vec{z},t), W_C(\vec{z},t), W_F(\vec{z},t), W_I(\vec{z},t)\right] - \overline{W}(t)$$

is a function of the following basic components: $W_0(\vec{z},t)$ and $W_C(\vec{z},t)$ are the field contributions arising from marketing and political efforts to attract opinions to choice "0" and to all other competitive choices "1", respectively; $W_F(\vec{z},t)$ stands for the contributions from general economic, natural and social factors. $W_0(\vec{z},t)$, $W_C(\vec{z},t)$ and $W_F(\vec{z},t)$ are external fields. $W_I(\vec{z},t)$ is the internal field, arising from within-system connectivity (i.e., interpersonal relations, like WOM, stable traditions, etc.). In the self-consistent form (i.e., where a field that affects density distributions in its turn is determined by the distributions themselves), $W_I(\vec{z},t)$ is a function of $G(\vec{z},t)$. The last uniform term

$$\overline{W}(t) = \frac{1}{V} \int\limits_V f\left[W_0(\vec{z},t), W_C(\vec{z},t), W_F(\vec{z},t), W_I(\vec{z},t)\right] d\vec{z},$$

where $V = \int\limits_V d\vec{z}$ is the considered space volume. Thus, $\int\limits_V W(\vec{z},t) d\vec{z} = 0$.

As it follows from the above, it is impossible in principle to make an exact decomposition of different effects (motivation fields) as separated ones. Indeed, if, for example, in regression models such decomposition plays an important role in interpretation (like coefficient of determination might be presented as a sum of partial contributions of factors), the sociophysical analysis demonstrates that there is always an effect of internal connectivity (population distributions with interactions) in a system, spread all over the fields in an inseparable way. The only way to get an impression about the comparative importance of different factors, including internal fields, is to make models with and without these factors. All such calculations require basic middle-level programming skills in any computing language; the corresponding professional software is not available at this point.

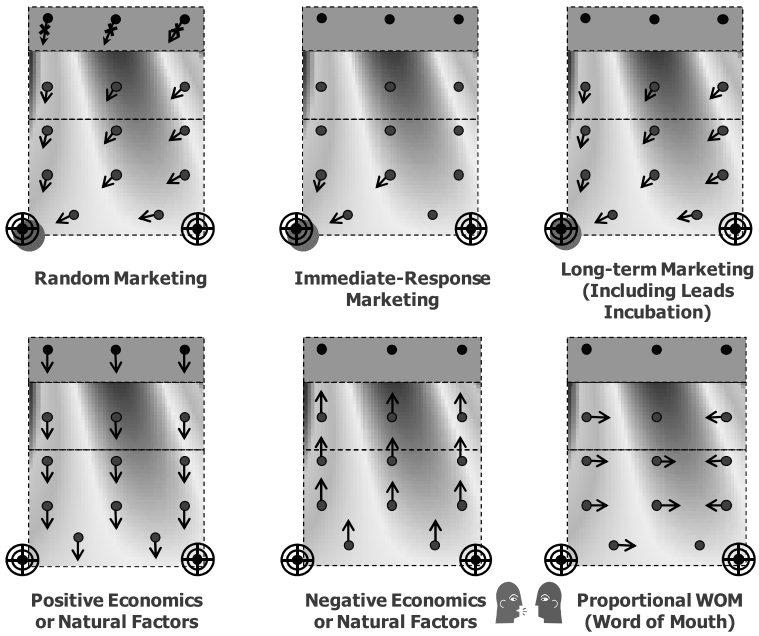

Fig. 2. Directions of the effects initiated by application of generic (not-personalized) marketing activities, and economic, natural and social factors for a few person's mindsets (circles in the figures), located at different parts of the "sociophysics picture".

