Application of Fuzzy Approach in Modeling of Psychodiagnostic Decision Support Systems for One Class of Tasks

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Abstract

The problem of decision making on the basis of production rules of fuzzy logic application application for a class of level gradations tasks which take place in psychological express diagnostics is considered. A mathematical model of estimating the indicators of the personality's psycosocial sphere on the basis of linguistic approximation using the compositional rule of fuzzy inference is offered. It allowed to formalize the procedure of making a diagnostic decision on the respondent's gradation level of the studied indicator and to obtain an effective tool for solving the tasks. A psychodiagnostic decision support system for the express diagnostics of the students' emotional state affected by cyberbullying has been developed. It's followed by structuring the obtained data of respondents according to the level of emotional response severity. Approbation of the model showed that fuzzy evaluation methods provide the possibility of rapid holistic assessment of the situation by a specialist and the variability of the obtained interpretation results.

Keywords [1]

fuzzy models, level gradation tasks, psychodiagnostic decision support systems (PDSS), psychological express diagnostics

1. Introduction

Nowadays a lot of attention is paid to the problems of computer decision support in the field of psychodiagnostic research. This is due to the dynamic growth of the complexity of diagnostic objects and the relevance of psychodiagnostic tasks in modern society. The active implementation of computer technologies, in particular Internet technologies, in the process of psychological research and processing results makes it possible to provide psychologists with qualitative psychodiagnostic tools. Moreover, in applied psychology there is a gradual transition of computer technologies from the auxiliary sphere to the sphere of work style of practical psychologists, which becomes especially relevant in the conditions of remote work.

The positive effects of the implementation of computer applications, in particular, web versions in psychological research are well-known and well-covered is scientific publications [1]:

1. Fast diagnostic results.
2. The expert (a psychologist who conducts the research) is released from the routine operations (instructions, presentation of the task, checking the accuracy of responses, keeping the research protocol, processing of the results.
3. Accuracy of results registration, absence of processing errors.
4. Efficiency of data processing.
5. Implementation of intelligent interface. Opportunity to receive in the dialogue various explanations, recommendations on carrying out the procedure, the substantiated psychodiagnostic conclusion in the expanded form.

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To ensure the effects 1-4 the formalized model of the survey procedure is sufficient, and such a type of web applications is mainly presented in the Internet space.

Due to the issues of formalization of expert assessment which is determined by many factors, in particular, experience and knowledge in the problem area, intrinsic motivation, etc., there are difficulties in mathematical modeling of the intelligent interface [2]. The limitation of traditional mathematical methods is that they do not allow to describe the causal relationship between the indicators of the psychological-social sphere and the decision on the presence and intensity of the studied indicator in the natural language, which represents the logic of a specialist in psychodiagnostics.

To delegate, at least partly, the competence of a psychologist-researcher in decision making on the assessment of the developmental level of indicators of the studied personality's psychosocial sphere, it is necessary for the intellectual system to build an acceptable model of the psychodiagnostic decision-making process. Numerous studies by foreign and national researchers in the field of computer psychodiagnostics show that the most successful and perspective is the use of fuzzy models build using fuzzy Zade sets [3,4,5]. After extensive scientific discussions in the 80s-90s of the last century fuzzy sets acquired a certain degree of legitimacy in psychology. It was facilitated by such scientists as Averkin A.N., Tarasov V.B., 1987; Prior P., Hesketh B., 1988 and Smithson M., 1999. It should be mentioned that the Ukrainian segment of this area is underrepresented and needs further in-depth study.

The purpose of the research is to study the possibilities of using a fuzzy approach to assess the indicators of the psychosocial sphere in modelling psychodiagnostic decision support systems.

2. Tasks of constructing level gradations in the process of making psychodiagnostic decisions

One of the important classes of tasks of psychodiagnostic examination which requires the use of mathematical methods are the tasks of constructing level gradations. In such tasks there is a need to assess individual indicators of the psychosocial sphere of the subjects and, if necessary, to integrate them into a united indicator in order to assign the appropriate level. Applied tasks of this class arise:

- in situations of determination of school maturity level and a child's psychological readiness for school;
- to study frustration reactions in situations of real or imaginary insurmountable obstacles;
- to determine the value-oriented unity of the group and the developmental level of interpersonal relations;
- to conduct psychological express-diagnostics of cyberbullying to indentify the level gradations of the victims.

