

Develop and validate CPI questionnaires to measure mental processing in steel industry

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Abstract

Background: In most industrial environments, people are exposed to noise on a daily basis. In this study, due to the lack of brain processing questionnaires in the field of adults and industries, new CPI questionnaires with general focus on all adults and industries were designed, psychometrically and reliably. **Objectives:** In this study, an attempt has been made to use the California Cognitive Processing and Personality Questionnaire based on the cognitive characteristics of Iranian employees. **Methods:** To determine the validity of the questionnaire, face validity and content validity methods were used. CVR and CVI were used to evaluate the validity of quantitative content. The reliability of the questionnaire was then assessed by alpha-chronobach method. **Results:** In this study, the study of qualitative formal validity showed that it is necessary to remove 23 questions from 50 questions. The value of CVI and CVR is higher than 79 / respectively. And 0.56 was obtained. The results of this study showed that the questionnaire designed in terms of content validity index is higher than their standard, which is 0.84 and 0.56, respectively. **Conclusions:** The obtained alpha coefficient indicates that the questionnaire is strong in terms of internal compatibility. As a result, the questionnaire designed to examine the impact of noise on processing and mental performance of employees in current industries should be useful.

Keywords: Questionnaire, Validity, Reliability, CPI, Sound, Mental Processing

INTRODUCTION

Today, with the development of science, technology and the use of various tools and devices in the process of production and facing workers with various harmful factors has led to increasing attention to workers' occupational health as the main assets of the industrial sector ^[1]. According to studies, noise is considered a risk factor for employment, which affects millions of workers around the world. In addition, exposure to high levels of noise in the workplace is a common risk factor worldwide ^[2]. According to US reports, nearly 22.4 million (17.2%) of workers are exposed to high noise in the workplace ^[3]. On the other hand, the National Occupational Health and Safety Agency (NIOSH) estimates that 14% of workers worldwide are exposed to noise levels ^[4] Considering Iran's working population according to statistics The Ministry of Health's Workplace Environmental Health Center estimates that more than 2 million workers are exposed to occupational hazards ^[5].

Noise is an unwanted sound whose harmful effects are widely heard in terms of hearing and non-hearing impairment, the most important effects of which are disorders such as

discomfort, sleep disorders, cardiovascular disease and disorders. Cognitive function, nerve stimulation, and stress were noted, and it is worth noting that depending on the exposure of the person to sound and the degree of tolerance a person has, it can have a variety of effects ^[6]. As a result, sound can be considered the most pervasive harmful physical factor in the workplace ^[7]. Other effects of this harmful factor include psychological disorders, which include anxiety,

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stress, restlessness, sleep disturbances, and impaired mental function and information processing (stimulus identification, response selection, and response planning) [8]. The human body's response to loud noise is similar to that of an imminent risk, including adrenaline secretion, changes in heart rate and blood pressure, pressure in the head and eyelids, fatigue, and difficulty concentrating [9, 10]. In jobs where people have a lot of noise and cognitive impairment (reaction time, attention, etc.) increases the risk, more attention should be paid because the slightest delay in the reaction time of people in sensitive jobs can lead to irreparable risks [11, 12].

Studies have shown that sound exposure affects cognitive processing [13]. Cognitive processing is defined as the reception of data, the creation of a process of comparison, and ultimately the change or non-alteration of existing information in another way that occurs through cognition in the brain [14]. The standard questionnaire was first proposed by Alviband in 1335, which includes 21 questions in the Likert range, which include 1 question related to stress, 1 question related to anxiety, and 1 question related to depression [15]. In 1999, Cruz introduced the CPI Cognitive Processing Model to help with the Differential Detection Process. In fact, the CPI processing model is based on the latest cognitive research related to neurodevelopment and six general areas (vision, hearing, sequential / logical processing). Conceptual / Abstract, developed processing speed, attention) to measure cognitive processing and assist in the process of differential diagnosis of specific learning disabilities for ages 7 to 19 years. The purpose of each information processing model is to explain the reasons for the educational problems experienced by the students, and finally it was found that the processing model used in the CPI not only helps to explain the existing problems but also leads to the specific guidance of the interventions. Powerfully predicts problems in areas (educational and non-educational) that are generally related to a particular style of information processing [16].

