

Study of the Endogenous Influences System in the Consumer's Decision

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Abstract— The purpose of this paper is to complete the research about the anime culture perception among the young and the adult entertainment consumer. We are dealing with a particular form of art, of animation art, which is proved that please the young and the adult generation, all the same, surely, from different reasons, so the goal is to analyse these reasons, especially in the male and female consumers. For that goal we use statistical, mathematical, but mainly the information theory calculus.

Index Terms — anime culture, globalization, information theory, marketing.

I. INTRODUCTION

In the context of globalization, Romania has opened its doors to cultural influences from outside after the 1989 revolution. A culture that has taken place in the Romanian cultural space is the anime culture, a culture that revolves around Japanese animations called anime and manga comics. Its presence led to the opening of a new market for anime-specific products and cultural events with adjacent economic effects. Initially, the anime was presented to the public in Romania through a multitude of anime films and series aired by Romanian televisions and newly established televisions after the revolution, serials and anime movies, which enjoyed a growing popularity among the Romanian audience.

There was even in the 2000s a television channel called A+ dedicated to the anime, later replaced by the Animax channel. The rising popularity of the anime in Romania has led, since 2007, to anime-themed conventions in Romania such as Nijikon, Asia Fest, Otaku Fest, and so on. which are taking place since then every year.

Also, online shops specializing in anime, manga and cosplay products were founded, and even a number of bookstores, such as Cărturești and Antic Ex Libris, include manga and other anime-specific products in their offer.

Buyers of these products collect the information from websites, but as presented in author's research, the information comes mainly from anime-specific groups in the facebook social network. Within these groups, anime reviews are presented, opinions on animes, mangas, and other anime-specific products are formed. Also in these groups, anime products are marketed and promoted, making a whole e-marketing of this culture. The same researches showed that on the decision of the buyer of anime products in Romania, act exogenous influences, many of which are presented in the above. In a large study, we considered the analysis of endogenous influences on

the buyer's decision, of which we highlight *perception* and *motivation*.

Although these influences have been the subject of previous research of the author, the present article proposes a new perspective to approach the analysis in order to obtain further conclusions and complement those already presented.

II. THE SYSTEM OF THE ENDOGENOUS INFLUENCES

C. Theoretical considerations

We start from the mathematical model proposed in a previous studies [2],[4] for the system of interactions of endogenous influences which, as a whole, form the "black box" or **BB** in the specialised literature.

$$\mathbf{v}^{(5)} - \mathbf{a}\mathbf{v}^{(4)} - \mathbf{b}\mathbf{v}^{(3)} - \mathbf{c}\ddot{\mathbf{v}} - \mathbf{d}\dot{\mathbf{v}} - \mathbf{e}\mathbf{v} = 0 \quad (1)$$

where the endogenous variables were denoted : $\mathbf{a}=\textit{need}$, $\mathbf{b}=\textit{motivation}$, $\mathbf{c}=\textit{intention}$, $\mathbf{d}=\textit{preference}$, $\mathbf{e}=\textit{attitude}$.

The interactions between these influences lead, finally, to the buyer's decision, and are, in their turn, under the influence of external, disturbing factors, represented by exogenous influences, thus forming an open dynamic system, representing decisional behavior.

According to the following notations:

$$\begin{aligned} \mathbf{v} &= \mathbf{x}_1 \\ \dot{\mathbf{v}} &= \dot{\mathbf{x}}_1 = -\mathbf{x}_2 \\ \ddot{\mathbf{v}} &= \ddot{\mathbf{x}}_2 = \mathbf{x}_3 \\ \mathbf{v}^{(3)} &= \dot{\mathbf{x}}_3 = -\mathbf{x}_4 \\ \mathbf{v}^{(4)} &= \dot{\mathbf{x}}_4 = \mathbf{x}_5 \end{aligned} \quad (2)$$

the equation of the mathematical model can also be written as a differential equation in the vector variable \mathbf{x} :