3. Generic and personalized 1-to-1 marketing in the "sociophysics picture"

Now, knowing how to understand the "sociophysics picture", we can consider how the picture is transforming under different motivation factors. This is what is important to rule the marketing. At the beginning, let us consider application of generic (not-personalized) marketing activities, and economic, natural and social factors. Directions of the effects for a few person's mindsets (circles in the figures), located at different parts of the "sociophysics picture", are demonstrated in Fig. 2. Economic and natural factors are typically not specific-brand oriented and, thus, can motivate a person to change his/her mindset up (unfavorable) or down (favorable conditions) to decrease or increase his/her readiness to buy the product from any brand (with no "left" or "right" brand preferences in the corresponding parts of Fig. 2). Marketing activities are usually brand oriented and, thus, attract to a specific brand (with "left" or "right" brand preferences along with a general product-awareness motivation directed down in Fig. 2). Orientation to a brand is usually stronger in brand-awareness area (bottom area) and weaker in product-awareness area (middle area). Population, which located in the top area, typically is not responsive to any marketing but can be affected by economic and natural factors.

Different types of generic (non-personalized) marketing target population either randomly or selectively. Random marketing targets uniformly all population and, thus, with a higher probability motivates people from higher populated mindsets areas. Marketing, which is based on a model constructed for immediate response, attracts people with mindsets located already close enough to the promoted brand. (This can increase immediate response but can be not so good in long-term perspective and it is more reasonable for smaller players in the market.) Long-term marketing strategy can be optimized for a specific objective to target population with a high selectivity.

On the top of marketing, economic and natural factors, there is Word of Mouth (WOM). In self-consistent approach the WOM creates an attraction to each opinion in such a way that force of the attraction is proportional to the volume of population that supports this opinion. In many cases it leads to dominated attraction to the opinions of population majority. The approach of self-consistence means the fact that WOM effects depend on population mindsets distribution created by all other marketing and non-marketing factors, and, simultaneously, effects of these other factors depend on WOM. So, long-term marketing strategy has to be optimized with WOM inclusion.

Marketing activities in Fig. 2 do not include any 1-to-1 personalization features. Figure 3 demonstrates a personalization "dimension" of multi-dimensional "sociophysics picture": for the same brand, there can be a few

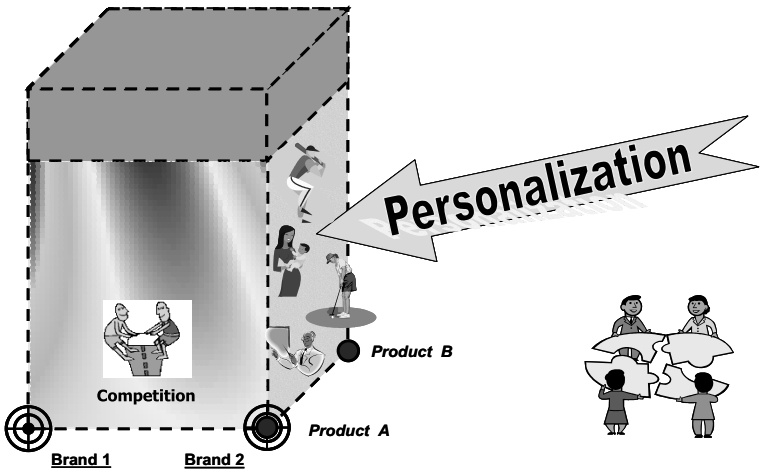

Fig. 3. Personalization "dimension" of multi-dimensional "sociophysics picture": for the same brand, there can be a few products that fit individual needs differently.

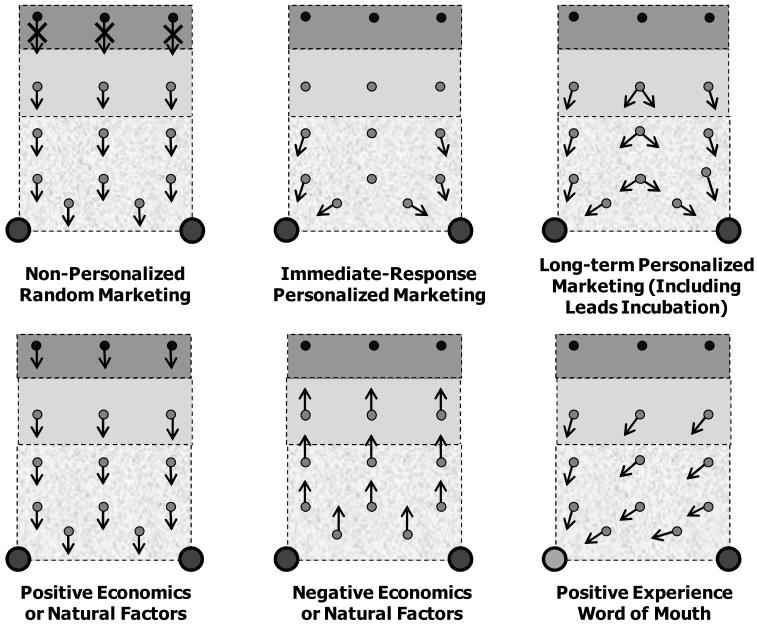

Fig. 4. Possible directions of the effects of different types of marketing activities and economic, natural and social factors in the personalization "dimension" with two same-brand products.

