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IS 2006

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Ljubljana, Slovenia

PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2006

V svojem devetem letu ostaja multikonferenca Informacijska družba 2006 (http://is.ijs.si) ena vodilnih srednjeevropskih konferenc, ki združuje znanstvenike z različnih raziskovalnih področij povezanih z informacijsko družbo. V letu 2006 smo v multikonferenco povezali osem neodvisnih konferenc. Informacijska družba postaja vedno bolj zapleten socialni, ekonomski in tehnološki sistem, ki je pritegnil pozornost vrste specializiranih konferenc v Sloveniji in Evropi. Naša multikonferenca izstopa po širini in obsegu tem, ki jih obravnava.

Rdeča nit multikonference ostaja sinergija interdisciplinarnih pristopov, ki obravnavajo različne vidike informacijske družbe ter poglabljajo razumevanje informacijskih in komunikacijskih storitev v najširšem pomenu besede. Na multikonferenci predstavljamo, analiziramo in preverjamo nova odkritja in pripravljamo teren za njihovo praktično uporabo, saj je njen osnovni namen promocija raziskovalnih dosežkov in spodbujanje njihovega prenosa v prakso na različnih področjih informacijske družbe tako v Sloveniji kot tujini.

Na multikonferenci, ki bo trajala šest dni, bo na vzporednih konferencah predstavljenih preko 200 referatov, vključevala pa bo tudi okrogle mize in razprave. Referati so objavljeni v zbornikih multikonference, izbrani prispevki pa bodo izšli tudi v dveh posebnih številkah znanstvenih revij, od katerih je ena Informatica, ki se ponaša s 30-letno tradicijo odlične znanstvene revijei. Multikonferenco Informacijska družba 2006 sestavljajo naslednje samostojne konference:

- BIOMA 2006 – Bioinspired Optimization Methods and their Applications
- Mejne kognitivne znanosti
- Kognitivne znanosti
- Sodelovanje in informacijska družba
- Rudarjenje podatkov in podatkovna skladišča
- Vzgoja v informacijski družbi
- Inteligentni sistemi
- Jezikovne tehnologije.

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi tudi ACM Slovenija. Zahvaljujemo se tudi Ministrstvu za visoko šolstvo, znanost in tehnologijo za njihovo sodelovanje in podporo. V imenu organizatorjev konference pa se želimo posebej zahvaliti udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V letu 2006 sta se programski in organizacijski odbor odločila, da bosta podelila posebno priznanje Slovencu ali Slovenki za izjemen prispevek k razvoju in promociji informacijske družbe v našem okolju. Z večino glasov je letošnje priznanje pripadlo prof. dr. Cenetu Bavcu. Čestitamo!

Viljan Mahnič, predsednik programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2006

In its 9th year, the Information Society Multiconference (http://is.ijs.si) continues as one of the leading conferences in Central Europe gathering scientific community with a wide range of research interest in information society. In 2006, we organized eight independent conferences forming the multiconference. Information society displays a complex interplay of social, economic, and technological issues that attract attention of many scientific events around Europe. The broad range of topics makes our event unique among similar conferences.

The motto of the Multiconference is synergy of different interdisciplinary approaches dealing with the challenges of information society. The major driving forces of the Multiconference are search and demand for new knowledge related to information, communication, and computer services. We present, analyze, and verify new discoveries in order to prepare the ground for their enrichment and development in practice. The main objective of the Multiconference is presentation and promotion of research results, to encourage their practical application in new ICT products and information services in Slovenia and also broader region.

The Multiconference is running in parallel sessions for six days with over 200 presentations of scientific papers. The papers are published in the conference proceedings, and in two special journal issues. One of them is Informatica with its 30 years of tradition in excellent research publications.

The Information Society 2006 Multi-Conference consists of the following conferences:

- BIOMA 2006 - Bioinspired Optimization Methods and their Applications
- Borderline Cognitive Sciences
- Cognitive Sciences
- Collaboration and Information Society
- Data Mining and Data Warehouses
- Education in Information Society
- Intelligent Systems
- Language Technologies.

The Conference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of ACM. We would like to express our appreciation to the Slovenian Government for cooperation and support, in particular through the Ministry of Higher Education, Science and Technology.

At the end we would like to bring your attention to a special event. In 2006, the Programme and Organizing Committees decided to award one Slovenian for his/her outstanding contribution to development and promotion of information society in our country. With the majority of votes, this honor went to Prof. Dr. Cene Bavec. Congratulations!