$$(3)$$

$$\begin{aligned} \dot{\mathbf{x}} &= \mathbf{v}^{(5)} = \mathbf{a}\mathbf{x}_5 - \mathbf{b}\mathbf{x}_4 + \mathbf{c}\mathbf{x}_3 - \mathbf{d}\mathbf{x}_2 + \mathbf{e}\mathbf{x}_1 = \\ &= \mathbf{e}\mathbf{x}_1 - \mathbf{d}\mathbf{x}_2 + \mathbf{c}\mathbf{x}_3 - \mathbf{b}\mathbf{x}_4 + \mathbf{a}\mathbf{x}_5 = \\ &= \begin{pmatrix} \mathbf{e} & 0 & 0 & 0 & 0 \\ 0 & \mathbf{d} & 0 & 0 & 0 \\ 0 & 0 & \mathbf{c} & 0 & 0 \\ 0 & 0 & 0 & \mathbf{b} & 0 \\ 0 & 0 & 0 & 0 & \mathbf{a} \end{pmatrix} \cdot \begin{pmatrix} \mathbf{x}_1 \\ \mathbf{x}_2 \\ \mathbf{x}_3 \\ \mathbf{x}_4 \\ \mathbf{x}_5 \end{pmatrix} \end{aligned}$$

The corresponding dynamic system S , written in the form of the state equations, will have the matrix form:

$$\left\{ \begin{array}{l} \frac{dx}{dt} = \begin{pmatrix} e & 0 & 0 & 0 & 0 \\ 0 & d & 0 & 0 & 0 \\ 0 & 0 & c & 0 & 0 \\ 0 & 0 & 0 & b & 0 \\ 0 & 0 & 0 & 0 & a \end{pmatrix} \cdot x + \begin{pmatrix} \alpha & 0 & 0 & 0 & 0 \\ 0 & \beta & 0 & 0 & 0 \\ 0 & 0 & \gamma & 0 & 0 \\ 0 & 0 & 0 & \delta & 0 \\ 0 & 0 & 0 & 0 & \mu \end{pmatrix} \cdot u = A \cdot x + B \cdot u \\ y = \begin{pmatrix} 1 & 0 & \dots & 0 \\ \vdots & \ddots & \vdots & \\ 0 & \dots & 1 \end{pmatrix} \cdot x = C \cdot x \quad x(0) = x^0 \quad S \end{array} \right. \quad (4)$$

where: A = the state matrix, $x = (x1, x2, x3, x4, x5)$ is the state vector, $y = (y1, y2, y3, y4, y5)$ is the system response-decision, C = the response vector matrix (consumer decision) or output matrix, which, on the main diagonal, has elements equal to 0 or 1, on the other rows and columns being null. The disturbing vector $u = (u1, u2, u3, u4, u5)$ has the matrix B , matrix of disruptive coefficients, coefficients of exogenous influences, influences that according to Thorstein Veblen's theory are the following: culture, subculture, social class, reference groups, membership groups. Context and mathematical reasoning are preserved.[5]

D. A new approach

Customising the coefficients of the system $a_i = -p_i \log_2 p_i$ ($i=1...5$), where: p_i = the probability of the influence of v_i in the consumer's decision, the mathematical model becomes:

$$\begin{aligned} v^{(5)} + \sum_{i=1}^5 p_i \cdot \log_2 p_i \cdot v^{(5-i)} = 0 \quad \Rightarrow \\ v^{(5)} + p_1 \cdot \log_2 p_1 \cdot v^{(4)} + p_2 \cdot \log_2 p_2 \cdot v^{(3)} + \\ + p_3 \cdot \log_2 p_3 \cdot v^{(2)} + p_4 \cdot \log_2 p_4 \cdot v^{(1)} + p_5 \cdot \log_2 p_5 \cdot v = 0 \end{aligned} \quad (5)$$

In terms of the state equations, we return to the variable x , and we also assume that matrix B is null, so there is no external influences, remembering that such an open system is only ideal or experimental, laboratory.