In the steel and steel industries, smelting and rolling, rolling, textile and process industries, sound is considered a very important job risk. Rolling is one of the most important industries in any country and the sources of sound propagation in this group are various industries. It should be noted that in the steel industry, there are special equipment and systems such as pumps, compressors, furnaces, motors, air blower systems and cooling towers, gas and steam ducts and valves, electric arc furnaces, rolling mills, and fans. The ones used for ventilation and other equipment are considered to be the most important sources of sound [17]. Considering that Cruz's cognitive questionnaire was designed for individuals in the field of education and its possibility of adapting to the cognitive problems of workers in the existing industries. There was also a growing need for organizations to investigate the harmful effects of the work environment and the degree of stress, anxiety, and concentration of individuals. We have studied the harmful factors of the work environment in order to study the validity and reliability of its

validity in Iranian industries in a study and to evaluate and evaluate the effect of noise on staff stress and anxiety.

OBJECTIVES

In this study, an attempt has been made to use the California Cognitive Processing and Personality Questionnaire based on the cognitive characteristics of Iranian employees.

METHODS

The present study is a descriptive-analytical-applied study conducted with the aim of designing and determining the validity and reliability of a questionnaire to examine the mental processing of employees in the face of harmful factors in the workplace. The study population was part of the staff of one of the major steel industries in Isfahan. The sample size was calculated with 95% confidence, 80% test power, two-sequence test using G-Power 330 software, which is 300 people considering the amount of drop in sampling of questionnaire studies. This number was randomly selected from the staff. Data collection was done with the full consent of the individuals and on a voluntary basis. The collected information was without mentioning the names and details of the individuals and was kept completely confidential. The conditions for entering the study were having at least one year of work experience in various units of the industry under study and the desire to cooperate with researchers. Incomplete questionnaires were also excluded.

In the first stage of the study, the concept of mental processing and its dimensions were examined by reviewing previous studies (by referring to reputable scientific databases and reviewing related journals, publications and related articles) and consulting professors and relevant experts. A 50-question letter entitled "Assessing the validity and reliability of the CPI questionnaire for measuring mental processing" was drafted and then, with the discretion and guidance of 12 professors and experts in the field of occupational health engineering and occupational medicine, changes. The questions were simplified and simplified, which confirmed the formal validity of the questions.

The final questionnaire consisted of two general sections, demographic specifications and dimensions of mental processing. The demographic specifications section includes the variables of organization name, age, gender, marital status, position in the organization, job title, job history, history of major accident, level of education, as well as the mental processing dimensions of the designed CPI questionnaire. Question), audio processing (10 questions), sequential / logical processing (9 questions), conceptual / abstract processing (10 questions), processing speed (10 questions) and attention (9 questions). To be more sensitive to measurement, each item was rated using a 5-point Likert scale from "strongly agree" (1) to "completely opposite" (5). Thus, the total score related to the mental processing evaluation will be obtained by multiplying the total number of questionnaire questions in the Likert score of each of the answers.

The present study consisted of three stages:

Step 1 - Translate and customize the questions for the work environment and prepare the initial questionnaire:

The original English version of the CPI Questionnaire was translated into Persian after obtaining permission from the original author to translate and review the reliability and validity of the questionnaire in Iran. Initially, the original English version of the questionnaire was translated into Persian by two independent translators simultaneously. Then the translations were further studied and finally a Persian version was prepared. In the next step, this version was translated into English by two other translators separately. Again, a final English version was prepared and a questionnaire was sent to the developer to match the original version in terms of quality. After performing the above steps and confirming the same, a Persian version of the mental processing questionnaire was prepared. At this stage, by holding 8 to 10 sessions in the research work environment and by emphasizing on the above criteria, questions were designed in such a way that by explaining the parameters of mental processing, each of the researchers could take into account what could happen to them. In order to avoid falling out of business, which could have happened in the workplace, the participation of employees working in the industry in question was attracted, and they were asked to give similar cases to express similar cases, and these questions were asked according to Conducted studies and opinions of experts in different dimensions and layers of classification c Rejected. At this stage, it has been decided that the staff of the specialized group has been formed through various population groups, including simple workers with service jobs, operators, technical and safety experts, and by asking a sample question from each class as a guide, other questions were asked by the staff. . At this stage, a questionnaire emerged from a research paper that benefited from the following features:

1. Includes the most important aspects of mental processing that have been identified in the previous steps.
2. The questions posed in the predefined categories could be classified.
3. Matching questions were designed with mental processing in mind.

The second step is to develop and increase the partial effect of writing the questionnaire:

Since the questions were posed by a special group, it seemed necessary to use scientific guidelines in generating and developing the questionnaire. Therefore, the guidelines provided by Lidi and Urmrud and the artists and colleagues in the field of parenting, such as a general and comprehensive questionnaire, were used to increase the effectiveness of the responses ^[18, 19].

Finally, a 50-year questionnaire was designed using these guidelines and corrective action.

