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Application of Fuzzy System in Psychological Tests: Optimize the Number of Questions for WHOQOL-BREF

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The WHOQOL-BREF is one of the best known questionnaires for measuring the quality of life. It is currently available in more than 40 languages and has been used frequently in cross-cultural comparison studies on subjective well-being and quality of life studies. Some research shows that due to certaincultural biases Iranian respondentshave no tendency or willingness to responding some questions, more specially, question 21, in WHOQOL-BREF. The main aim of the current research was to use the ability and flexibility of fuzzy systems to analyse the WHOQOL-BREF questions to reduce some unclear or doubtful questions. A fuzzy system model proposes to diminish the errors that produce ambiguous concepts by not responding to certain biased questions.The *WHOQOL-BREE*questionnaire was analyzed and both the traditional model and the fuzzy model analyses were compared for results using fuzzy systems.As a result, question 21 was removed from the WHOQOL-BREF questionnaire used by the fuzzy system.

Keyword: WHOQOL-BREF, psychological test, fuzzy system, Wang & Mandel method, Quality Of Life, Cultural Bias

The theoretical definitions of the “quality of life” and some related concepts such as “well–being”, “ happiness”, “ life satisfaction” and “good life” have preoccupied a wide range of

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disciplines, dating as far back asAristotle (384-19 BC) and early Greek philosophy (Bowling, 2001). Aristotle, using the Greek *eudaimonia* (a concept which for Aristotle meant having an understanding of the best way to live one's life), whichis commonly translated as 'happiness', affirms that the quality of life is highly relative: it means different things to different people, and conditions for happiness vary according to a person's current condition. Happiness for Aristotle was the product of activities directed towards clearly defined goals which inform our whole life rather than being simply short-term (Chang, Killingworth, & Noaln., 1997).

Self-report rating scales are one of the most common methods to assess overall SWB. Sandvik, Diener, and Seidlitz (1993) suggest that standard self-report measures of SWB are adequate for most research as there is "a unitary core of experience for well-being, which self-reports reflect to a great extent. Thus, researchers using standard well-being scales can generally expect to obtain meaningful, interpretable information from these scales under ordinary conditions" (p.337). This is partly attributable to the moderate stability of SWB across situations and over the life span (Diener & Lucas, 2000). For example, SWB has been found to correlate 0.85 over a four-year period (Diener, Suh, & Oishi, 1997).

According to Andrich (1978) and Guilford (1954), there are four main reasons for the frequent use of the rating scale method of measurement:

1. Rating scales are relatively easy for researchers to construct and use compared with other scale formats.
2. They provide the respondent with a limited number of response options, facilitating data registration for both the subject and the researcher.
3. The numbering continuum provides respondents with a

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ruler upon which they can mentally gauge the intensity and/or direction of their reactions to a statement.

4. Accuracy and reliability of one's ability to communicate mental maps increase with experience in using mental rulers. Also, conceivably, the repeated use of similar formats increases the accuracy and reliability of the measurement process. One internalized ruler can be used to measure directions and intensities across a variety of sentiments.

There are four major methods for constructing rating scales: Thurstone type or equal-appearing interval scales (Thurstone & Chave, 1929), Guttman type or cumulative scales (Guttman, *1950)*,Semantic differential scales (Osgood, Suci & Tannenbaum, *1957)*, and Likert-type orsummated rating scales (Likert, 1932).

The Likert-type rating scale was recently proclaimed to be one of the most important tools in attitude and survey measurement (Bergstrom & lunz, 1998).The use of this measuring device in psychological and educational settings is virtually universal. Attitudinal data in marketing and public opinion research and many types of organizational surveys rely heavily on the rating scale method of measurement (Green & Rao, 1970). On a Likert or Likert-type scale generally associated with the work of Likert (1932), respondents are presented with a series of statements and they are asked to indicate their degree of agreement (or disagreement) with each item. Responses are usually made on a *5*- or 7-point scale, with response categories ranging from "strongly agree" to "strongly disagree", or other scale point labels referring to frequency or quality. All items are considered to be of equal value, and response to an item is weighed to reflect the degree of agreement or disagreement. The scale score may be either the total number of points (over all items) or the average of all the item scores. Since the total scale

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score is obtained by adding the scores from individual items, a Likert scale is also referred to as a summative scale.

