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Multiple Intelligence Prioritizations for People with Epilepsy

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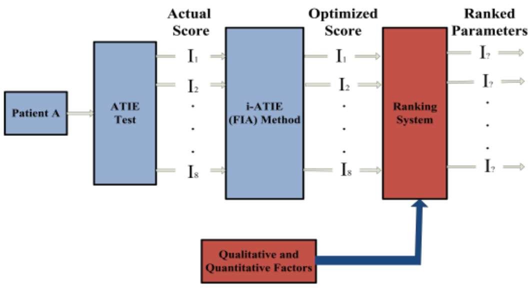
GRAPHICAL ABSTRACT



ABSTRACT

This study uses the data envelopment analysis (DEA) interval efficiency to determine the priorities of eight perceived intelligence parameters skills by considering the people with epilepsy (PWE)'s demographic background. The results of this study help the PWE to identify their strengths and weaknesses where to improve the chances of employability in the job market and to improve their inherent skills for suitable employment. The ranking of PWE's intelligence parameters would describe the status quo of epilepsy sufferers with respect to their intelligence level. Gardner had introduced related activities, products, and suitable careers to each of eight intelligence parameters. Therefore, training the various recommended activities for an epileptic sufferer is paramount in order to be successful in the workplace.

Keywords: Interval Efficiency, Data Envelopment Analysis, Multiple Intelligence, People with Epilepsy

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1. INTRODUCTION

Intelligence is defined as a distinct collective ability that can act and react in response to the surrounding environment. The question of the existence of one or more intelligences was explored during the previous two centuries. Howard Gardner, a contemporary psychologist, believes the existence of multiple intelligences (MI), which asserts that each person possesses a combination of several intelligences of different strengths. In the first statement of Gardner MI theory in 1983 [1], he introduced musical, kinesthetic, verbal, mathematical/logical, spatial, interpersonal, naturalist, and intrapersonal elements of intelligence.

Epilepsy, is one of the oldest disorders in history, has affected many people over several centuries [2, 3]. Awang classified people with epilepsy's (PWE's) intelligence patterns and characteristics based on an intelligence scale known as the Ability Test in Epilepsy (ATIE©) [4]. ATIE©, a psychometric test, was developed to measure eight types of intelligence [5]. In Awang's work, several intelligence parameters are characterized that PWE could improve.

In this paper the performance of the intelligence parameters are evaluated and ranked for epileptics by considering the demographics and illness background based on Awang's database by an interval efficiency method with a common set of weights in Data Envelopment Analysis (DEA) [6]. As the employment is one of the most challenging issues facing people with epilepsy (PWE) that based on the previous studies have high unemployment rates and cannot keep their jobs, the results from this study are important and may improve the employment opportunities of PWE.

The rest of this paper is organized as follows: in Section 2, the related works are described. Section 3 presents the ranking of multiple intelligences of PWE using DEA interval efficiency method. Finally, the paper is concluded in Section 4.

2. RELATED WORK

A conceptual model for ranking multiple intelligences of people with epilepsy considering demographics and illness background has been introduced [7, 8]. This model suggests using the Analytic Hierarchy Process (AHP) to obtain the local weights score for intelligence parameters considering demographic of epileptics. Rezaie et al. [9] obtained the local weights score for intelligence parameters using AHP considering demographic of epileptics by *Expert Choice* software. The considered demographics are educational level, gender, marital status, seizure type, employment status, and ethnicity. In [10] the authors evaluate the performance and rank the intelligence parameters for epileptics by considering the demographics and illness background using Enhanced Russell Measure (ERM) and ERM super-efficiency [11] in Data Envelopment Analysis (DEA). They have determined the priorities of eight intelligence parameter skills by considering epileptics' demographic. The ranking and the efficiency measurement in [10] leads to a fixed value for the efficiency score while using the interval efficiency measure, an interval is introduced for the efficiency score that can imply on the fact that the efficiency is not a fixed value. The interval efficiency allows the decision makers to make the subsequent decisions more carefully, considering uncertainty. On the other hand, the assessment by ERM and ERM super-efficiency is not a comprehensive performance evaluation method because of choosing the desirable weights for each input and output of each DMU in DEA model individually. Choosing the individual desirable weights for each input and output of each DMU estimates the highest efficiency for each DMU and the DMUs cannot be evaluated at the same point of view. Therefore, the interval efficiency model is generated based on a common set of weights by considering positive and anti-ideal DMU [6].