Problem statement

According to the results of the respondent's personal date measuring a number of PSS indicators, it's necessary to assign the respondent the appropriate level (rank, gradation) from the category accepted in this structure.

Procedures

Solving the problem we need to highlight several procedures which should be formalized:

1. Procedure of measuring indicators and their quantitative presentation. Ordinal scales are used more often to measure PSS indicators, thus scale gradations can be interpreted as grades. Questionnaire items are closed questions. Respondents are asked to rate in linguistic terms the degree of agreement with judgements, for example, “agree”, “rather agree”, “rather disagree”, “disagree”. The assessment of the intensity of psychic features and reactions can also be measured with the help of responses to the closed questions, for example, “indifferent”, “insignificant”, “significant”, “strong”, “very strong”. Quite typical situation is the necessity of assessment of heterogeneous indicators which are evaluated in different ordinal scales and their subsequent integration into a united indicator in order to assign the appropriate level. Nevertheless, it's incorrect to apply the algebraic addition to the data obtained in the ranking scales, which complicates the process of formalizing the task and, consequently, the development of the model of psychodiagnostic decisions support system (PDSS).

2. Procedures of data processing, interpretation of the obtained results and formulation of psychodiagnostic conclusions. PSS indicators obtained as a result of questionnaires and computer diagnostics are quite often interpreted by a specialist in the natural language, in terms of psycholinguistic scale: “low”, “significant”, “medium”, “high”. So a psychologist usually evaluates PSS indicators generally through his experience, determines the level of PSS indicators and draws psychodiagnostic conclusions. In this case, the fewer gradations on the psycholinguistic scale are, the potentially greater impact the subjectivity of the researcher’s personality has on the assessment of PSS indicators. Thus, there is a problem of “gray areas” of the representation of “quantitative” indicators of the measured indicators intensity in the “qualitative” indicator of the corresponding level gradation. Such uncertainty is not probabilistic but “fuzzy” in nature, so the description of such information in the language of traditional mathematics makes the model of the real system inaccurate and ambiguous. At the same time, the subject’s bias in answering any type of the questionnaire cannot be ignored. Therefore, the data obtained through the questionnaire are inaccurate, as respondents’ raw data contain hidden uncertainties.

Today, the number of studies in the field of mathematical psychology, in particular, methods of analysis and data processing, is growing, and there is a tendency to use fuzzy logic apparatus to model measurement procedures [5,6,7], in particular, in fuzzy rating scales [8,9]. The potential application of the apparatus of fuzzy sets to the tasks of expert evaluation, which also include the tasks of psychodiagnostics, has been studied by well-known national and foreign scientists [4,7,10]. Actual information on the current state of theoretical and empirical developments in the field of fuzzy sets in psychology is published periodically in the reference edition of the Europian Association of Psychologists «Advances in psychology” in the series “Fuzzy Sets in Psychology” [11]. The effectiveness of fuzzy logic is explained by the fact that it provides a mechanism for dividing fuzzy information into structural parts and allows calculations that operate with the terms of the natural language.

2.1. Types of membership functions for the representation of the linguistic terms

As a result of testing and computer diagnostics, the obtained data on the level of severity of PSS indicators in the vast minority of cases are interpreted in terms of a linguistic scale T={L(“Low), A(“Average), H(“High”)}, where each term is fuzzy concept, therefore to formalize this process it is the most appropriate is to use the fuzzy logic apparatus and fuzzy sets theory. Fuzzy logic operates with approximate concepts which makes it similar to human reasoning.

Membership function represents the degree of truth in fuzzy logic with a range covering the interval [0,1]. In practice it is convenient to use membership functions that allow analytical representation in the form of some simple mathematical function.

Let $x_1, x_2, .., x_n$ be the variables of the subject area under study (indicators).