In light of the extensive use of rating scales, it would be also useful to have a clear understanding of how to optimize reliability and validity through use of the scale. The number of rating points used on the "ruler" can vary from 2 to 100 or more. There is a general consensus that the optimal number is from 5 to 7 points. However, the specific number of points eludes researchers. Whether to use an even or odd number of categories is another source of debate among practitioners (e.g., Gable & Wolf, 1993). Cox (1980; p.408) provides the following definition of the optimal number of rating points: "At a general level, a scale with the optimal number of response alternatives is refined enough to be capable of transmitting most of the information available from respondents without being so refined that it simply encourages response error. At that optimal number, the ratio of meaningful or systematic variation on total variation is maximized. At an operational level, the optimal number depends on the purpose of the scale and, thus, the nature of its systematic variation."

The WHOQOL-BREF is one of the best known instruments that has been developed for cross-cultural comparisons of quality of life and currently it is available in more than 40 languages. The WHOQOL-BREF is a modified version of The World Health Organization Quality of Life Instrument. The abbreviated version contains 26 questions divided into four domains. The WHOQOL-BREF has 26 items derived from the WHOQOL-100. The items are rated on a 5-point Likert scale. The four domain scores are scaled in a positive direction, with a score range of 0-20, and with higher scores denoting higher QOL. It also includes one facet ofoverall quality of life and general health. These items are scaled in a positive direction,

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with a score range of 1-5, and with higher scores denoting a better quality of life and general health.

(Fig. 1)

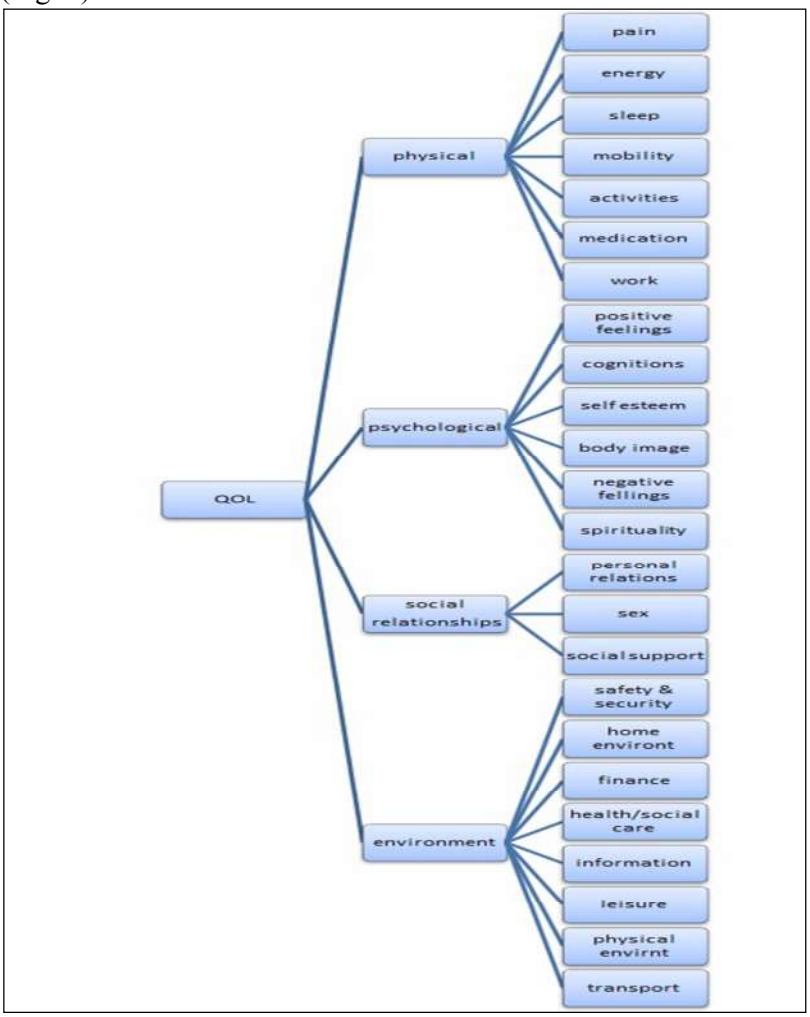


Figure 1
WHOQOL-BREF Questionnaire Chart

Cultural biases have been shown not to suffice to explain the major differences in SWB between countries (Veenhoven,