products that fit individual needs differently (products "A" and "B" in Fig. 3). Thus, we have to solve a puzzle to create a personal offer to each individual. Possible directions of the effects of different types of marketing activities and economic, natural and social factors in the personalization "dimension" with two same-brand products are shown in Fig. 4.

4. Critical phenomena and personalization in marketing

Now we can consider the next step of the methodology to dive from its surface (understanding of qualitative directions of different effects) to the deepness of quantities and the corresponding possible issues with hidden reefs.

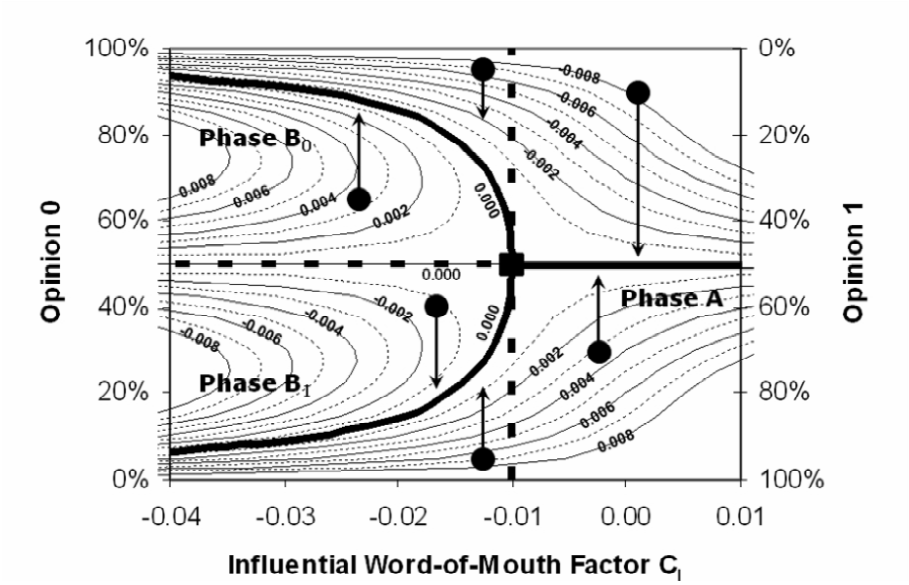

Fig. 5. Phase diagram inspired by word-of-mouth effects with no advertising activities. Three phases are separated by dashed lines. Solid thick curves represent equilibrium states. Circles and arrows demonstrate the convergence process to equilibrium states. Rates of opinion dynamics to the equilibrium states are demonstrated by same-rate curves.

Here, we demonstrate a few very challenging peculiarities of marketing in the presence of WOM as it can be discovered by this methodology.

Let us consider a competition between two brands. Phase diagram in Fig. 5 (we described derivation of this and similar phase diagrams in JSM proceedings [4]) is composed in terms of percentage of population preferred brand 0 (left vertical axis) and brand 1 (right vertical axis with opposite direction of percentage increase) versus influential world-of-mouth factor C_I without external (i.e. advertising, economic, natural, etc.) factors. Here, negative values of C_I with larger absolute values mean stronger attractions to the opinion of population majority, and therefore stronger advantage of the majority opinion. There are three phases. Phase A is located on the right hand from the critical value C_I^{cr} (vertical dashed line). In this phase A, in the absence of external factors, the WOM is not strong enough to support a majority fraction and prevent it from its disappearance among all opinions due to entropic disorganizing. Thus, for any initial opinion distribution between two choices the final distribution will be equalized at 50/50% level (solid thick line). On the left hand of the vertical dashed line, there are two phases: B_0 and B_1 (above and below 50/50% level). Any initial opinion distribution inside each of these phases will converge to the corresponding point on the equilibrium (solid thick) curves with the same C_I value as in the initial state (see circles and arrows in Fig. 5). Each convergence process can take different time (days or even months) depending on type of social system and its initial state. Moreover, speed of the convergence process is usually different at its different stages (see the same-rate curves in Fig. 5). During that transitional period just time factor (even without any external factors like advertising) can determine results of voting or sales. At some time point it could be just too early or already too late to have an expected result. Moreover, if slowly changing the strength of world-of-mouth factor C_I, the system in equilibrium is moving along solid thick line, for example, from left to right, then at $C_I = C_I^{cr}$ the system will undergo the second order phase transition with a jump of the first derivative.