Let *X* be the domain of the variable x_i, $i = \overline{1, n}$. Typically, *X* is a range of scores designed for measuring the intensity of indicators development in a study.

The fuzzy concepts of the linguistic scale *T* “Low” (L) та “High” (H) can be represented Z-shape and S-shape membership functions which are generally described by analytical expression (1):

$$\mu(x_i) = \frac{1}{1 + e^{-a(x_i - b)}}, \qquad (1)$$

where a,b, a<b – numeric parameters that characterize the tolerance interval and steepness of the function. Here, in the case a>0 S-shape membership function can be obtained, and in the case a<0 - Z-shape function. The values of parameters a and b are selected by experts in accordance with the preferences of a psychologist who conducts the assessment.

Z-shape membership function is used to represent such fuzzy sets that are characterized by uncertainty of the type: “low level”, “insignificant”, “small value”. Figure 1 shows a graph of the membership function $\mu_L(x_i)$ for the fuzzy set “Low” and the universal set X=[0,10] for the values of the parameters a=-2, b=4

Figure 1: Example of Z-shape membership function

S-shape membership function is used to represent such fuzzy sets which are characterized by uncertainty of the type: "high level", "significant value", "large value". Figure 2 shows a graph of the membership function $\mu_H(x_i)$ for the fuzzy set "High" for the values of the parameters a=4, b=6

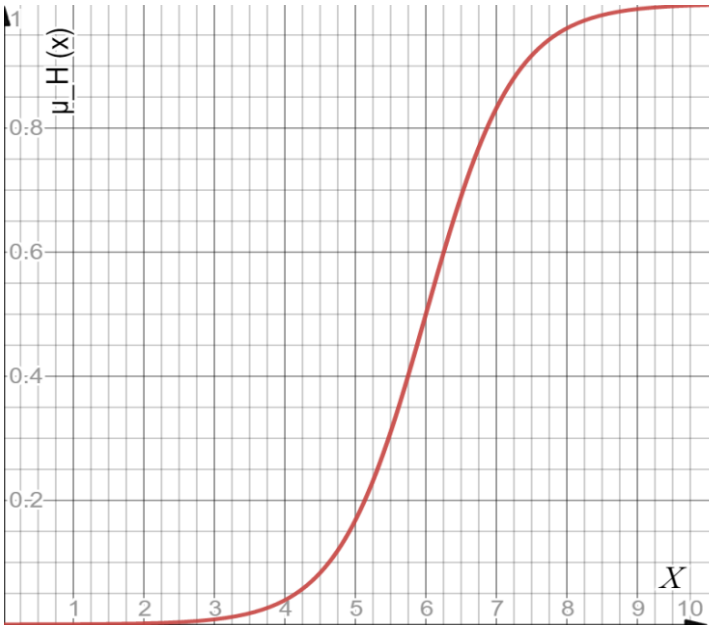


Figure 2: Example of S-shape membership function

Various utility functions can be used for approximation of the fuzzy term "Average" (A): triangular fuzzy membership functions (2), trapezoidal membership functions (3) and Π-shape membership functions,

$$\mu_A(x_i) = \begin{Bmatrix} 0, & x_i \le a \\ \frac{x_i - a}{b - a}, & a \le x_i \le b \\ \frac{c - x_i}{c - b}, & b \le c \le x_i \\ 0, & c \le x_i \end{Bmatrix}, \quad (2)$$

where a,b, c are some numeric parameters, a and c characterize the base of the triangle, b is its vertex and $a \leq b \leq c$.

Sometimes it is more convenient to use the trapezoidal function function of the form:

$$\mu_A(x_i) = \begin{cases} 0, & x_i \leq a \\ \frac{x_i - a}{b - a}, & a \leq x_i \leq b \\ 1, & b \leq x_i \leq c \\ \frac{d - x_i}{d - c}, & c \leq x_i \leq d \\ 0, & d \leq x_i \end{cases}, \quad (3)$$

where a,b,c, are some numeric parameters, a and d characterize the lower base of the trapezoid, and the parameters b and c are its vertex, $a \leq b \leq c \leq d$.