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1997), but they still pose a major problem to the international comparison of QOL data (Schimmack et al., 2002). Asians, for instance, usually have intermediate mean ratings, with a much narrower distribution than Westerners (Diener, Smith & Fujita., 1995). This phenomenon has been attributed to the cultural valuation of moderation (Diener et al., 1995). Another factor possibly contributing to the distinctive distribution of SWB among Asians is less individualism and the persistent closeness of family ties. Such ways of life are characterized by increased control, and thus tend to limit the impact of perturbations on SWB and they affect balance, whether by buffering negative events or by blunting positive affects.

According to their personality, living circumstances or culture, people may vary in response to questions concerning overall life (dis)satisfactions. Schwarz and Strack (1999) have identified several sources of bias in (conventional) self-reported global assessments of SWB. These include assimilation and contrast effects, when current feelings are coloured or discoloured by the past. Similarly, the mood of the day or events of the moment may distort responses. In addition, responses about well-being may be biased by social acceptability (Schwarz and Strack, 1999).

Iranian people don't have any tendency toward answering some questions, because the questions are related to their sexual relationships.

As the main aim of the current study, we were interested in using the ability and flexibility of fuzzy systems in order to eliminate some inappropriate questions from WHOQOL-BREF questionnaire. .A fuzzy system was designedto diminish the errors that causeambiguous concepts by not answering specific questions.

Question 21 was removed from thequestionnaire by using the

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fuzzy system.We aimed to calculate this question from the measure of the social relation dimension of the questionnaire (DOM-3) by removing this specificallyculturally biased question. (Fig 2)

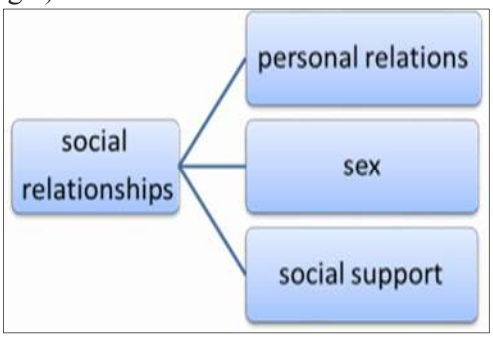


Figure 2
The Social Dimensionof **the WHOQOL-BREF Questionnaire Chart**

Fuzzy Systems and the Features:

The conclusions of psychological studies and educational sciences are based on uncertain data at this stage and they resulted in inaccurate fuzzy concepts (Zetenyi, 1998).

Fuzzy systems are the systems based on knowledge or rules; they are very suitable tools for the modeling of uncertainties and ambiguities on the basis of the Fuzzy Sets Theory (Wang, 1997).

A fuzzy inference system is a set of fuzzy input(s), fuzzy rules and fuzzy output(s) that can receive input data accurately and give the final output in the form of accurate numbers.

Inputs of the fuzzy inference system are the concepts that psychological and educational researches use to explain the output(s) (Smithson & Verkuilen, 2006).

The Deduction Process and Inference Process of the fuzzy system have five stages:

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Fuzzification, Application of Fuzzy Operators, Conclusion, Composition, and Defuzzification

1-Fuzzification

In this phase, we putaccurate data into the system and determine the measure of their attachment to fuzzy sets by membership functions. In fact, we measure the satisfaction of *(the IF) part* of the rule.

2- Application of Fuzzy Operators:

Where (*the IF) part* is made of some statements, we use the fuzzy operators to compose statements and determine the conclusion of (the IF) part of the rule.

3-Inference:

At this point, we define (*the THEN)* part on the base of (*the IF*) part. The input of inference is a number from the prior stage and the output is a fuzzy set. This step is applied once toeach rule.

4- Composition:

At this stage, we compose different outputs of rules to each other, (each of them is a fuzzy set) and it determines the overall space of the fuzzy system. This stage is used once for each output variable.

5- Defuzzification:

We estimate certainty from uncertainty at this stage. The input of the defuzzification stage is a composed fuzzy set and the outputof the defuzzification stage is an exact number. A fuzzy rule consists of a set of *(IF-THEN) fuzzy* rules. It is the heart of the system, because we use other implements of the system effectively to obtain the rules.