This paper uses the new ranking method proposed by Rezaie et al. [6] that considers an integration of both “optimistic” and “pessimistic” efficiencies in the form of an interval. The method determines the lower- and upper-bounds of the interval efficiency with a common set of weights. Then, the intelligence parameters of people with epilepsy (PWE) are ranked using this interval.

3. RANKING MULTIPLE INTELLIGENCES OF PWE

In this paper the ATIE© scores for the eight perceived multiple intelligences (musical, bodily/kinesthetic, mathematical/logical, spatial, linguistic, interpersonal, intrapersonal and naturalist) of PWE are used. With regard to the existing database, every patient’s demographic information was also considered.

There are 158 data of epileptic patients are used to measure the relative performance of their each perceived intelligence parameters. However in this paper, 30 epileptic patients are presented. Rezaie et al. [10] explained how the inputs and outputs of each epileptic patient as a DMU are determined. The patient's onset age and the total score of each perceived intelligence parameter are considered as two outputs. The patient's real age is also determined as input for this DMU.

The lower-bound and the upper-bound of the interval efficiency are calculated based on [6]. The interval efficiency for presenting the relative performance of each DMU in each category of intelligence parameters is determined. The results are shown in Table 1. Based on [6], the DMU with the highest lower-bound in interval efficiency has the best rank. If two DMUs have same value in lower-bound, the DMU with higher upper-bound will have better rank. Table 2 shows the ranking results of each intelligence parameters for all of the 30 patients. As shown in both Tables 1 and 2, each intelligence parameter for these 30 PWE is evaluated and ranked separately, i.e., the performance of each intelligence parameters for these 30 patients is evaluated and ranked without considering other intelligence parameters.

On the other hand, in Table 1, for example for DMU10, the patient number 10 has a set of eight different relative interval efficiency for his/her own intelligence parameters, which can be prioritized for his/her intelligence parameters based on this set of interval efficiency. The relative musical interval efficiency is [0.6228 , 41.7827] among 30 patients, and for body, math, visual, and so on, this patient has got the intervals [0.6223 , 41.7828], [0.6227 , 41.7829], [0.6226 , 41.7826], … respectively. The priorities of intelligence parameters for patient number 10 based on relative interval efficiency are as below:

$$\text{Interpersonal} \succ \text{Musical} \succ \text{Mathematical} \succ \text{Visual} \succ$$
$$\text{Intrapersonal} \succ \text{Verbal} \succ \text{Body} \succ \text{Naturalist}$$

where symbol "$a \succ b$" represents that the "a" has higher performance and better rank in compare with "b" for patient under evaluation. In other words, the rank of interpersonal intelligence is 1 and the rank of naturalist intelligence is 8 for this patient. This priorities show that the patient number 10 is strong in interpersonal intelligence and weak in naturalist intelligence in compare with other patients. These priorities are different from patient to patient. Table 3 shows this ranking procedure for all 30 patients.