Figure 3 showed the corresponding graphs of membership functions $\mu_A(x_i)$ for the fuzzy set "Average".

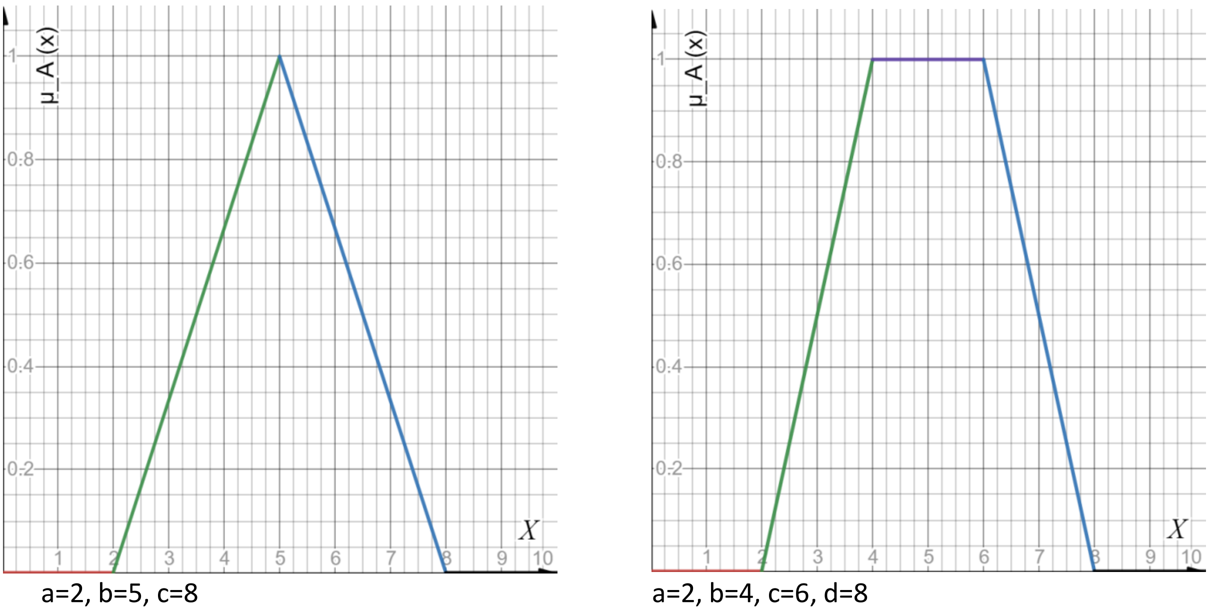


Figure 3: Examples of triangular (on the left) and trapezoidal (on the right) membership functions

It should be mentioned that the parameters of the relevant membership functions are determined by the experts and are adapted by means of a training sample in the process of implementation.

The wide distribution of membership functions (1) - (3) is caused by their ease of perception and simplicity of their practical application in computational procedures.

2.2. Fuzzy model of PDSS for the problem of constructing level gradations

To make decision on the gradation level of the studied indicator it is offered to build an appropriate mathematical model based on linguistic approximation using the rules of fuzzy logic conclusion.

Let's introduce the necessary formalizations.

Let, y – output variable (level of the studied concept), $x_1, x_2, .., x_n$ – input variables (partial PSS indicators which make up the integral concept).

We consider known:

1. the set of inputs (partial indicators of PSS $x_1, x_2, .., x_n$, $i = \overline{1, n}$, which are usually measured in grades and affect the decision on the level of gradation;

2. sets of terms for qualitative evaluation x_i, $i = \overline{1,n}$ from the corresponding linguistic scale $T_{x_i} = \left\{T_{x_i}^1, T_{x_i}^2, \dots, T_{x_i}^{m_{x_i}}\right\}$, where m_{x_i} is the number of linguistic variables on the scale for input x_i, which is usually equal for all inputs;

3. membership functions which allow to represent qualitative terms T_{x_i} for inputs x_i, $i = \overline{1,n}$ in the form of fuzzy sets. The membership functions of the form (1) - (3) are usually used taking into account the simplicity of construction.