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To analyze the psychological and social phenomena is one of the most important abilities of the fuzzy system, the possibility of quantitative analysis based on fuzzy rules for data that are not exact (Smithson & Verkuilen, 2006).

In this research, we design an empirical and scientific rules based on the capabilities of thefuzzy system with the search table of (Wang & Mandel) input - output data which has three input parameters: personal relations relationships, sexual relationships, and social supports of the subjects.

We obtain these three input parameters on the basis of the measure of psychological tests (WHOQOL-BREF), and estimate the fuzzy output parameter from the view of social relationships, and then comparethis conclusion with the conclusion of the normal method.

Method

A sample of 130 voluntary participants including 30 Swedish residents, 30 Iranians living in Sweden, and 80 Iranians living in Iran were asked to fill out the WHOQOL-BREF questionnaire.

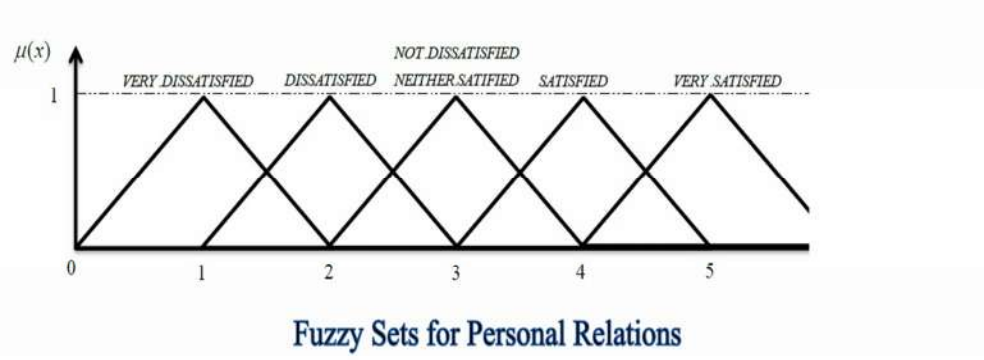
The MATLAB software was applied to design the fuzzy research system by (Wang – Mandel) input-outputsearch table.

We design fuzzy systems to analyze complex psychological tests by fuzzy (linguistic) rules and nervous networks, because of the fuzzy rules are an effective and convenient approach tothepairs of input-output data. The Wang-Mandel approach is composed offuzzy (linguistic) rules and the nervous networks in psychological tests and it makes an appropriate method fromthe pairs of input-output data. It has five basic steps (Wang, 1997).

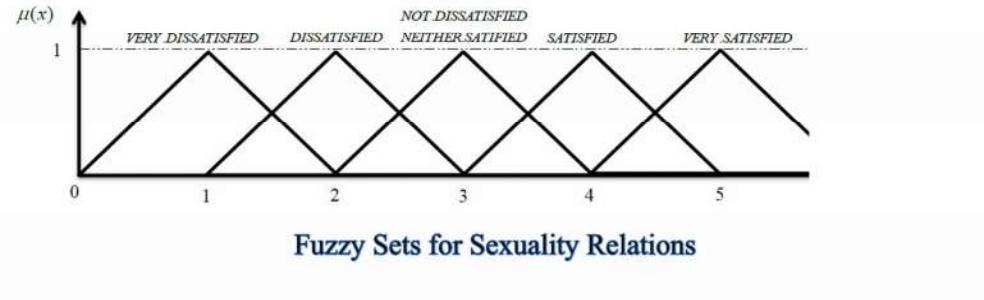
We design the fuzzy membership function of variables of personal relations relationships, sexualyrelationships, social supports of the subjects in terms of the WHOQOL-BREF questionnaire with 90 Swedes, Iranians living in Sweden, and