Table.1(a) The results of interval efficiency

Interval Efficiency DMU	Musical	Body	Mathematical	Visual
1	[0.2711 , 17.7261]	[0.2712 , 17.7261]	[0.2710 , 17.7261]	[0.2718 , 17.7260]
2	[0.0491 , 1.9565]	[0.0490 , 1.9565]	[0.0487 , 1.9565]	[0.0497 , 1.9565]
3	[0.4279 , 28.3314]	[0.4281 , 28.3314]	[0.4275 , 28.3314]	[0.4287 , 28.3313]
4	[0.4521 , 29.9979]	[0.4523 , 29.998]	[0.4515 , 29.9980]	[0.4527 , 29.9978]
5	[0.2496 , 16.0704]	[0.2499 , 16.0704]	[0.2497 , 16.0704]	[0.2503 , 16.0703]
6	[0.2796 , 18.2800]	[0.2798 , 18.2800]	[0.2796 , 18.2801]	[0.2800 , 18.2800]
7	[0.3105 , 20.4531]	[0.3108 , 20.4532]	[0.3107 , 20.4532]	[0.3111 , 20.4531]
8	[0.2304 , 14.9990]	[0.2305 , 14.999]	[0.2303 , 14.999]	[0.2310 , 14.9990]
9	[0.5494 , 37.1223]	[0.5500 , 37.1224]	[0.5494 , 37.1225]	[0.5498 , 37.1223]
10	[0.6228 , 41.7827]	[0.6223 , 41.7828]	[0.6227 , 41.7829]	[0.6226 , 41.7826]
11	[0.2966 , 19.2844]	[0.2963 , 19.2844]	[0.2961 , 19.2845]	[0.2969 , 19.2844]
12	[0.2970 , 19.2844]	[0.2959 , 19.2844]	[0.2962 , 19.2845]	[0.2970 , 19.2844]
13	[0.0817 , 4.4998]	[0.0805 , 4.4998]	[0.0808 , 4.4998]	[0.0818 , 4.4998]
14	[0.4502 , 29.9979]	[0.4506 , 29.9980]	[0.4499 , 29.9980]	[0.4509 , 29.9978]
15	[0.3973 , 26.4687]	[0.3975 , 26.4688]	[0.3975 , 26.4688]	[0.3979 , 26.4687]
16	[0.5889 , 39.7030]	[0.5893 , 39.7031]	[0.5891 , 39.7032]	[0.5896 , 39.7030]
17	[0.3114 , 20.5700]	[0.3117 , 20.5700]	[0.3112 , 20.5701]	[0.3119 , 20.5700]
18	[0.3488 , 23.1412]	[0.3490 , 23.1413]	[0.3489 , 23.1413]	[0.3493 , 23.1412]
19	[0.1943 , 12.4992]	[0.1944 , 12.4992]	[0.1942 , 12.4992]	[0.1946 , 12.4991]
20	[0.1847 , 11.9992]	[0.1846 , 11.9992]	[0.1841 , 11.9992]	[0.1846 , 11.9992]
21	[0.4695 , 31.1517]	[0.4698 , 31.1517]	[0.4689 , 31.1518]	[0.4700 , 31.1516]
22	[0.1698 , 10.2267]	[0.1699 , 10.2267]	[0.1688 , 10.2267]	[0.1704 , 10.2266]
23	[0.4742 , 31.3022]	[0.4740 , 31.3022]	[0.4739 , 31.3023]	[0.4749 , 31.3021]
24	[0.1624 , 9.7820]	[0.1625 , 9.7821]	[0.1614 , 9.7821]	[0.1630 , 9.7820]
25	[0.5086 , 33.7476]	[0.5089 , 33.7477]	[0.5086 , 33.7477]	[0.5091 , 33.7476]
26	[0.4814 , 31.8728]	[0.4819 , 31.8728]	[0.4809 , 31.8729]	[0.4818 , 31.8727]
27	[0.3840 , 25.1983]	[0.3843 , 25.1983]	[0.3835 , 25.1983]	[0.3844 , 25.1982]
28	[0.1494 , 8.9995]	[0.1496 , 8.9995]	[0.1487 , 8.9995]	[0.1498 , 8.9995]
29	[0.3442 , 22.4985]	[0.3442 , 22.4985]	[0.3441 , 22.4985]	[0.3447 , 22.4984]
30	[0.3942 , 25.9597]	[0.3944 , 25.9598]	[0.3942 , 25.9598]	[0.3951 , 25.9597]

Table.1(b)