Now let us consider the same social system, but with the presence of advertising activities. Then, we come to Fig. 6 with a symmetry break. In this diagram, advertising in favor of opinion 0 is stronger than its opponent's one. Now only two phases exist, they are separated by the dashed curve. Solid thick curves are equilibrium lines for each phase with the critical point marked by solid square. Directions of convergence to equilibrium are demonstrated like in Fig. 5 by arrows. With weak or even absent word of mouth the equilibrium states are shifted to higher percentages of the better advertised opinion. If slowly changing the strength of world-of-mouth factor C_I, the system in equilibrium is moving along solid thick line of phase 1 (with opinion 1 majority) from left to right, then at $C_I = C_I^{cr}$ the system will undergo a first order phase transition with a jump of the opinion distribution forming a solid

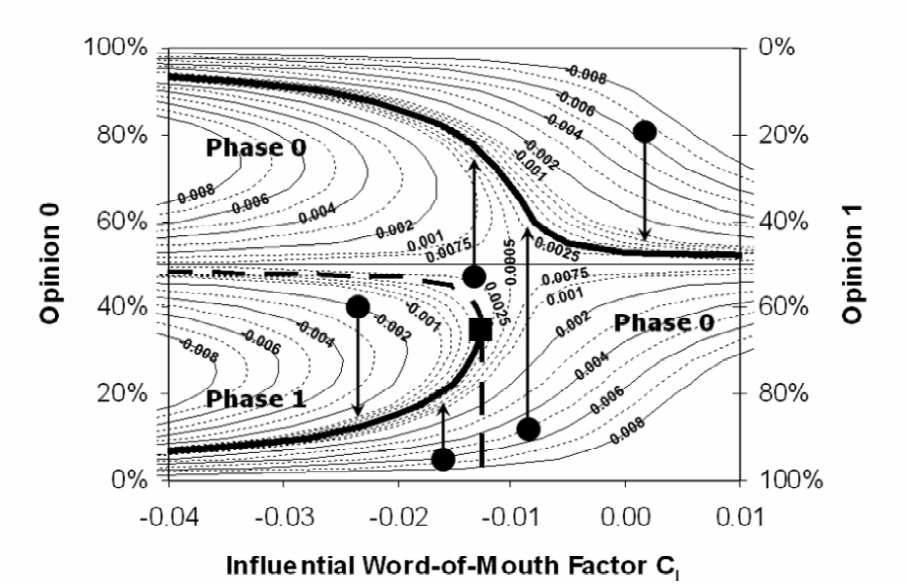

Fig. 6. Phase diagram inspired by word-of-mouth effects in the presence of advertising activities. Two phases are separated by dashed line.

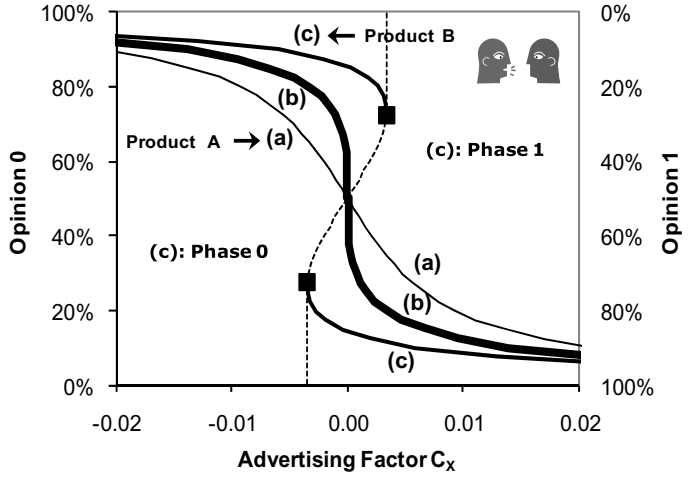

Fig. 7. Effect of advertising and other external (economic, natural, etc.) factors C_X on equilibrium states. (a) in the absence of word of mouth with $C_I = 0 > C_I^{cr}$ (b) with its critical value $C_I = C_I^{cr}$ and (c) $C_I < C_I^{cr}$, stronger than that critical one. There are two phases for $C_I < C_I^{cr}$ separated by dashed line.