4. The set of solutions (the term set of the variable *y*) in the subject area under consideration, $T_y = \left\{T_y^1, T_y^2, \dots, T_y^{m_y}\right\}$, where m_y is the number of linguistic variables in the scale for output *y*.

Then the structural identification of the model is carried out by forming a fuzzy knowledge base. The results of the so-called virtual (imaginary) experiment are entered in the database in the process of which the expert answers the questions: what is the linguistic estimate of the initial indicator *y* with a given combination of linguistic estimates of indicators x_i, $i = \overline{1,n}$.

The set of fuzzy productional rules $Rules = \{Rule_j\}$, $j = \overline{1,r}$ for the given knowledge base has the form [12]:

$$Rule_j = "if\ x_1\ is\ T_{x_1}^{any}\ and\ x_2\ is\ T_{x_2}^{any} \dots and\ x_n\ is\ T_{x_n}^{any}, then\ y^j\ is\ T_y^{any}" \qquad (4)$$

The application of rules of form (4) in PDSS allows a fixed set of qualitative estimates of partial PSS indicators $\{T_{x_i}\}$, $i = \overline{1,n}$ of a particular respondent to match the decision T_y on the level of the studied concept.

The development of the psychodiagnostic decision support system based on the usage of a fuzzy model will allow a psychologist to obtain the appropriate computer tools, in particular, to solve the problems of psychological express diagnostics.

2.3. Development of PDSS on assessing the personality's emotional state in a cyberbullying situation: results and discussion

A virtual platform "Psychological Laboratory" (https://www.cuspu.edu.ua/ua/kafedra-praktychnoi-psykholohii/virtualna-psykholohichna-laboratoriia) has been created in Volodymyr Vynnychenko Central State Pedagogical University on the basis of the departments of Practical Psychology and Informatics and IT. One of its directions is conducting cyberbullying research among students. The main objectives are to determine the number of people who suffered and to identify the level of their emotional response and necessity to carry out counselling work. Methods of psychological express diagnostics are used to conduct the research [13].

The purpose of psychological express diagnostics is to cover the required range of respondents quickly and to process the results with minimum time consumption. Students surveys are conducted using Google Forms and providing general statistics and possibility to save a database of respondents in Google Sheets.

Nevertheless, in order to obtain the necessary information about the respondent's level of suffering from cyberbullying, to assess the level of criticality of the victims' emotional state, to separate "risk groups" for further counselling, it's not enough to use possibilities of Google Forms.

Therefore, to highlight the level gradations of criticality of the individual's emotional state in the situation of cyberbullying the psychodiagnostic decision support system was developed in collaboration with psychologists and computer science specialists to assess the emotional state of the individual by means of python language.

The development of PDSS was carried out in several stages:

1. **Determination of system of indicators (input parameters of the model)** to assess the emotional state of individuals who suffered from cyberbullying. Questionnaire questions are formulated for each indicator. Extreme polar terms (min–max) are set to represent the degree of indicator's severity. Levels for assessing their manifestation are determined in the form of a corresponding term set. Table 1 shows the input parameters of the model

Table 1
Input parameters of the model

Indicator	Questionnaire questions	The indicator severity (min–max)	Level of manifestation
x_1	Have you ever been a victim of cyberbullying?	Never…Very often	{Low,Average,High}
x_2	Indicate the degree of your emotional experience under stress in cyberbullying situations	Indifferent..Intolerable	{Low,Average,High}
x_3	How long was the humiliation in personal messages?	Situational (1-2 times).. Regular	{Low,Average,High}
x_4	How real was the threat in your opinion?	Unlikely..Absolutely real	{Low,Average,High}
x_5	Have you ever thought of suicide experiencing cyberbullying?	Never..Constantly	{Low,Average,High}
x_6	It is recommended to seek guidance from a psychologist in the situation of cyberbullying	Absolutely disagree.. Absolutely agree	{Low,Average,High}

Thus, to estimate the levels of indicators manifestation $x_1,.,x_6$ the only scale of linguistic terms is used $T_{x_i} = \{L(\text{“}Low\text{”}), A(\text{“}Average\text{”}), H(\text{“}High\text{”})\}$.

