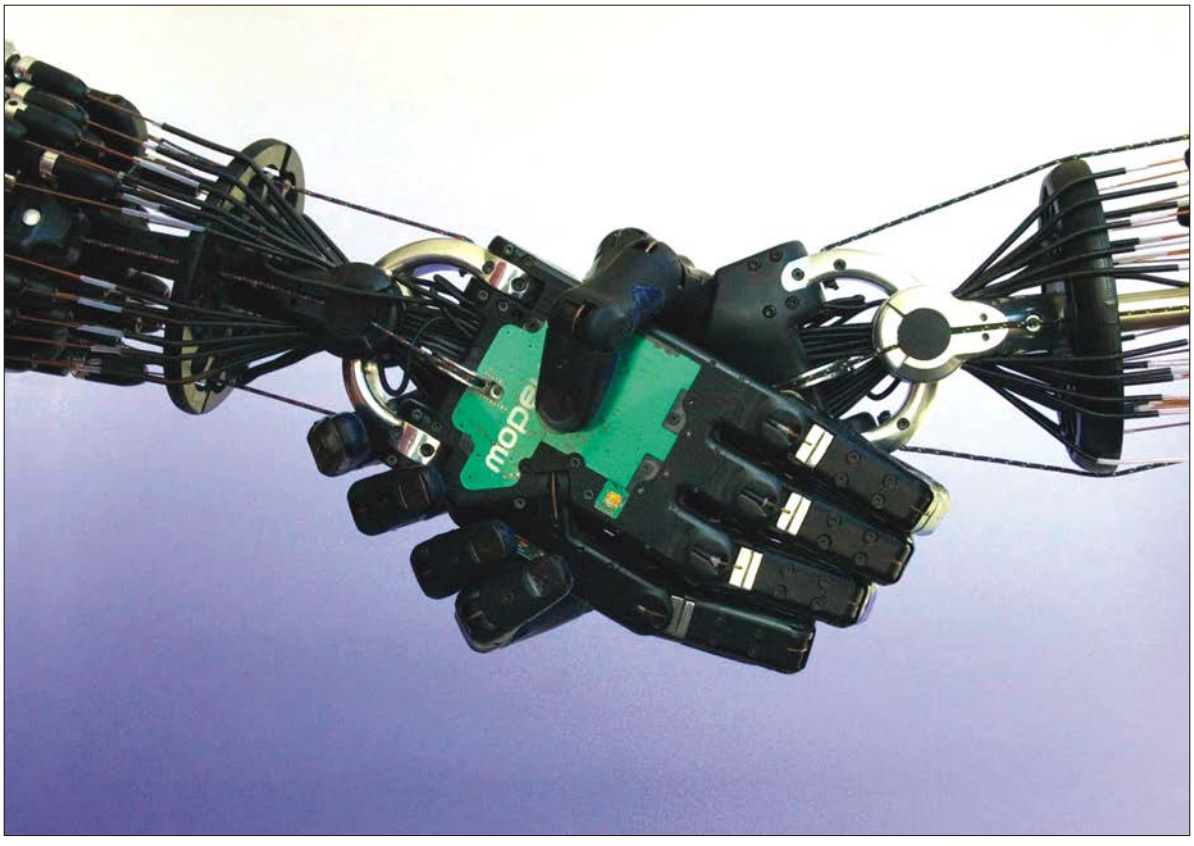

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Research Article
Development of a Smart Program for the Intellectual Style Inventory