Interval Efficiency DMU	Verbal	Interpersonal	Intrapersonal	Naturalist
1	[0.2710 , 17.7261]	[0.2725 , 17.7259]	[0.2725 , 17.7259]	[0.2707 , 17.7261]
2	[0.0481 , 1.9565]	[0.0518 , 1.9565]	[0.0519 , 1.9565]	[0.0483 , 1.9565]
3	[0.4279 , 28.3315]	[0.4292 , 28.3311]	[0.4296 , 28.3311]	[0.4279 , 28.3315]
4	[0.4521 , 29.9980]	[0.4533 , 29.9976]	[0.4536 , 29.9976]	[0.4521 , 29.9980]
5	[0.2492 , 16.0704]	[0.2515 , 16.0702]	[0.2516 , 16.0702]	[0.2493 , 16.0704]
6	[0.2793 , 18.2801]	[0.2810 , 18.2798]	[0.2810 , 18.2798]	[0.2794 , 18.2801]
7	[0.3104 , 20.4532]	[0.3119 , 20.4529]	[0.3120 , 20.4530]	[0.3104 , 20.4532]
8	[0.2303 , 14.9990]	[0.2317 , 14.9989]	[0.2318 , 14.9989]	[0.2300 , 14.9990]
9	[0.5498 , 37.1225]	[0.5499 , 37.1220]	[0.5500 , 37.1220]	[0.5498 , 37.1225]
10	[0.6223 , 41.7829]	[0.6229 , 41.7824]	[0.6224 , 41.7824]	[0.6219 , 41.7829]
11	[0.2961 , 19.2845]	[0.2981 , 19.2842]	[0.2979 , 19.2842]	[0.2956 , 19.2845]
12	[0.2961 , 19.2845]	[0.2979 , 19.2842]	[0.2976 , 19.2842]	[0.2958 , 19.2845]
13	[0.0806 , 4.4998]	[0.0830 , 4.4998]	[0.0828 , 4.4998]	[0.0803 , 4.4998]
14	[0.4504 , 29.9980]	[0.4514 , 29.9976]	[0.4516 , 29.9976]	[0.4502 , 29.9980]
15	[0.3972 , 26.4688]	[0.3982 , 26.4685]	[0.3984 , 26.4685]	[0.3974 , 26.4688]
16	[0.5894 , 39.7032]	[0.5895 , 39.7027]	[0.5895 , 39.7027]	[0.5889 , 39.7032]
17	[0.3113 , 20.5701]	[0.3125 , 20.5698]	[0.3129 , 20.5698]	[0.3116 , 20.5701]
18	[0.3488 , 23.1413]	[0.3496 , 23.1410]	[0.3496 , 23.1410]	[0.3484 , 23.1413]
19	[0.1939 , 12.4992]	[0.1956 , 12.4991]	[0.1956 , 12.4991]	[0.1940 , 12.4992]
20	[0.1840 , 11.9992]	[0.1854 , 11.9991]	[0.1854 , 11.9991]	[0.1840 , 11.9992]
21	[0.4696 , 31.1518]	[0.4709 , 31.1514]	[0.4710 , 31.1514]	[0.4693 , 31.1518]
22	[0.1693 , 10.2267]	[0.1724 , 10.2266]	[0.1726 , 10.2266]	[0.1691 , 10.2267]
23	[0.4740 , 31.3023]	[0.4755 , 31.3019]	[0.4757 , 31.3019]	[0.4738 , 31.3023]
24	[0.1620 , 9.7821]	[0.1649 , 9.7820]	[0.1651 , 9.7820]	[0.1618 , 9.7821]
25	[0.5084 , 33.7478]	[0.5102 , 33.7473]	[0.5101 , 33.7473]	[0.5084 , 33.7478]
26	[0.4813 , 31.8729]	[0.4831 , 31.8725]	[0.4832 , 31.8725]	[0.4815 , 31.8729]
27	[0.3836 , 25.1984]	[0.3855 , 25.1980]	[0.3859 , 25.1981]	[0.3842 , 25.1984]
28	[0.1487 , 8.9995]	[0.1517 , 8.9994]	[0.1519 , 8.9994]	[0.1491 , 8.9995]
29	[0.3437 , 22.4985]	[0.3457 , 22.4983]	[0.3459 , 22.4983]	[0.3441 , 22.4985]
30	[0.3942 , 25.9598]	[0.3959 , 25.9595]	[0.3959 , 25.9595]	[0.3937 , 25.9598]