majority with opinion 0. This transition is irreversible because it is impossible to come back to phase 1 from phase-0 equilibrium by changes only in WOM factor. However, dynamics of the transition to an equilibrium state can take a relatively long time, and therefore it can be enough time to make some changes in parameters before it is too late to reverse the process.

In a different cross-section of the problem, Fig. 7 (originally presented in [4]) demonstrates equilibrium-states dependencies of opinions percentages on advertising activities and other external factors. Negative values of external (advertising) factors mean dominated motivation in favor of the brand 0, and positive values – in favor of the brand 1. The higher the absolute value of the factor, the stronger the motivation in favor of the corresponding brand. There are three solid curves for three different values of WOM factor: (a) WOM is absent or weak, (b) WOM is present and equal to its critical value, and (c) WOM is present and above its critical value. These curves describe equilibrium states of the corresponding markets: the stronger advertising in favor of brand 1 (i.e. the higher positive values of

the advertising factor), the higher portion of population that prefers brand 1 and less portion that likes brand 0 better. The curves “a” and “b” are continuous, monotonic and almost linear for weak advertising (around zero values of advertising factor), and, thus, corresponding weak WOM does not bring any qualitative changes to typical statistical factors-target dependencies, but only quantitatively corrects numeric coefficients in such dependencies. For stronger WOM the curve “c” is significantly different and consist of two parts broken in the middle (around zero values of advertising factor). This is the “reef” we are talking about: it is impossible to pass through the disconnection without a significant jump in population preferences and corresponding market share (when dominated and secondary brands are switching).

Here, a brief qualitative explanation is needed for the reasons why so different disconnected behavior can take place. The effect of strong WOM is roughly similar to the domino effect along social networks. In such analogy, the case with no WOM means that each domino (individual) is staying far from each other (disconnected in decision making) and its falling (voting for one of the brands) cannot cause falling (voting for the same brand) of any one else. Dominos can fall in opposite directions (brands), their pushing in different directions (competitive advertising) means that different dominos fall in different directions. If dominos are disconnected from each other, then falling in different directions is straightforwardly following the pushing in such directions. A stronger WOM means that more dominos are staying close enough to each other and falling of one of them leads to falling of more dominos in the network. Thus, a smaller advantage in competitive pushing (advertising) is required to have a higher portion of dominos failed in the pushing side (higher ROI). At the point of critical connectivity (critical WOM) a dominated closely-connected network is forming, such network determines falling direction of majority of dominos (opinion of population majority and corresponding market share). The marketing fight is for the control of such majority. If a brand had such supportive majority, then it can keep it even with an advertising that is slightly weaker than from competitors (hysteresis-type effect for overheated market) but not beyond the critical point (solid squares in Figs 7 and 8). However, to win back such a market, it is necessary to solve an opposite problem (hysteresis-type effect for overcooled market).

In other words, if brand-1 advertising increases, it leads to increasing number of brand-1 proponents. At the same time WOM becomes less supportive for brand 0 and more supportive for brand 1. The reason for this is that brand-1 market share is increasing and strength of WOM is increasing with the increase of share of the brand-1 proponents. If the system has passed a critical point, the process is going as an avalanche due to this positive feedback: the higher the share because of advertising, the higher the WOM due to the increased share. If WOM is not that strong (curves “a” and “b”), the same type of sharp changes in the shares is observed, but not in the described catastrophic form.