On behalf of the conference organizers we would like to thank all participants for their valuable contribution and their interest in this event, and particularly the reviewers for their thorough reviews.

Viljan Mahnič, President of the Programme Committee
Matjaž Gams, President of the Organizing Committee

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Evaluation of the semantic similarity of the words denoting emotions

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ABSTRACT

This paper presents the results of an experiment designed to investigate the semantic similarity of various words denoting emotions. The data of this psycholinguistic experiment bring evidence about the organisation of the emotional space which is considered to be circular in the psychological theories. The results support the theory for the polarity of the primary emotions as well as the circular structure of the emotional space in the long-term memory.

Emotions are not an easy concept to study. In any of the disciplines that study emotions there is no agreement concerning the number or nature of the basic emotions. Some authors suggest that emotions should be conceptualised as dimensions, like pleasure, arousal and dominance, or as emotional categories, such as disgust, expectancy, etc. There are many categorizations of primary emotions (Ortony and Turner, 1990). Plutchik identified eight primary emotions emphasizing their relations to adaptive biological processes. Arnold expanded the number of primary emotions to eleven based on their relations to action tendencies. Watson postulated that there are three types of basic emotional reactions fear, rage and love. Ekman and Friesen recognized six universal facial expressions. Izard emphasized the survival role of emotions and identified ten primary emotions through the facial expressions.

Plutchik (1980, 1997) proposed circular ordering of the primary emotions, similar to that of the colours. Figure 1 shows the ordering of primary emotions given by Plutchik.

Figure 1. Circular ordering of primary emotions proposed by Plutchik

According to Plutchik "primary emotions can be conceptualised in terms of pairs of polar opposites" and "all emotions vary in their degree of similarity to one another" (Plutchik, 1980). For example, shame and guild are more similar, in comparison with happiness and disgust. Another important aspect concerning the representation of emotions is that they vary in the intensity. For example, there is difference in the intensity between fear and panic. Considering the intensity as a separate dimension, the emotional space is regarded as a three-dimensional.

A lot of words are used in every language to denote various emotional states. Some of them belong to the subjective language, others to the language of behaviour or to the functional language. For example, fear and anger in the subjective language, correspond to escape and attack in the language of behaviour and to protection and destruction in the functional language. The words that are used in this experiment belong to the subjective language.

As an appropriate method for obtaining the organisation of the expected multidimensional space, multidimensional scaling is used. This method was applied to discover the structure of the cognitive space for terms about professions, sicknesses and colours (Gerganov, 1987).

This work describes an experiment for obtaining the model of the human memory for emotions. The approach is based on the evaluation of the semantic similarity of the concepts denoting emotions. The results might be useful for developing an agent architecture that can handle cognitive and emotional aspects of behaviour.

Model of the emotional space

In the experiment subjects are instructed to evaluate the semantic similarity of various words denoting emotions. Actually subjects define similarity relations between emotional concepts. The set of emotional concepts used in the experiment consists of primary and secondary emotions from the subjective language. This set together with the similarity relation forms an undirected graph

$$G_K=(T, S)$$

where T is the set of emotional concepts and S stands for the similarity relation between the emotional concepts defined as

$$S \subseteq T \times T.$$

The graph that represents the organisation of the emotional space is shown in Figure 2. This model

illustrates the structure created over the emotional concepts. Arcs denote that two concepts are related on the basis of their similarity.

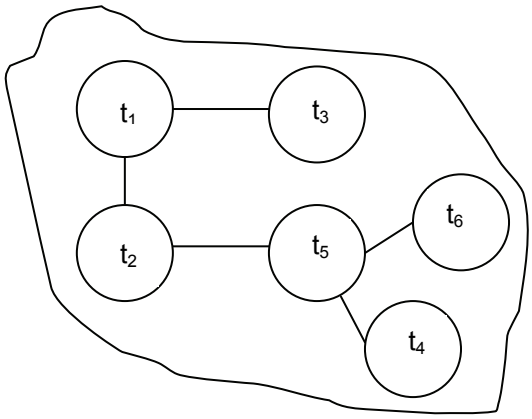

Figure 2. Graph representing the subject's organisation of the emotional space

Multidimensional scaling theory

Multidimensional scaling (Kruskal and Wish, 1978) theory postulates that judgements about the similarity of the members in a set of objects are done according to the integral feature, which can be decomposed to several primary features. Similar objects are represented in the space by two points located close together, and dissimilar objects by two points far apart. The space is usually a two- or three-dimensional Euclidean space but in some cases might have more dimensions. The distance between the points can be expressed through the projections on the axes, in the Euclidean metric,

$$d_{ij} = \sqrt{\sum_{m=1}^{n} (a_{im} - a_{jm})^2}$$

where dij is a distance between the points i and j, a_{im}, a_{jm} are projections of the points i and j on axis m, n is a number of axes or space dimensions.