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Abstract

Background and Objective: The intellectual style inventory (ISI) is a reliable and valid tool for learning style assessment. It is based on the most popular and recent theories that describe learning. The ISI introduces four styles of thinking and four styles of perception and roots them in the four cortical lobes of the brain. It is able to describe one's natural lead in learning with respect to cortical preference in thinking and perception and produce different learning profiles, accordingly. The aim of the present study was to use potentials of software programming in converting the paper based psychometric tool of the ISI into a readymade, user-friendly program. **Materials and Methods:** The software was developed using visual basic and microsoft access. It was then tested on 42 volunteers working at the National Research Centre of Egypt. Volunteers successfully used the program and interesting data were collected describing their learning styles. Results collected were analyzed statistically using Statistical Package for the Social Sciences (SPSS). Descriptive statistics, comparative test and chi-square test were done for all data. **Results:** Females showed significantly higher score on the base right thinking style at $p<0.01$. Similarly, scores for the front left thinking style as first preference were significantly higher than perception style at the same lobe. The developed software program succeeded to represent the ISI and to introduce it to end user in an interesting and easy way. **Conclusion:** The ISI software program is recommended to be used by practitioners in fields of education, human resources, counseling, research and others. As an extension of the MBTI, the ISI could enrich the field of personality software engineering and introduce a new material that could expand knowledge about personality theory and application. The ISI has many advantages as it is designed in Arabic and English, easy, accurate, can easily run on most operating systems with simple installation process and introduces scientific reporting for individuals about their learning abilities.

Key words: Intellectual style inventory, learning styles, concept learning, software engineering, MBTI

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Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Learning styles as a term defines how people learn information in different ways[1]. While learning styles as an indicator describes the stable individuals' characteristic way by which they perceive, interact with and respond to the learning environment[2]. Accumulated evidence from literature signified the important role of understanding learning styles in many fields including but not limited to, effective teaching in the teaching/learning process and identifying occupational preferences according to learning style type[3]. Besides, learning-styles as a concept has gained a wide acceptance not only among professional educators but also among parents and the general public[1].

One of the most popular learning-style schemes is the Myers-Briggs Type Indicator (MBTI)[4]. The MBTI was a psychometric questionnaire designed to measure psychological preferences in how people perceive the world and make decisions. The MBTI is theoretically based on the theory of types first introduced by Jung[5]. Another approach that deals with the Jungian psychological functions for learning style assessment is the Benziger Thinking Styles Assessment Model (BTSA). The BTSA introduces four types of thinking and roots them in four distinct areas of the brain cortex which creates a neuropsychological model after cortical functional specialization[6]. The intellectual style inventory (ISI)[7] represented an extension to both the MBTI and the BTSA that proved to be a valid and reliable tool for learning style assessment.

The ISI is a psychological tool that could be described as an "information processing style" since it defines an individual's intellectual approach for information processing. Besides, it was regarded as a "personality cognitive style" as its characteristic descriptions for styles was permanent personality dimension instinct for each individual. As a neuropsychological tool, the ISI helps to explore individual variations in the two principal faculties of the human learning; thinking and perception. From the perspective of neuroscience, the ISI was able to extend the neurophysiologic model introduced by the BTSA and emphasizes the modular nature of the brain.

The ISI states that the four cortical lobes offer four different types of thinking and four different types of perception, where the functions of thinking and perception are discriminated from each other in the same lobe. At the same time, psychological processing of such functions differs from one lobe to another providing the different styles with the distinct nature for each. Besides the ISI states that the four lobes act preferentially, concerning either function such that the first preference in thinking may or may not be represented by the same lobe as that showing the individual's first preference in perception.

The ISI as an instrument for learning style assessment was comprised of 48 sentences; 24 describing the four thinking styles-rooted in the four cortical lobes- in four sets of six sentence each. The other 24 four sentences describe the four styles of perception in the same manner. Five different responses to each sentence are introduced that range from 'strongly agree' to 'strongly disagree'. In between the other options include 'agree', 'not sure' and 'disagree'. A corresponding five point Likert scale was used to calculate the total score for each set of sentences. Upon completing the questionnaire, the total score for each set of sentences signifies the preferential predominance of the corresponding style. The four styles of thinking are arranged in descending order with the style recording the highest score representing the most preferred thinking style and that with the lowest score representing the least preferred thinking style. Similarly, the four perception styles are arranged separately in the same way. For interpretation of results a report was provided that identifies the predominant intellectual style in terms of the first preference in thinking and the first preference in perception. A written report describes the main features of the predominant styles with graphical representation showing the percentages of preferences for the four thinking styles and the four perception styles. Hence, the ISI would help the user to know the order of preference of his four cortical lobes with respect to the two faculties; perception and thinking. The user would also be able to know the characteristic learning features specific to his style.