As we mentioned, points on the solid curves are equilibrium states for the corresponding values of the factors. If a market is not in equilibrium and market conditions are not changing rapidly, then during a certain interval of time the market will reach the respective equilibrium point on the appropriate solid-curve. In Fig. 8 arrows demonstrate convergence from different points (solid circles) to the corresponding equilibrium states for the case of curve “c” conditions. All points to the left of the dashed line are converging to the top part of curve “c” (brand-0 domination) and all points to the right are converging to the bottom part of curve “c” (brand-1 domination). Therefore, we can say about two phases (to the left or to the right from the dashed line) for the curve “c” conditions (WOM is stronger than the critical one) and only one phase otherwise when equilibrium curves (“a” and “b”) are continuous.

For slowly changing conditions, market is usually in the current-time equilibrium and describing by points on the equilibrium curves. Slow changes in advertising can slowly move current point of the equilibrium along the corresponding solid curve. If being in a state at the top part of curve “c”, where brand 0 is dominant, a marketing manager decides to save too much money and weaken advertising for brand 0, then the effect can be catastrophic. Thus, if following reduction in brand-0 advertising the social system is moving from left to the right along top part of curve “c”, then it can pass the critical point (the corresponding black square in Figs 7 and 8) and undergo a dramatic phase transition with a jump of opinion allocation to the bottom part of curve “c” with brand-1 majority. Naturally, this jump will take a certain period of time, but it can happen. The rates of opinion changes are demonstrated by the same-rate curves in Fig. 8. If a voting is occurring during this transitional process, then selection of a correct time of voting is crucial for desired results: before or after the society will pass the 50/50% distribution. If the manager observing the undesired results (or even just undesired tendency of the started dramatic transition) would try to restore the initial status quo and increase spending on marketing, it could be too late or would take much more efforts and money: to achieve the back transition to brand-0 domination it is necessary to pass the other critical point

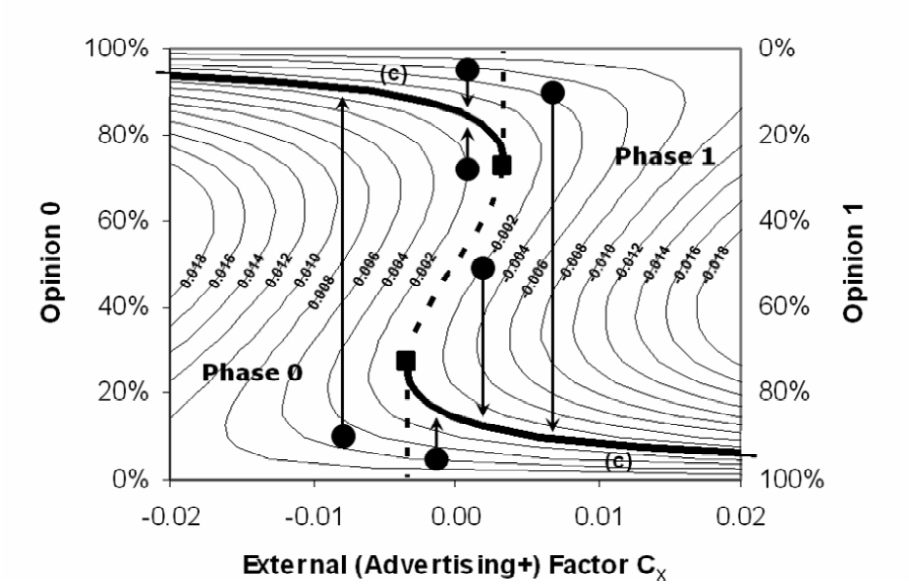

Fig. 8. Phase diagram for case (c) from previous figure with the same rate curves. Phases are separated by the dashed line.

that is in the bottom part of curve "c", moving now from right to the left far behind the values of advertising factor that were enough just to keep the brand-0 domination in the top-part of curve "c". In physics such behavior is called as the first order phase transition with hysteresis-type effects for the transition (overheated or overcooled market). Generally speaking, this collapsing process describes not only marketing issues, but also the present financial and economic crisis from sociophysical point of view.

For the case of two or more different products for each brand, power of WOM can be different for different products. For example, the product "A" can have weak WOM and be described by curve "a" in Fig. 7, and, simultaneously, the product "B" can be widely discussed and, so, have a strong WOM factor as for the curve "c". If such different products are available for the same brands at the same time, then marketers have to consider their optimal advertising to avoid and/or appropriately use tough "reefs" for one product and adopt higher marketing flexibility for other products.