Without any external influence, assuming that the x state vector has a unitary initial value:

$$x^0 = (x_i^0)_{i=1,2,3,4,5} \text{ cu } x_i^0 = 1 \quad (6)$$

As a result, the conversion from the zero moment is:

$$\dot{x}^0 = -\sum_{i=1}^5 p_i \cdot \log_2 p_i \cdot x_i^0 = -\sum_{i=1}^5 p_i \cdot \log_2 p_i = H \quad (7)$$

where H is the notation known for information entropy.

Interpretation:

The evolution of the system S of the endogenous influences in the time unit, for the positive values of the variables *intentions*, *attitudes*, and negative of the variables *motives*, *preferences*, is identified with the entropy of the system. Therefore, *intentions*, *attitudes*, and respectively needs mainly lead to entropy, the system of endogenous influences stagnates.

On the other hand, by giving values corresponding to the coefficients of the proposed model, it is mutually demonstrated that the *reasons* and *preferences*, are the variables that mainly determine Onicescu's information energy. The system S "evolves" as a result of the action of

these two variables, which we can consider endogenous determinant variables, while intentions, attitudes, and needs can be considered as resultant, thus determined variables.

Indeed, if $a_i = p_i^2$ ($i = 1 \dots 5$), replacing in the equation of the proposed model for the system of endogenous influences, we obtain:

$$v^{(5)} - \sum_{i=1}^5 p_i^2 \cdot v^{(5-i)} = 0 \quad (8)$$

Without any external influence assuming again that the x state vector has a unitary initial value:

$$x^0 = (x_i^0)_{i=1,2,3,4,5}, \quad x_i^0 = 1 \quad (9)$$

By replacing in (8) we obtain:

$$\dot{x}^0 = \sum_{i=1}^5 p_i^2 \cdot x_i^0 = \sum_{i=1}^5 p_i^2 = E \quad (10)$$

where E is the notation for Onicescu information energy

Considering the marginal probabilities equal to the measurable frequencies of the influences exercised within a decisional system, related to the products of a particular market, such as the anime culture's market, we will customize the previous results for two concrete examples, namely two researches made by the author in the form of surveys conducted in the online environment among Romanian entertainment consumers.

III. FORMULAS VALIDATION

If we refer to the variable reasons, the first study conducted by the author in the form of an online survey on a sample of 422 respondents led to the following results [1]

A. Motivations

Table 1. Motivations frequencies-var1

THE PURPOSE FOR ACQUIRING ANIME RELATED PRODUCTS	FREQUENCES
For me	308
To make a gift	12
Because a friend asked me to buy for him	1
I did not buy	89

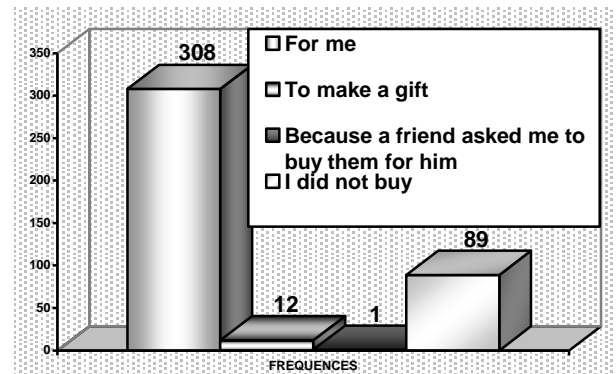


Fig. 1

The same research also provided the frequencies of the respondents' options, regardless of the biological type or age (age > 18), and for the other variables mentioned above.