When k objects are used in the experiment, there are $\frac{k(k-1)}{2}$ equations. Left parts of the equations are known distances, obtained through the method of one-dimensional scaling. The unknown parameters in this system of equations are a_{im} (i=1,2,....,k; m=1,2,...,n). Because the number of the axes n is smaller than the number of the objects, this system of equations can be easily solved.

Use of the Euclidean metric for the distances between the objects in the cognitive system is not always the best choice. Different formulas are proposed for different empirical data

$$d_{ij} = \begin{cases} \left[\sum_{m=1}^{n} |a_{im} - a_{jm}|^1\right]^{1/1} & \text{– city block metric} \\ \left[\sum_{m=1}^{n} |a_{im} - a_{jm}|^2\right]^{1/2} & \text{– Euclidean metric} \\ \left[\sum_{m=1}^{n} |a_{im} - a_{jm}|^l\right]^{1/l} & \text{– 1 metric of Minkowski} \end{cases}$$

where dij is a distance between the points i and j, a_{im}, a_{jm} are projections of the points i and j on axis m, n is a number of axes, l is an exponent that determines the kind of the metric.

Kruskal gives the criterion for determining the most adequate metric for certain empirical data. He proves that the following functional called stress, has a minimum for that value of l that is adequate metric for the empirical data:

$$S = \sqrt{\frac{\sum_{i<j} (d_{ij} - \hat{d}_{ij})^2}{\sum_{i<j} (d_{ij} - \bar{d})^2}}$$

where $\hat{d}_{ij}$ is a distance between the points i and j, obtained theoretically using suitable metric, dij is an empirical evaluation of the similarity between the objects i and j, $\bar{d}$ is a mean value of all the distances.

One variant of the multidimensional scaling is INDSCAL (individual multidimensional scaling). The idea in INDSCAL is that for different subjects, or under various perceptive conditions the axes of multidimensional space will have different weights. The formula for distances in INDSCAL is

$$d_{ij}^{(p)} = \left[\sum_{m=1}^{n} w_{pm} |a_{im} - a_{jm}|^l\right]^{1/l}$$

where $d_{ij}^{(p)}$ is the distance between the points i and j for a subject p or a condition p, a_{im}, a_{jm} are projections of the points i and j on axis m, w_{pm} is the weight of the axis m for a subject p or a condition p, n is a number of axes in the space, l is a kind of a metric.

The dyads that are used in the multidimensional scaling have to be scaled according to their semantic (dis)similarity.

Experiment

Multidimensional scaling method is used as a methodology for investigating how adults understand the relationship between various concepts of emotions.

Material

Primary emotions like fear, anger, happiness and sadness, as well as other more or less similar to them and some that represent variations in the intensity of the emotions, were used as a data set.

These emotions are not chosen according to any psychological theory. They are just a starting point for creating models of agents that display competent actions, goal-directed behaviour and appropriate emotions. Some of the emotions are caused by goal failure or success, like sadness and joy, and others are related to the attitude of another agent, as remorse and pride.

The twenty-six terms, shown in Figure 3 were written on a slip of paper.

1. fear
2. anger
3. greed
4. fury
5. regret
6. pity
7. anxiety
8. hate
9. respect
10. pride
11. gratification
12. happiness
13. disgust
14. resentment
15. remorse
16. grief
17. panic
18. jealousy
19. sadness
20. envy
21. expectation
22. sympathy
23. shame
24. pain
25. surprise
26. love

Figure 3. Emotions used in the experiment

Subjects

In the experiment 11 subjects were asked to participate and none used to have any mental diseases. The average age of the subjects was 34 years and varied in the range from 27 to 60 years.

Procedure

The slips of paper with 26 terms were given to all the subjects. They were instructed to read the terms that denote emotions carefully and to form groups from emotions they consider to be similar. Groups that consist of only one term were allowed as well as a group that contains all of the terms. Subjects were told that they might revise their solutions and might work as long as they want. They had to write the groups on the blank slips of paper.