Another real-life peculiarity that has to be understood is the possibility to have different inertia (or inclination to stability) for carriers of different opinions. Thus, for example, most likely people with traditional opinions are less sensitive to new affections and disorganizing factors, i.e. have higher inertia to change their opinion or lower coefficient of diffusion leading to lower entropic disorganization. In Fig. 9 we reproduced the case of Fig. 5 (no dominant advertising) but disorganizing diffusion from opinion 1 to opinion 0 is much higher than in the opposite direction, i.e. opinion 0 is more inertial like it can be for more conservative opinions. There are three phases and two critical points (marked by solid squares) in the last figure. In the right critical point the system undergoes second order phase transition with a jump of first derivative of population fraction like in Fig. 5, while in the left critical point the system obeys first order phase transition with a jump of the population fraction itself like in Fig. 6. Both critical points are located on the 50/50% distribution line and form a gate on this line. It has to be mentioned that convergence from an initial state to the corresponding equilibrium state, which passes this gate, can take very long time because on the gate line the rate of opinion changes equals zero (with bending, not extremum).

5. Practical real-life applications based on the methodology

Naturally, the optimization of advertising dollar allocation across marketing of different products for the same brand is much simpler without strong WOM effects. Meantime, we can say that this is the case mostly for some companies or brands that are not widely discussed. For such case all products are describing by advertising

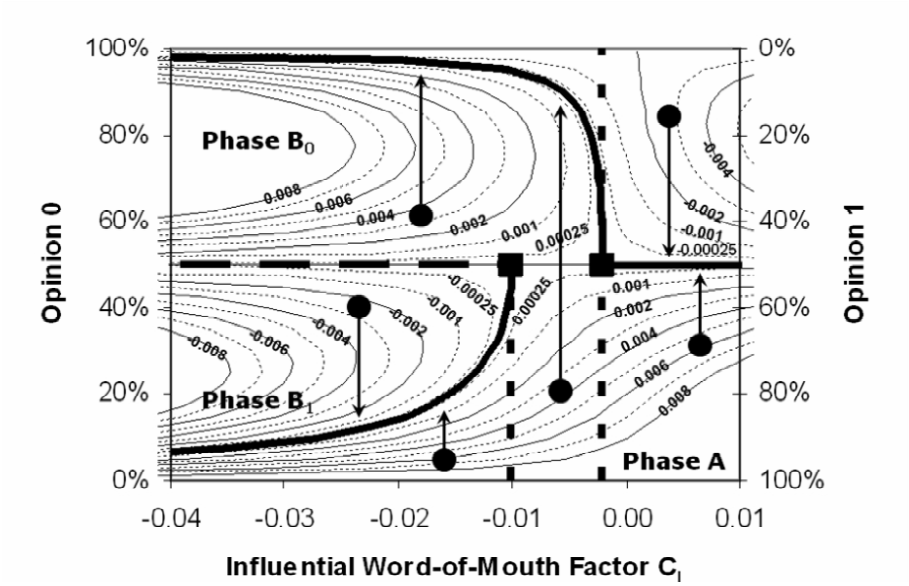

Fig. 9. Effect of different inertia (or inclination to stability) for carriers of different opinions. Here, opinion 0 is more inertial like it can be for more conservative opinions.

dependencies like curve “a” in Fig. 7. There are linear-response effects for weak advertising and some non-linear saturation effects (diminishing return) for stronger advertising. Steeper curves (because of stronger WOM, like curve “b” versus “a”) have a higher ROI for weak advertising, but, also, they reach significant diminishing return earlier. Thus, depending on the total advertising amount the optimal allocation is different, but relatively easy estimated. An adequate 1-to-1 personalization scheme has to follow such optimized allocation by adjusting weights for corresponding scores in customer-product relationships.