In their first review about the influence of personality in software engineering Cruz *et al.*[8] suggested that such field of research was still immature and needs a big deal of exploration by the research community. In their latest review[9] concerning the same topic they found that the MBTI was the most used test in software programming and strengthened on the fact that the research community needs to improve and extend findings in personality software engineering. From this perspective, the present study aimed to introduce the ISI as a personality based software program for learning style assessment that is clear, easily accessible and user-friendly. The ISI-as an extension of the MBTI-could enrich the field of personality software engineering and introduce a new material that could expand knowledge about personality theory and application.

MATERIALS AND METHODS

Description of the software: This study has been conducted in 2015. The software was programmed using visual basic and

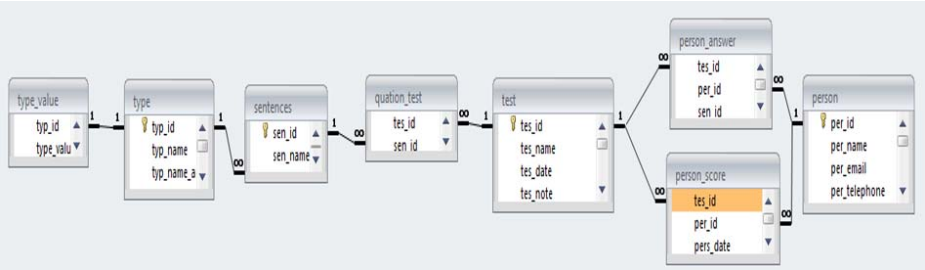


Fig. 1: Database structure

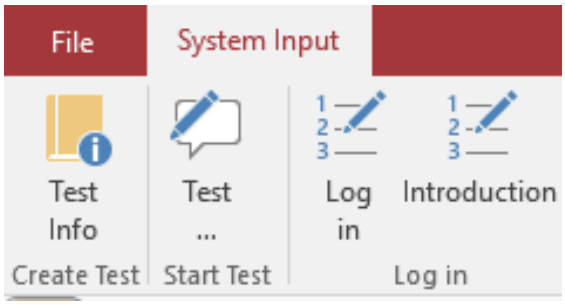


Fig. 2: User window toolbar

microsoft access. The database structure relationship is shown in Fig.1. About the installation process, the compressed ISI file was copied into a folder and expanded, after which the ISI. jar file was run. The graphical user interface (GUI) had three windows. The first window was for users (Fig. 2 User Window) and included two tabs: One for test information from which the user can identify his test ID and the other tab for the user test with the 48 sentences of the questionnaire. There was two general tabs in all windows, Introduction that had a brief explanation of the program and Log in was used for switching between windows.

The second window was for the person responsible for running the program (Fig. 3 IT Admin Window), starting from preparing the test and assigning users to it and ending with printing the final reports for these users and such person was assumed to be one of the IT members of the firm. This window had nine tabs. The Add New User tab displays the information of the new users to be tested. The New Test tab was used to add the test with different arrangement of its sentences. The Assign User To Test tab ensures that every user was assigned to the specific test in use The Test Info tab was used to review the number of tests. The Test Result tab displays results of test users. The Print Hard Copy Test tables allowed to print a hard copy of the test to be used for data entry later instead of online test entry and it could be useful in case there is lack in number of computers. Finally, the three Graphic Results tabs-both in English and Arabic- are used for illustration of the thinking and perception styles for the final reports.