Results

The free classification data were converted into the similarity matrix. The algorithm for converting the data obtained with a free classification method into a similarity matrix is given by Miller. The similarity matrix was processed using non-metric multidimensional scaling analyses (SYSTAT). The Euclidean model was used and two analyses were requested, the first with two and the second with three dimensions. Two-dimensional plot is presented in Figure 4. The model is built using the data given in Table 1.

Table 1. Coordinates for two-dimensional model

variable	dimension	
	1	2
1. fear	0.91	0.41
2. anger	-1.21	-0.68
3. greed	-1.32	0.27
4. fury	-0.29	-0.64
5. regret	0.26	-1.08
6. pity	1.05	-0.90
7. anxiety	0.89	-0.04
8. hate	-0.64	-0.50
9. respect	-0.03	1.17
10. pride	-0.50	0.73
11. gratification	-0.14	0.90
12. happiness	0.08	0.52
13. disgust	-0.58	-1.09
14. resentment	-0.63	-0.79
15. remorse	0.21	-0.80
16. grief	0.85	-0.14
17. panic	1.14	0.13
18. jealousy	-0.79	0.12
19. sadness	0.50	-0.18
20. envy	-1.54	0.14
21. expectation	0.35	0.21
22. sympathy	0.15	0.88
23. shame	-0.54	0.54
24. pain	1.32	-0.11
25. surprise	0.66	0.24
26. love	-0.16	0.69

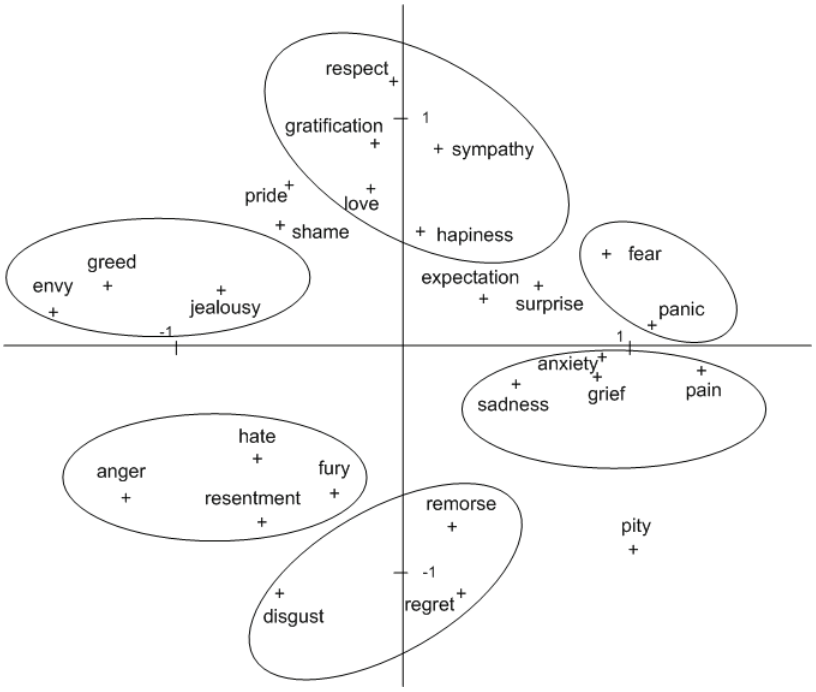

Figure 4 Two-dimensional plot based on the results of the multidimensional scaling

Discussion

The two-dimensional plot of the emotional space shown in Figure 4 supports the hypotheses for the polarity of the emotions. It presents an evidence that in the long-term memory emotions are organised according to the principle of polarity: happiness is against sadness, fear against anger and disgust against greed.

There are six groups of emotions clearly separated around the primary emotions: happiness, sadness, fear, anger, disgust and greed. These results differ from the model of Plutchik represented in Figure 1, where these six emotions together with expectation and surprise are regarded as primary and opposite emotions. Also, surprise is treated as more similar to fear and sadness, while anticipation is more similar to anger and joy.

The differences between obtained results and the Plutchik's model are probably due to using words for emotions that are not enough representative.

I expected that the three-dimensional plot will express the intensity differences. There are some variations in the third dimension, for instance between remorse and regret, between sympathy and love, etc. The intensity differences are slightly expressed and further investigations with more appropriately chosen terms could bring more evidence.

The results support the findings for the polarity of the primary and other emotions, as well as the circular structure of the emotional space in the long-term memory.

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