Table.2 The result of ranking each intelligence parameter among 30 epileptics

Rank	Musical	Body	Mathematical	Visual	Verbal	Interpersonal	Intrapersonal	Naturalist
DMU								
1	21	21	21	21	21	21	21	21
2	30	30	30	30	30	30	30	30
3	10	10	10	10	10	10	10	10
4	8	8	8	8	8	8	8	8
5	22	22	22	22	22	22	22	22
6	20	20	20	20	20	20	20	20
7	17	17	17	17	17	17	17	17
8	23	23	23	23	23	23	23	23
9	3	3	3	3	3	3	3	3
10	1	1	1	1	1	1	1	1
11	19	18	19	19	18	18	18	19
12	18	19	18	18	18	19	19	18
13	29	29	29	29	29	29	29	29
14	9	9	9	9	9	9	9	9
15	11	11	11	11	11	11	11	11
16	2	2	2	2	2	2	2	2
17	16	16	16	16	16	16	16	16
18	14	14	14	14	14	14	14	14
19	24	24	24	24	24	24	24	24
20	25	25	25	25	25	25	25	25
21	7	7	7	7	7	7	7	7
22	26	26	26	26	26	26	26	26
23	6	6	6	6	6	6	6	6
24	27	27	27	27	27	27	27	27
25	4	4	4	4	4	4	4	4
26	5	5	5	5	5	5	5	5
27	13	13	13	13	13	13	13	13
28	28	28	28	28	28	28	28	28
29	15	15	15	15	15	15	15	15
30	12	12	12	12	12	12	12	12

Table.3 The result of ranking intelligence parameters for each patient

Rank	Musical	Body	Mathematical	Visual	Verbal	Interpersonal	Intrapersonal	Naturalist
DMU								
1	4	3	5	2	5	1	1	6
2	4	5	6	3	8	2	1	7
3	6	4	7	3	5	2	1	5
4	6	4	7	3	5	2	1	5
5	6	4	5	3	8	2	1	7
6	5	3	4	2	7	1	1	6
7	6	4	5	3	7	2	1	7
8	5	4	6	3	6	2	1	7
9	7	1	6	5	4	3	2	4
10	2	7	3	4	6	1	5	8
11	4	5	6	3	6	1	2	7
12	3	6	4	3	5	1	2	7
13	4	7	5	3	6	1	2	8
14	7	4	8	3	5	2	1	6
15	6	4	4	3	7	2	1	5
16	7	4	5	1	3	2	2	6
17	6	4	8	3	7	2	1	5
18	6	3	4	2	5	1	1	7
19	4	3	5	2	7	1	1	6
20	2	3	4	3	5	1	1	5
21	6	4	8	3	5	2	1	7
22	5	4	8	3	6	2	1	7
23	4	6	7	3	5	2	1	8
24	5	4	8	3	6	2	1	7
25	6	4	5	3	7	1	2	7
26	6	3	8	4	7	2	1	5
27	6	4	8	3	7	2	1	5
28	5	4	7	3	7	2	1	6
29	4	4	5	3	6	2	1	5
30	5	3	4	2	4	1	1	6

4. CONCLUSION

The performance evaluation and ranking of perceived intelligence parameters can be used to assist PWE identify their levels of competencies, strengths, and weaknesses. The study has successfully determined the priorities of eight intelligence parameters skills by considering epileptics' demographic that these priorities can be used to enhance the employability of PWE. One way to assist PWE to be competitive in the job market is by promoting their inherent skills. With this assessment, it is now possible to improve the skills of PWE. The priority of eight perceived intelligence parameters for epileptic patients based on their demographic is determined. The interval efficiency for ranking the intelligence parameters presents the performance of DMUs using a common set of weights which is an advantage of this model. Using a common set of weights allows the decision makers to make the subsequent decisions more carefully, considering uncertainty.

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