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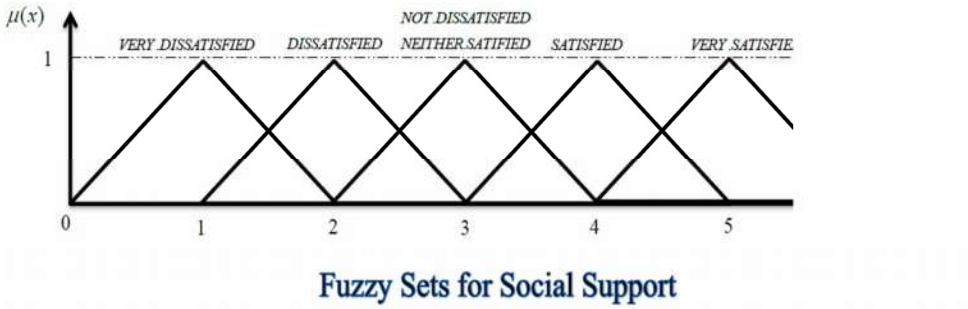
Iranians living in Iran, toestablish the questionnaire by fuzzy sets in the form below (fig 3)(Klir,& Yuan, 1995).



Fuzzy Sets for Personal Relations



Fuzzy Sets for Sexuality Relations



Fuzzy Sets for Social Support

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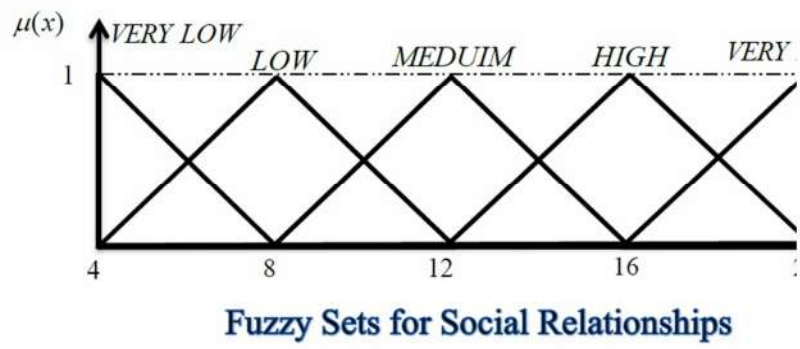


Figure 3

Membership Functions of Fuzzy Variables in the Domainof Social Relationships (Personal Relations, Sexualy Relations, Social Support)

Five basic steps of the Wang-Mendel method are (Wang, 1997):

1- to determine the input-output membership function and to determine membership degree of each data
2- To attain a rule for each pair of input - output data.
3- To determine a weight and a degree for each rule. We obtain the degree of each rule by determineof the membership degree of components and the membership degrees of the pairs of data.
4- To choose the rule that has the maximum degree, we obtain the number of fuzzy rules in return for the different reasonsAt this stage we might have similar introduction of (the IF) part and different conclusion of (the THEN) part, so we have a conflict. In this case, to resolve the conflict, we choose the rules that have the highest weight and degree.
5- To determine the measure of the output based on the pairs of input data related formulas (defuzzification formulas).

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RuleBases

We use the Wang & Mendel method to design the fuzzy systems of the research. We consider 37 rules for the fuzzy system; two of them are mentioned below:

1. *If* you are ***very satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***very satisfied*** with your social support, then your social relationship is ***very high*** (weight of rule is 1).
2. *If* you are ***very satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***very high*** (weight of rule is.66).
3. *If* you are ***satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***very satisfied*** with social support, then your social relationship is ***very high*** (weight of rule is.66).
4. *If* you are ***very satisfied*** with your personal relationships, and ***satisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
5. *If* you are ***satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
6. If you are ***very satisfied*** with your personal relationships, and ***very satisfied***with your sex relationships, and ***neither satisfied not dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is .66).
7. *If* you are ***satisfied*** with your personal relationships, and ***satisfied***with your sex relationships, and ***very satisfied*** with social support, then your social relationship is ***high*** (weight of

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rule is .66).

8. *If* you are***very satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***neither satisfied not dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is .66).
9. *If* you are ***very satisfied*** with your personal relationships, and ***satisfied*** with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is 1).
10. *If* you are ***satisfied*** with your personal relationships, and ***satisfied***with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is 1).
11. *If* you are ***satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is 1).
12. *If* you are ***very satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is 1).
13. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***satisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is 1).
14. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***very satisfied***with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is 1).
15. *If* you are ***satisfied*** with your personal relationships, and ***satisfied***with your sex relationships, and ***neither satisfied nordissatisfied*** with social support, then your social relationship

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is ***high*** (weight of rule is.66).