The third window was for the administrator, who was meant to control the core of the program including any changes in the number and content of the questionnaire sentences (Fig. 4 Admin Window). This window had three tabs: The Type Edit where characteristic sentences, choice sentences and gender choice can be edited and re-instructed; the Choices Values that the value of the five answers can be changed, which will affect the final results, the Characteristic Sentences, from which the questionnaire can be changed and/or new one can be added.

Implementation: The program was installed and implemented on employees working at the Training and Capabilities Development Unit (TCD) of the National Research Centre of Egypt. Participants were 42 volunteers (12 males and 30 females) with mean age 40.7 years ranging from 22-58 years old. Participants were asked to respond to the 48 sentences of the program questionnaire. Sentences were organized randomly to ensure true results. For each user two graphs were generated: Thinking style preferences and perception style preferences. Sample of thinking style preferences reports is shown in Fig. 5. Introduction of the program in also found in Arabic and English.

The program was designed in a way to calculate the total score corresponding to each of the four perception styles and each of the four thinking styles. Then the program converts the total scores to percentages to be illustrated graphically. Hundred percent corresponds to the highest possible score for any style which was 60 and 20% corresponds to the lowest score which equals to 12.

Statistical analysis: After implementation, results collected were analyzed statistically using Statistical Package for the Social Sciences (SPSS) 19.0 (SPSS Inc., Chicago, IL, USA). Descriptive statistics, comparative test and chi-square test were done for all the data. p-value <0.05 considered to be significant.

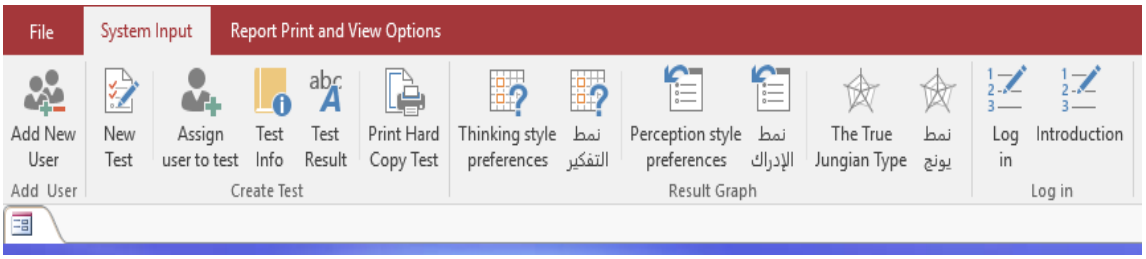


Fig. 3: IT admin window toolba

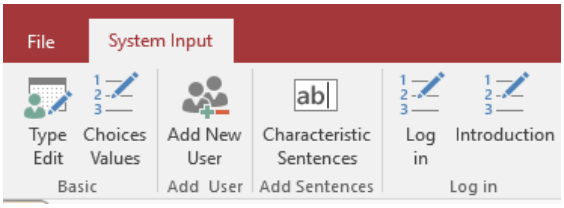
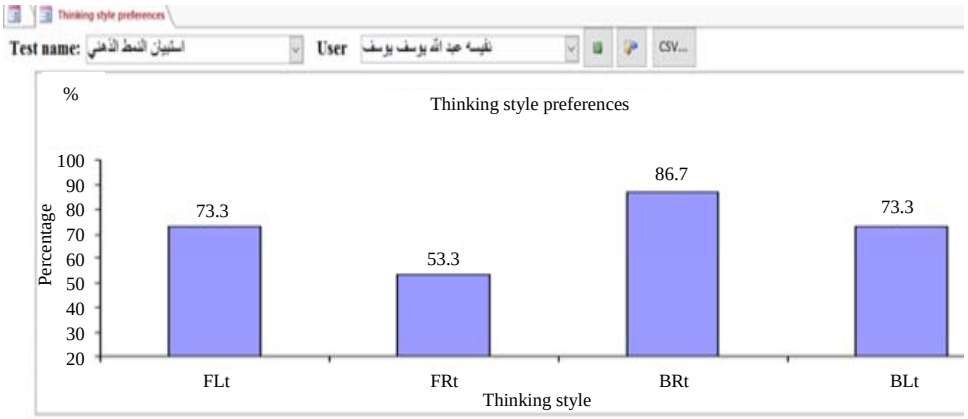