2. **Development of scales of indicators measuring and procedures for assessing their level.**

A geometric approach to obtaining qualitative fuzzy estimates from respondents on a continuous numeric segment with their subsequent phasing into fuzzy sets proved to be expedient [12]. Respondents were asked to give answers in a sliding grade scale from 0 to 9. The rating is ranked this way on a numeric interval [min, max]. To approximate the indicators values $x_1,.,x_6$ into fuzzy sets T_{x_i}, $T_{x_i} \in \{L, A, H\}$, the membership functions of the form (1) - (3) are used. To represent polar terms “Low” and “High” Z-shape and S-shape spline-functions were used accordingly . Trapezoidal membership function was used to represent the term “Average”. Figure 4 shows corresponding terms.

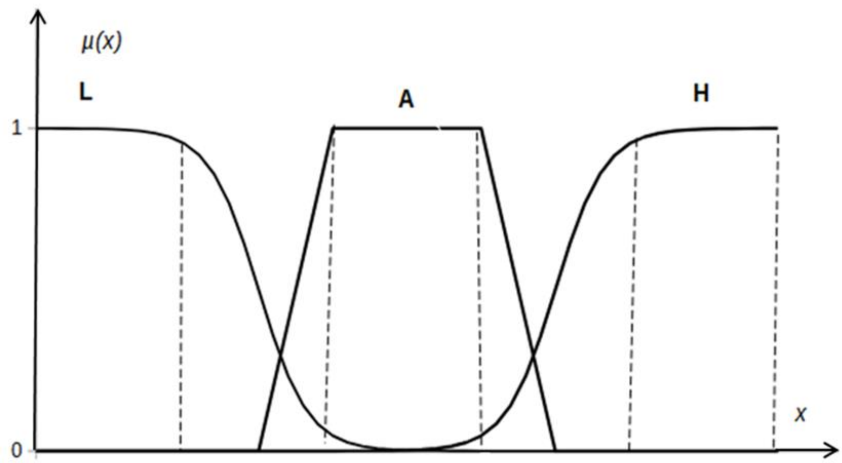


Figure 4: Membership functions for fuzzy terms {L, A, H}

Parameters a, b, c, d were selected by experts in collaboration with a psychologist to clarify the specific type of functions (1) - (3). After calculations according to the analytical expressions of the corresponding membership functions the level of indicator manifestation x_i, $i = \overline{1,6}$ is defined as a term with the maximum membership function $\max \mu_{T_{xi}}(x_i)$, $T_{x_i} \in \{L, A, H\}$.

3. **Construction of a knowledge matrix** that connects the linguistic assessments T_{x_i}, the input indicators of the psycho-social sphere of subjects, who suffered from cyberbullying, and the output assessment of their emotional state *y*. The output assessment is interpreted as the level of suppression of the individual's emotional sphere due to cyberbullying and is represented by a term set $T_y = \{L(\text{"}Low\text{"}), A(\text{"}Average\text{"}), H(\text{"}High\text{"}), VH(\text{"}Very\ High\text{"})\}$.

The formation of the base of psychodiagnostic knowledge took place in the process of explaining the interpretive schemes of the expert-psychologist by constructing production rules of the form (4). Table 2 shows the corresponding knowledge matrix.

Table 2

Knowledge matrix for input indicators $x_1,..,x_6$ and output levels y

x_1	x_2	x_3	x_4	x_5	x_6	Y
L	L	L	L	L	L	
L	A	L	A	L	L	
L	L	A	L	A	L	**L**
L	L	L	A	L	L	
L	A	L	L	A	L	
L	A	L	A	L	L	
A	A	L	A	A	A	
A	H	A	H	A	A	
A	A	A	A	H	A	**A**
A	A	A	H	A	A	
A	H	A	A	H	A	
A	H	A	H	A	A	
A	H	A	A	H	H	
A	A	H	H	H	A	**H**
H	H	A	A	A	H	
H	A	H	A	H	A	
H	A	H	H	A	H	**VH**
H	H	H	H	H	H	