16. *If* you are ***satisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is .66).
17. *If* you are ***satisfied*** with your personal relationships, and ***very satisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
18. *If* you are ***very satisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
19. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***very satisfied***with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
20. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***satisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
21. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied***with your sex relationships, and ***very satisfied*** with social support, then your social relationship is ***high*** (weight of rule is.66).
22. *If* you are ***issatisfied*** with your personal relationships, and ***satisfied***with your sex relationships, and ***neither satisfied nor dissatisfied***with social support, then your social relationship is ***high*** (weight of rule is.66).
23. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***satisfied***with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your

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social relationship is ***medium*** (weight of rule is .66).

24. *If* you are ***satisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your social relationship is ***medium*** (weight of rule is .66).
25. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***medium*** (weight of rule is .66).
26. *If* you are ***satisfied*** with your personal relationships, and ***dissatisfied***with your sex relationships, and ***satisfied*** with social support, then your social relationship is ***medium*** (weight of rule is .66).
27. *If* you are ***satisfied*** with your personal relationships, and ***satisfied*** with your sex relationships, and ***very dissatisfied*** with social support, then your social relationship is ***medium*** (weight of rule is 1).
28. *If* you are***neither satisfied nor dissatisfied*** with your personal relationsrelationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***neither satisfied nor dissatisfied*** with social support, then your social relationship is ***medium*** (weight of rule is 1).
29. *If* you are ***satisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***medium*** (weight of rule is 1).
30. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***neither satisfied nor dissatisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***medium*** (weight of rule is .66).
31. *If* you are ***neither satisfied nor dissatisfied*** with your personal relationships, and ***dissatisfied*** with your sex relationships, and

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dissatisfied with social support, then your social relationship is ***low*** (weight of rule is.66).

32. *If* you are ***dissatisfied*** with your personal relationships, and ***dissatisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***low*** (weight of rule is 1).
33. *If* you are ***dissatisfied*** with your personal relationships, and ***very dissatisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***low*** (weight of rule is .66).
34. *If* you are ***very dissatisfied*** with your personal relationships, and***very dissatisfied*** with your sex relationships, and ***very dissatisfied*** with social support, then your social relationship is ***very low*** (weight of rule is 1).
35. *If* you are ***very dissatisfied*** with your personal relationships, and ***dissatisfied*** with your sex relationships, and ***very dissatisfied*** with social support, then your social relationship is ***very low*** (weight of rule is .66).
36. *If* you are ***very dissatisfied*** with your personal relationships, and ***very dissatisfied*** with your sex relationships, and ***dissatisfied*** with social support, then your social relationship is ***very low*** (weight of rule is .66).
37. *If* you are ***dissatisfied*** with your personal relationships, and ***very dissatisfied*** with your sex relationships, and***very dissatisfied*** with social support, and then your social relationship is ***very low*** (weight of rule is .66).

Inference

The true value of the hypothesis is one of the rules of calculation, and the true value of the conclusion is one of the applied rules. These conclusions are especially for the output variable of each rule in a fuzzy subset.The rule ofthe *MIN*

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Inference or rule of *Multiplication* Inference are often used as the Inference rule. In MIN Inference, membership function of the output is a section of height, we calculate it by the real degree of (the If) parts of the given rules (rule weight, α). In the Multiple Inference, we measure and calculate the membership function of output by the real degree of (the If) parts of rules.

Composition

There are some fuzzy subsets for each output variable; all of these variables composing together apply as a single fuzzy subset for each output variable. MAX or SUM isusually used for the Composition.In MAX Composition, we compose fuzzy subsets of outputs according to the reasonable maximum point which is made especially considering Inference rules of all fuzzy subsets.

In SUM Composition, we compose fuzzy subsets of outputs according to allof the reasonable points which aremade especially considering Inference rules of all fuzzy subsets.

DeFuzzifier

Sometimes it is useful to review fuzzy subsets which are the conclusion of the composition process, but sometimes is necessary changing the fuzzy measure to the more clear measure. The defuzzification process does this stage. Two of the most common techniques for the parameters are the *Center of Gravity* and *the Maximum Method.*In the Center of Gravity method, we calculate the clarityvalue of the output variable by finding the measure of the variable from the center of gravity of the membership function of the fuzzy value.

In the Maximum method, we calculate the clarityvalue of the output variable by finding the measure of a variable which has the fuzzy subsets with the maximum value of clarity.