Fig. 4: Admin window toolbar



You prefer to use your base right cortical decision making with the following characteristics
-Your interest is in the 'human' rather tan the technical aspects of any problem
-Your put a premium on facilitating harmononious interactions.
You are emotional and interpersonal
-You are an intrapersonal individual
-Easily pass your own mood to other.
Flt: Front left thinking. FRt: Front right thinking, BRt: Base right thinking, BLt: base left thinking

Fig. 5: Thinking style preferences

RESULTS

Table 1 shows total score for the intellectual style, the thinking style and the perception style as mean and standard deviation. Similarly, individual scores of perception and thinking styles for each cortical lobe were represented. Base left perception showed the highest mean (54.7) among the four perception styles and the base right thinking styles showed the higher mean (51.2) among the four thinking styles.

Percentage distributions of the first, second third and fourth preferences of the different thinking and perception styles for each cortical lobe were also calculated and illustrated in Table 2. According to tabulated results, the base left cortical lobe as first preference in perception was significantly predominating at $p<0.05$. While thinking style of the front left cortical lobe showed significance with very low percentage having it as the fourth style in preference.

Chi-square test and student's t-test were used for test of significance at $p<0.05$ between male and female results (un-tabulated results). Significance at $p = 0.014$ was detected that showed great discrepancy between males ($n = 4$) and females ($n = 24$) with base right cortical lobe showing first preference in thinking. Mean values for their scores

Table 1: Different test scores represented as mean and standard deviation

	Sample number	Score (Mean±SD)	Minimum Score	Maximum score
Intellectual style	42	384.9±30.4	260	436
Thinking styles	42	189.2±18. 4	136	216
Perception styles	42	195.6±20.4	124	224
Front left thinking styles	42	48.6±6.8	28	60
Front right thinking styles	42	41.3±9.5	20	60
Base right thinking styles	42	51.2±7.4	20	60
Base left thinking style	42	48.1±5.7	36	60
Front left perception styles	42	48.1±7.4	28	60
Front right perception styles	42	42.6±9.5	24	60
Base right perception styles	42	50.3±7.2	28	60
Base left perception styles	42	54.7±5.9	28	60

Table 2: Frequency distribution test results

	First preference in		Second preference in		Third preference in		Fourth preference in	
	Thinking style	Perception style	Thinking style	Perception style	Thinking style	Perception style	Thinking style	Perception style
Front left cortical lobe (%)	33.3	14.3	38.1	40.5	23.8	31.0	4.8	14.3
Front right cortical lobe (%)	7.1	11.9	21.4	7.1	54.8	50.0	16.7	31.0
Base right cortical lobe (%)	66.7	19.0	23.8	50.0	4.8	26.2	4.8	4.8
Base left cortical lobe (%)	19.0	71.4	61.9	19.0	16.7	9.5	2.4	0.0

*Significant at $p<0.05$

(males = 46.3 and females = 53.2) in the base right thinking style also showed highly significant difference at $p = 0.005$.

DISCUSSION

The functioning of the human mind is still one of the great scientific mysteries. According to theory of mind Albus[10] improved the knowledge regarding human thinking and cognition, allowed us to interpret the human behavior as well as directing his response. Mastering human behavior could show tremendous impact on the social and economic levels. Improving output of workers and employees, increasing benefits from the different teaching methodologies and improving techniques used in counseling and therapy are some of the applications of mind investigation. Moreover, knowing more about the human personality and processing tasks and mechanisms helps us to discover the points of strengths and weaknesses in each individual and maximize the benefit from his abilities. Software engineering as a technology could help in providing end users with an easy and accurate form of the different cognitive and personality assessment tools and questionnaires.