To illustrate this we can consider again the case of a real media efficiency problem that we have mentioned in introduction. Observed variables are time-dependent sales: (1) our own company’s sales and (2) total sales for all competitors. Real sales are represented in monthly increments. The information was used historically to create a model and to estimate model parameters, including external and internal fields (motivations). Then, using the model with the estimated parameters, we forecasted both our own and our competitors’ sales simultaneously for the next 12 months and compared them with the real sales for those months. There are several noteworthy aspects of this case study. First, the mediaphysics approach examines both our own and our competitors’ sales simultaneously in the frameworks of a single complex model, which is quite unusual for traditional statistics. Second, the study’s forecasting accuracy is an improvement over the traditional-statistical approaches examined for the same case. Moreover, it is significantly better if the forecasting area does not follow a simplistic reaction but sales dropped significantly in the forecasting months. The mediaphysics approach was able to catch the corresponding long-term reasons of the drop. Long-term or even infinitely long-term effects, which can be accounted for in mediaphysics, are very important not only to increase forecasting accuracy, but also to understand what is the reason behind a phenomena and how it can be treated by a company in short- and long-term perspectives. In some cases even small changes in advertising activities can lead to blockbuster or catastrophic results due to some secondary effects of WOM and mechanisms of opinion propagation in specific population distributions. Not as abrupt but still important are the effects of ceasing advertising activity for a short period of time and its resuming later to the original level. Dropping sales do not stop instantly after the resuming, and the sales never resume on the initial level after a long period of time, as would be the case using a traditional-statistics regression approach (even with lags). Instead, sales dynamics caused by the ceasing and resuming is slowly stabilized on a lower level. Thus, sociophysics provide more realistic causing and results for different marketing activities.

However, the advertising optimization can be even more complicated if at least one product in the advertising set obeys strong WOM effects and can pass one of the critical points in the diagrams discussed above. Marketing

decisions about such products have to be considered as a first priority, but, of cause, taking into account acceptable flexibility (advertising amount and market share) for all other products.

The practical question #1 is how to understand that one of the brand's products is near critical conditions of a curve similar to the curve "c"? Symptoms can be the following: the product is widely discussed and opinion of others can be significant, and/or not-pricing-related high fluctuations in sales take place for the product, and/or there is a strong advertising campaign of competitors that stimulates WOM. If at least one of such symptoms is observed, then it is strongly recommended to treat such product with a higher attention to prevent and/or use dramatic marketing transitions as it is shown in Fig. 8.

The practical question #2 is how to treat the product that is in the near critical conditions? As it follows from the above discussion, such near critical conditions lead to additional significant constrains and additional local maximums of an objective function in the marketing-allocation optimization scheme and the following 1-to-1 personalization. This way, optimization requires a more complicated tool. The corresponding 1-to-1 personalization is becoming an integral part of the optimization process.

6. Conclusions

In conclusion, new sociophysical methodology, based on a concept of persons'-mindsets metric space with distributed population mindsets and applied motivation forces of marketing, economics and nature, was applied to the basic problems of marketing for business and politics in the presence of changeable power of word of mouth (WOM). The WOM, as an element of world connectivity, is crucial phenomena for many aspects of marketing and one of the leading topic of sociophysics, which is not usually addressed in statistics. This approach uncovered very challenging peculiarities of marketing with all the major real-life factors within one model. The present article demonstrates some critical phenomena and dramatic phase transitions in marketing that are crucial for business and political decisions and confirmed by life, but, up to the best of our knowledge, were not grasped by any other currently available statistical or sociophysical techniques.

References

[1] S. Fortunato and C. Castellano, Scaling and Universality in Proportional Elections, *Phys Rev Lett* **99** (2007), 138701.
[2] D.V. Kuznetsov and I. Mandel, Statistical physics of media processes: Mediaphysics, *Physica A* **377** (2007), 253–268.
[3] D.V. Kuznetsov and I. Mandel, Introduction to statistical physics of media processes: Mediaphysics, arXiv:physics/0506217v2 [physics.soc-ph], 2005.
[4] D.V. Kuznetsov, Dynamics of Opinion Spreading in Marketing, in: *Proceedings of the American Statistical Association*, Section on Statistics and Marketing [CD-ROM], Alexandria, VA: American Statistical Association, 2007, pp. 2321–2327.
[5] I. Mandel and D.V. Kuznetsov, Statistical and physical paradigms in the social sciences, *Model Assisted Statistics and Applications* (*MASA*) **4** (2009), 1–24.
[6] D. Stauffer, Opinion Dynamics and Sociophysics, 2007, http://arxiv.org/abs/0705.0891v1.
[7] L.T.Wille, (editor), New Directions in Statistical Physics: Econophysics, Bioinformatics, and Pattern Recognition, Springer, 2004.