As for the second *determinant* variable, the *preferences*, it appears to be, in fact, the most significant for the entire system of influences:

B. Preferences

Table 2. Preferences frequencies-var2

PREFERENCE FOR ANIME RELATED PRODUCTS	FREQUENCES
YES	316
NO	98

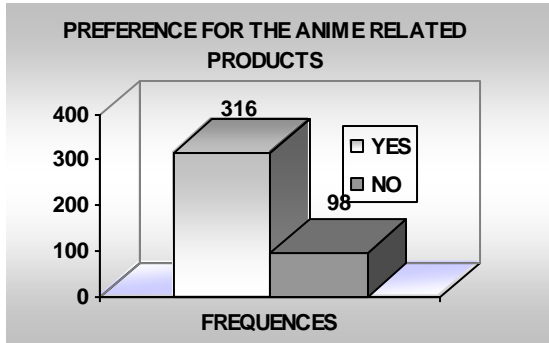


Fig. 2

The frequencies corresponding to the other three variables, called *determined*, are as follows:

C. Intentions

Table 3. Intentions frequencies-var3

ACQUIRING THE OFFICIALLY SUBTITLED ANIMES	FREQUENCES
YES	200
NO	210

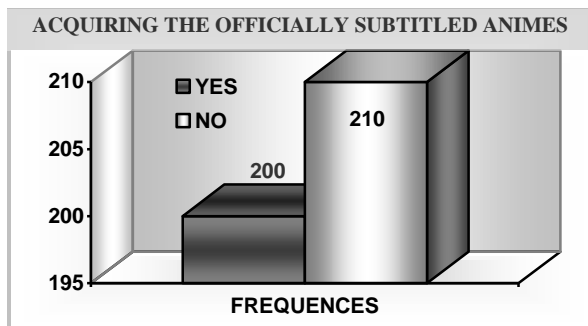


Fig. 3

Remembering that the first two variables are called determinant, and the last three are called determined, we denoted the five variables by **var1, var2, var3, var4, var5**, in the order they have been enumerated in the context, and we applied the information theory calculus, in four cases.

a) the negative alternatives of the determinant variables together with the positive alternatives of the determined ones: *no-yes*, and in a similar way:

- b) *yes-no*,
- c) *no-no*,
- d) *yes-yes*. (Fig. 6 a) and 6 b))

D. Attitudes

Table 4. Attitudes frequencies-var4

THE ANIME PRODUCTS SUBBING IMPORTANCE	FREQUENCES
Verry important	277
Enough important	110
Important	16
Less important	5
Not important	4

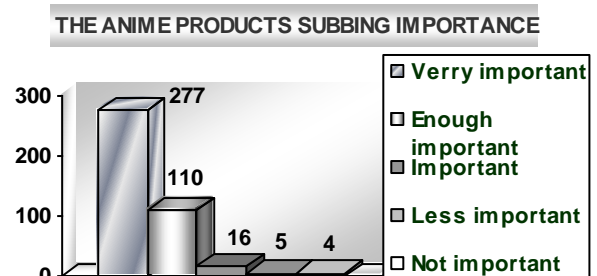


Fig. 4

E. Needs

Table 5. Needs frequencies-var5

SUBTITLED ANIMES WATCHING	FREQUENCES
All the time	73
Often enough	122
Sometimes	93
Never	125

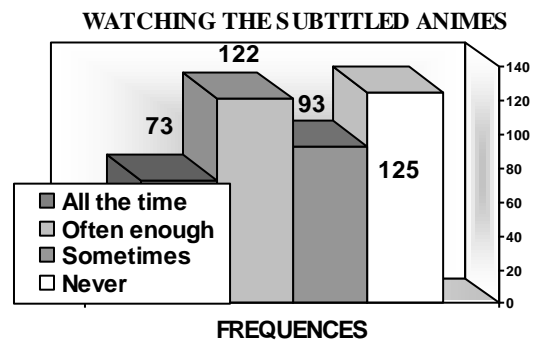


Fig. 5

The marginal frequencies, are used as the probabilities of the variables alternatives, regarding some items of author's survey. The results are included in the formulas of the informational entropy and Onicescu energy. We have demonstrated in the above paragraph that, for particular values of the endogenous influences system, the two main formulas of the information theory, can be obtained. In this paragraph, using the frequencies in the figures 1-5, we have calculated the entropy and the energy of the endogenous influences system, which are the most important in the consumer decision process. We have been led to three principal remarks, we have inserted below.(Fig.6)