One example of such applications is the work of Eliza, where the development of computer assisted interviewing software and other software programs were experiments in artificial intelligence designed to imitate human behavior. Now, after three decades of investigation, both researchers and clinicians generally accept computerized test administration as being a valid and reliable method[11].

In 1949, Cattell and Mead[12] published the first edition of this 16 personality factor (16 PF) questionnaire which measures the whole of human personality using structure discovered through factor analysis. The 16PF fifth edition questionnaire was a valuable assessment tool for professionals in a wide range of settings. In business and industry, for example, it facilitated personnel selection and development by identifying personal qualities that influence behaviors in work settings, such as problem-solving style and interpersonal style. For clinical/counseling applications, it offered in-depth interpretation of normal personality factors from a clinical perspective, enabling the presenting problems to be placed in the context of the total personality. The 16PF is now available as a web-based software program that is easily accessible to everybody.

Other examples of valuable personality tests that benefited from software engineering include the Minnesota Multiphasic Personality Inventory (MMPI). MMPI is the most widely used and researched standardized psychometric test of adult personality. Psychologists and other mental health professionals use various versions of the MMPI to develop treatment plans, assist with differential diagnosis, help answer legal questions (forensic psychology) and screen job candidates during the personnel selection process[13]. Similarly, the Synthetic Aperture Personality Assessment (SAPA) project is a collaborative data collection tool for assessing psychological constructs across multiple dimensions of personality. These dimensions currently include temperament, cognitive, abilities and interests. A personality description feedback on each of these dimensions was obtained after taking the test.

In this same context, the ISI was introduced through the present study as a personality and learning style software that

was highly recommended to be used in many fields. In human resources management and organizational development, organization-personality fit (OPF) and personality-job fit (PJF) are crucial principles used in all developed countries to potentiate the output of individuals in the workplace, reduce environmental stresses, improve quality of work and discover individual potentials and areas of innovation. These factors when adjusted save a lot of money wasted by organization in medical insurance, absenteeism, low productivity, ⋯etc[14-15]. The developed program for the ISI can perfectly serve in this application. It has been used by Saleh *et al*.[16] to discover the most labile personalities to stressful working environment. The ISI program can also be used as a data collection tool for research since it was an objective personality test that warrantees a good deal of reliability and validity[9]. Other advantages of using the computerized ISI questionnaire is that it alleviates the need for proctoring tests and manual data entry and that the only cost required would be an inexpensive computer to host the test and associated software.

CONCLUSION

It is concluded that the present study highly recommends the invented ISI software program for use in various fields of application of personality testing. The program is easy, accurate, bilingual (Arabic and English), easily installed and provided with detailed reports and can be used as a data base. Other advantages of the developed program rely on choosing the ISI in particular as the personality test in use. The ISI is a novel tool, not consumed, follow the latest theories in its design, describes many aspects of the personality like; thinking and decision making, perception of sensory stimuli, cortical specialization of the brain and hemispheric thinking and laterality. The ISI is a very promising personality and learning style assessment tool that is able to highlight individual characteristics and potentials and the developed software introduced in this work enables the wide spread of the ISI within different populations.

SIGNIFICANCE STATEMENTS

This study is unique in the field of personality software engineering. It discovers the presence of great difference between individuals in their intellectual styles and hence, their learning potentials. It also provides an easy, feasible and scientific way for figuring out the learning characteristics and abilities of each individual. Moreover, this study highlights the importance of the intellectual style inventory (ISI) in particular -as a learning styles assessment tool- over other tools. Besides, applying the ISI in the form of a software program, available in two languages; Arabic and English, extends the scope of its application among many populations that can use either of these two languages.

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