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In this research, we use the product method for Inference, SUM method for composition, and the Center of Gravity method for DeFuzzifier.

Mathematical Calculation of Example

We design a fuzzy set in the fuzzy system, and we calculate the measure of the social relationships for this data: Q22=5 and Q20=2, so we have DOM-3=16.

$$fuzzy(y)=\begin{cases} 0.66(y-12)/4 & 12\le y\le 16 \\ -0.66(y-20)/4 & 16\le y\le 20 \\ 0 & otherwise \end{cases}$$

$$Area=\int f(y)dy=\frac{0.66}{4}\left[\int_{12}^{16}(y-12)dy-\int_{16}^{20}(y-20)dy\right]=2.64$$

$$Moment=\int yf(y)dy==\frac{0.66}{4}\left[\int_{12}^{16}(y^2-12y)dy-\int_{16}^{20}(y^2-20y)dy\right]=42.24$$

$$Centroid=\frac{Moment}{Area}=\frac{\int yf(y)dy}{\int f(y)dy}=\frac{42.24}{2.64}=16$$

We obtain similar conclusions for the other inputs with different outputs of the fuzzy sets [8].

4. Discussion and conclusions:

We demonstrate the obtained conclusions from raw scores with and without the fuzzy method (normal method) in Table 1:

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Table 1

Calculation Results areSocialRangeof 50 Subjects (Healthy and Sick) No Fuzzy Method (Conventional and the Questionnaire WHOQOL-BREF) and Using Fuzzy Techniques (Output Fuzzy System Design).

N	*Gensiat*	*Q20*	*Q21*	*Q22*	*Dom-3 (Social Relationships) Without Fuzzy*	*Dom-3 (Social Relationships) With Fuzzy*
1	2	5	5	5	20.00	18.70
2	1	5	5	4	18.67	18.60
3	1	4	5	4	17.33	16.00
4	2	5	5	3	17.33	16.00
5	1	4	4	5	17.33	13.90
6	2	5	5	3	17.33	16.00
7	1	5	4	4	17.33	16.00
8	1	4	5	4	17.33	16.00
9	2	5	3	5	17.33	16.00
10	1	4	5	4	17.33	16.00
11	2	4	5	4	17.33	16.00
12	1	4	4	5	17.33	13.90
13	1	4	5	3	16.00	16.00
14	1	5	5	2	16.00	16.00
15	2	3	4	5	16.00	16.00
16	2	4	5	3	16.00	16.00
17	1	4	4	4	16.00	16.00
18	2	4	5	3	16.00	16.00
19	2	3	5	4	16.00	16.00
20	1	4	3	4	14.67	16.00
21	2	4	4	3	14.67	16.00
22	2	4	5	2	14.67	16.00
23	1	4	4	3	14.67	16.00

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24	2	5	3	3	14.67	16.00
25	1	4	4	3	14.67	16.00
26	1	4	3	4	14.67	16.00
27	2	4	4	3	14.67	16.00
28	2	3	4	4	14.67	16.00
29	2	3	3	5	14.67	16.00
30	1	2	4	5	14.67	16.00
31	2	4	4	3	14.67	16.00
32	1	4	3	4	14.67	16.00
33	2	4	4	3	14.67	16.00
34	1	4	3	4	14.67	16.00
35	2	3	3	5	14.67	16.00
36	1	4	4	3	14.67	16.00
37	2	3	4	3	13.33	12.00
38	1	4	3	3	13.33	12.00
39	2	4	3	3	13.33	12.00
40	1	4	3	3	13.33	12.00
41	2	3	3	4	13.33	12.00
42	2	4	3	3	13.33	12.00
43	2	4	4	1	12.00	12.00
44	2	3	3	3	12.00	12.00
45	1	4	3	2	12.00	12.00
46	1	4	3	2	12.00	12.00
47	1	3	3	2	10.67	12.00
48	1	3	2	2	9.33	8.00
49	2	1	1	2	5.33	5.40
50	2	2	1	1	5.33	5.40