4. **Obtaining a logical conclusion and interpretation of the results.**

A fuzzy logical inference is implemented, ranging from logical statements (Table 2) to fuzzy logic equations. Such equations are derived from the knowledge base by replacing the linguistic terms to the membership function, and the operations "and" and "or" to the operation of finding the minimum (⋀) and the maximum (⋁). The system of fuzzy logic equations has the form:

$$\begin{aligned}
\mu_L(y) = {} & \mu_L(x_1)\cdot\mu_L(x_2)\cdot\mu_L(x_3)\cdot\mu_L(x_4)\cdot\mu_L(x_5)\cdot\mu_L(x_6) \vee \\
& \mu_L(x_1)\cdot\mu_A(x_2)\cdot\mu_L(x_3)\cdot\mu_A(x_4)\cdot\mu_L(x_5)\cdot\mu_L(x_6) \vee \\
& \mu_L(x_1)\cdot\mu_L(x_2)\cdot\mu_A(x_3)\cdot\mu_L(x_4)\cdot\mu_A(x_5)\cdot\mu_L(x_6) \vee \\
& \mu_L(x_1)\cdot\mu_L(x_2)\cdot\mu_L(x_3)\cdot\mu_A(x_4)\cdot\mu_L(x_5)\cdot\mu_L(x_6) \vee \\
& \mu_L(x_1)\cdot\mu_A(x_2)\cdot\mu_L(x_3)\cdot\mu_L(x_4)\cdot\mu_A(x_5)\cdot\mu_L(x_6) \vee \\
& \mu_L(x_1)\cdot\mu_A(x_2)\cdot\mu_L(x_3)\cdot\mu_A(x_4)\cdot\mu_L(x_5)\cdot\mu_L(x_6) \\
\mu_A(y) = {} & \mu_A(x_1)\cdot\mu_A(x_2)\cdot\mu_L(x_3)\cdot\mu_A(x_4)\cdot\mu_A(x_5)\cdot\mu_A(x_6) \vee \\
& \mu_A(x_1)\cdot\mu_H(x_2)\cdot\mu_A(x_3)\cdot\mu_H(x_4)\cdot\mu_A(x_5)\cdot\mu_A(x_6) \vee \\
& \mu_A(x_1)\cdot\mu_A(x_2)\cdot\mu_A(x_3)\cdot\mu_A(x_4)\cdot\mu_H(x_5)\cdot\mu_A(x_6) \vee \\
& \mu_A(x_1)\cdot\mu_A(x_2)\cdot\mu_A(x_3)\cdot\mu_H(x_4)\cdot\mu_A(x_5)\cdot\mu_A(x_6) \vee
\end{aligned}$$

$$\mu_H(y) = \begin{matrix} \mu_A(x_1)\cdot\mu_H(x_2)\cdot\mu_A(x_3)\cdot\mu_A(x_4)\cdot\mu_H(x_5)\cdot\mu_A(x_6) \vee \\ \mu_A(x_1)\cdot\mu_H(x_2)\cdot\mu_A(x_3)\cdot\mu_H(x_4)\cdot\mu_A(x_5)\cdot\mu_A(x_6) \\ \mu_A(x_1)\cdot\mu_H(x_2)\cdot\mu_A(x_3)\cdot\mu_H(x_4)\cdot\mu_A(x_5)\cdot\mu_H(x_6) \vee \\ \mu_A(x_1)\cdot\mu_A(x_2)\cdot\mu_H(x_3)\cdot\mu_H(x_4)\cdot\mu_H(x_5)\cdot\mu_A(x_6) \vee \\ \mu_H(x_1)\cdot\mu_H(x_2)\cdot\mu_A(x_3)\cdot\mu_A(x_4)\cdot\mu_A(x_5)\cdot\mu_H(x_6) \vee \\ \mu_H(x_1)\cdot\mu_A(x_2)\cdot\mu_H(x_3)\cdot\mu_A(x_4)\cdot\mu_H(x_5)\cdot\mu_A(x_6) \end{matrix}$$

$$\mu_{VH}(y) = \begin{matrix} \mu_H(x_1)\cdot\mu_A(x_2)\cdot\mu_H(x_3)\cdot\mu_H(x_4)\cdot\mu_A(x_5)\cdot\mu_H(x_6) \vee \\ \mu_H(x_1)\cdot\mu_H(x_2)\cdot\mu_H(x_3)\cdot\mu_H(x_4)\cdot\mu_H(x_5)\cdot\mu_H(x_6) \end{matrix}$$