	var1		var2		var3		var4		var5
YES	308	YES	316	YES	200	YES	277	YES	73
	12	NO	98	NO	210		110		122
	1		T=41 4		T=410		16		93
NO	89						5	NO	125
	T=410		YES/NO var1,2 + YES/NO var3,4,5			NO	4		T=413
				T=	2059		T=412		
NO pi=p(not vari)	89		98	YES pi=p(vari)	200		403	YES	288
FREQUENCES	0,04		0,05		0,10		0,20		0,14
	4,53		4,39		3,36		2,35		2,84
pi*log2(pi)	0,2		0,2		0,3		0,5		0,4
pi*pi	0,00		0,00		0,01		0,04		0,02
				H1=	0,40	E1=	0,00		
	NOT var1,2 + YES var3,4,5								
				H2=	0,79	E2=	0,07		
YES pi=p(vari)	308		316	NO pi=p(not vari)	210		4		125
FREQUENCES	0,15		0,15		0,10		0,00		0,06
	2,74		2,70		3,29		9,01		4,04
pi*log2(pi)	0,4		0,4		0,3		0,0		0,2
pi*pi	0,02		0,02		0,01		0,00		0,00
				H1=	0,82	E1=	0,05		
	YES var1,2 + NOT var3,4,5								
				H2=	0,35	E2=	0,01		
FIRST REMARK: THE POSITIVE ALTERNATIVES OF THE VARIABLES HAVE INFORMATIONAL IMPORTANCE/ENERGY									
NO pi=p(not vari)	89		98	NO pi=p(not vari)	210		4		125
FREQUENCES	0,04		0,05		0,10		0,00		0,06
	4,53		4,39		3,29		9,01		4,04
pi*log2(pi)	0,20		0,21		0,34		0,02		0,25
pi*pi	0,00		0,00		0,01		0,00		0,00
SECOND REMARK: THE INFORMATIONAL ENTROPY OF THE SYSTEM IS EQUAL WTH 1									
			H1=	0,4	H2=	0,6			
			H≈1						
The system entropy formed by using the <i>negative</i> alternatives frequencies of the variables: pi=p(not vari), i=1,2,3,4,5									

Fig. 6 a)

	var1		var2		var3		var4		var5
YES pi=p(vari)	308		316	YES pi=p(vari)	200		403		288
FREQUENCES	0,15		0,15		0,10		0,20		0,14
	2,74		2,70		3,36		2,35		2,84
pi*log2(pi)	0,41		0,41		0,33		0,46		0,40
pi*pi	0,02		0,02		0,01		0,04		0,02
E=0,11 (INFORMATIONAL GAIN=11%)									
INFORMATIONAL GAIN IS DUE TO THE POSITIVE ALTERNATIVES OF THE VARIABLES									

Fig. 6 b)

IV. THE MAIN FORMULAS

The formulas we used in above paragraph are:

$$H_1 = -\sum_{i=1}^{n=2} p_i \cdot \log_2 p_i \quad (11)$$

$$H_2 = -\sum_{i=3}^{n=5} p_i \cdot \log_2 p_i$$

for the entropy calculus. The five variables we have divided in two groups: the two determining variables (var1 and var2), and the three determined ones (var3, var4, var5)

For each group it has been calculated the entropy and the energy. For calculating the informational energy transmitted to the decision we have used the Onicescu formula:

$$E_1 = \sum_{i=1}^{n=2} p_i^2 \quad (12)$$

$$E_2 = \sum_{i=3}^{n=5} p_i^2$$

where $p_i = p(v_i)$ or $p_i = p(\text{not } v_i)$ are the corresponding frequencies, when we consider the positive or the negative alternative of the variables.

V. CONCLUSIONS

From the considerations above, we conclude that the entropy of the decision process can be considered as given by the negative alternative of them, during the informational gain is due to the positive alternatives of the five endogenous influences: *motivations, preferences, intentions, attitudes, needs*, the two first determining the last three, in this order.

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