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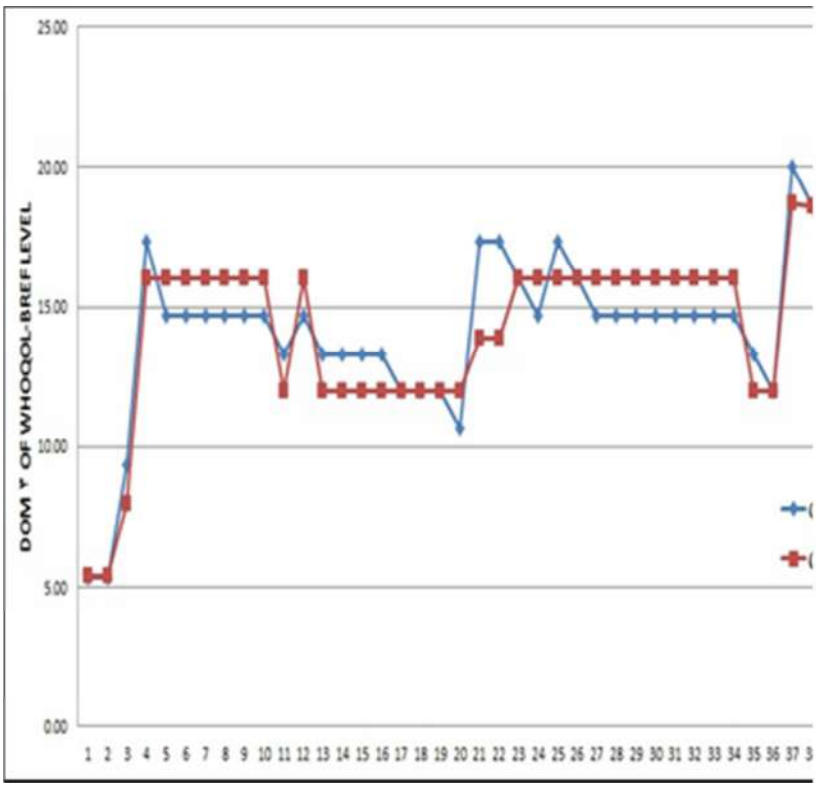


Figure 4

Graph comparing the Social Idomain without Using Fuzzy Techniques (Conventional) Using Fuzzy Technique for 50 Students

Table 6 shows the predictable mean and standard deviation of scores of the quality of life with a view to social relationships through the fuzzy method. They are based on two parameters: personal relationships, and social supports, they have anoticeable reduction. We compare the means by the related samples of t-test; they are presented in Table 3.

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Table 2

Comparison of the Results of a Questionnaire WHOQOL-BREF Social Domain with and without Using Fuzzy

Scores	N	Mean	Std. Deviation
Social relations domainofthe WHOQOL-Brief without using the fuzzymethod	50	14.64	2.80
Social relations domainofthe WHOQOL-Brief with usingthe fuzzymethod	50	14.55	2.79

Table3

Ttest forPairedSamples(Dependent)

t	df	Sig. (2-tailed)
.444	49	.659

We demonstrate that we can remove question number 21 fromthe questionnaire, according to the rules of the Wang-Mandel method, and we design a special fuzzy system.There is no meaningful difference between the mean of the scores before fuzzification and after fuzzification statistically in which 95% isn't reliable. It is a powerful system, because it can estimate the conclusions of the test questions that are predictable even if some questions are removed.

We show the standard deviation of the scores after fuzzification is 2.79, and the standard deviation of the scores by the conventional non-fuzzy method (normal method) is 2.80, so we have a little reduction from some annoying latent variables or parameters among the subjects.

The outstanding advantage of this fuzzy method is that the

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normal method collects irrelevant variables largely, and then it cannot control predictable scores accurately.

Our analysis shows that the fuzzy system can be inference reasonably [10]. We predict and conclude the social dimension in the questionnaire of the fuzzy systems by two input variables (Table 4) instead of three input variables, without using sexual scales. This is the unique feature of fuzzy logic.

We use fuzzy logic in research on human behavior because there are many uncertain data from psychological tests in real situations.

Uncertainty in related data leads to obtaining inaccurate concepts. We use fuzzy data instead of raw data, so we are able to reduce uncertainty. In this research we suggest a new dimension of the capability of fuzzy systems in educational and psychological researches. The major advantage of this modeling is that it predicts psychological parameters by measuring uncertainty and replacing it with a quantitative measure of ambiguity.

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