The last step is to obtain the result in the form of assigning the output indicator Y level R, for which the membership function acquires the maximum value

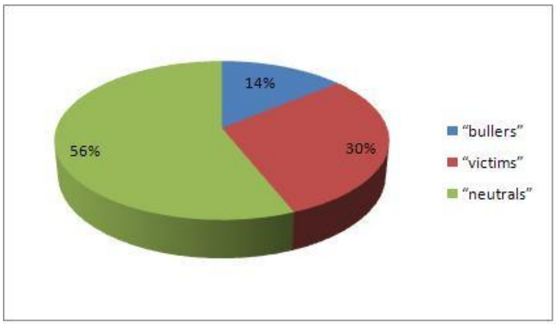
$$\mu_R = max\{\mu_L(y), \mu_A(y), \mu_H(y), \mu_{VH}(y)\},$$

The authors propose the following interpretation of the levels using appropriate color formatting for clarity:

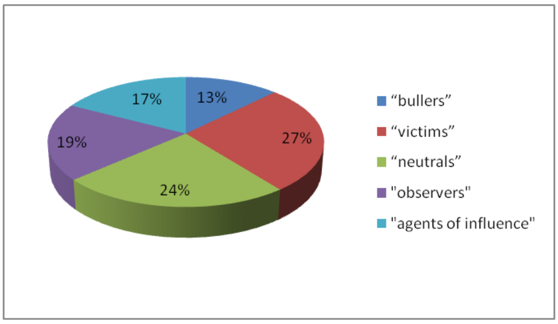
- L – low level of emotional response which does not require psychological counseling. Color is green.
- A – average level which indicates the presence of an emotional response but does not require special professional intervention. Color is yellow.
- H – high level which confirms the presence of a frustrating state and deep emotional feelings. Color is orange.
- VH – critical level that demands immediate response and psychological support. Color is red.

That is, the researcher-psychologist has a table with respondents' personal data, in which respondents with a critical suffering level are highlighted in red, with average level in yellow, with low level in green. So PDSS provides a psychologist with respondents' data obtained on the basis of questionnaires and already structured by levels. Visualization of the proceeded data gives a general statistical picture and level gradation of the presence and intensity of the problem for each individual respondent. Level gradation gives an opportunity to quickly navigate the database choosing the target audience for educational and psychological support.

The diagnostic study of cyberbullying has been conducted with a training sample of students for three years. The use of a fuzzy model contributed to the identification of the latent groups studied. Participants of the first group possess aggressive characteristics and might pose a potential threat in bully situations. Participants of the second group witnessed situations of cyberbullying but had no experience of victim behavior. The diagrams (Figure 5) show the data obtained as a result of a classical diagnostic research (on the left) and using the described fuzzy model (on the right).



Classical model research



Fuzzy model research

Figure 5: Results of panel research on the training sample of students

2.4. Conclusions

Methodological aspects of using a fuzzy approach to formalize expert assessment in psychodiagnostic procedures are analyzed. The expediency of using membership functions to present the obtained data on the intensity of the studied indicators in psycholinguistic scales is determined.

A model of psychodiagnostic decision support systems on the basis of linguistic approximation of numerically obtained indicators and their interpretation using the compositional rules of fuzzy inference is proposed. The model and functions of fuzzy psychodiagnostic decision systems for the study of the emotional state of students affected by cyberbullying are described.

Approbation of the developed PDSS proved the expediency of its use as an effective tool for fast and high-quality data preparation for researchers.

Prospects for further research are the development of fuzzy models of PDSS in the active collaboration of practicing psychologists and computer technology specialists.

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