Step 3 - Check the validity of the questionnaire

In order to evaluate the formal validity of the translation quality and eliminate possible defects, 300 people from the target group were performed and the questions that seemed vague in terms of expression were identified and the necessary changes were made. The content validity of the questionnaire was verified by its original creator, and the present study did not change the content. The questionnaire was also approved by the professors of occupational health engineering and occupational medicine.

Step 4 - Check the reliability of the questionnaire To check the reliability of the questionnaire, the internal consistency method was used and Cronbach's alpha was calculated.

Content validity

Validity is a measure of the accuracy of the study results and shows how well the study has measured what you intend to measure ^[20]. The content of the questionnaire was active, and in this way, the possibility of accurate and correct judgment of the questionnaire questions is provided. The criterion for experts to enter the study was having work or scientific experience in the field of cognition and psychology, as well as having at least one hour of free time to complete the questionnaire. Distribution and collection of Validity questionnaires: Communication with the panel members in person, by telephone or by e-mail. Panel members' votes are quantified from the votes of the panel members assigned to option E (essential) through the Ratio Content Validity ratio, hereinafter referred to as the CVR. The minimum acceptable CVR for each question is determined by the number of experts who commented on the content validity ^[19]. The following formula is designed for this purpose. Given that the number of experts who commented on the questionnaire in this study is 12 people, the numerical value of CVR is acceptable at 0.56, but to increase the accuracy of the value of CVR, 0.60 was accepted. Therefore, questions were retained in the questionnaire that had a CVR above 0.60.

In this study, since the purpose was to design a specific questionnaire for the work environment and employees, content validity was used because content validity is more valid than apparent validity.

In this method, in order to determine the quantitative formality of the questionnaire, a complete list of compiled items was given to a group of 12 professors and they were asked to "be related" according to the purpose of the research on the appearance of the questionnaire. " Evaluate and comment on "clarity" and "simplicity." The above three criteria were expressed in the Likert scale as follows. The criterion of "simplicity" consists of 4 parts: "1- It is incomprehensible, 2- It needs a lot of change, 3- It needs a little change, and 4- The phrase is completely

understandable." It included: "1- The phrase is irrelevant, 2- The phrase needs to be changed a lot, 3- The phrase needs to be changed a little, and 4- The phrase is completely related." Also, in relation to the criterion of "clarity", the following four parts were included: "1- The phrase is vague, 2- The phrase needs to be changed a lot, 3- The phrase needs to be changed a little, 4- The phrase is clear [15].

Importance × frequency (in percent) = impact score

To accept the formal validity of each item, the score of its effect should not be less than 1.5, and only questions that are acceptable in terms of formal validity with a score higher than 1.5 are acceptable.

$$\text{Formula No. 1} \quad \text{CVR} = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$

CVR: Content validity ratio

ne: The number of experts who have selected the important and relevant option for each question

N: The total number of specialists.

Determining the content validity index and introducing the final questionnaire using the content validity index (Validity Index Content), which is now abbreviated as CVI, is the average of the CVR values of the remaining items in the test model or validated instrument. CVI indicates the comprehensiveness of judgments about the validity or feasibility of implementing the model, test, or final instrument. The higher the 0 content content validity, the higher the CVI to 0.99. The opposite is also true.

$$\text{Formula No. 2} \quad \text{CVI} = \frac{\sum_n^1 \text{CVR}}{\text{RETAINED NUMBERS}}$$

CVI :Content Validity Index

CVR: Content validity ratio

Retained number: The number of items remaining

Step 3 - Check the reliability of the questionnaire

The internal consistency method was used to evaluate the reliability of the questionnaire and Cronbach's alpha was calculated. In order to determine the reliability of 300 selected steel industry workers in Isfahan province who were randomly selected, at the end of this study, the questionnaire contained 27 specialized questions in the field of cognitive processing, while the initial CPI questionnaire was designed by Cruz. There were six general areas of cognitive processing, each based on learning and cognitive research theories. Each question score was based on a five-choice scale of one to five, with the number one indicating the obvious problem and the number five indicating the problem. The ability is obvious and the number three is to show average skill or when the evaluator is about The correct answer is uncertain [16]. Thus, each person's score in the CPI questionnaire is in the range of 6 to 30, which is less

indicative of a mental processing problem. All employees answered the questionnaire to the interview method. In this study, respondents answered the questions of the questionnaire, which were unnamed and the answers were recorded in the answer sheet by the interviewer, without coercion and with peace of mind at the specified time, and finally the collected data by statistical methods. It needs to be analyzed and examined.

Measuring internal agreement on reliability

The degree of reliability of the results is the same over a period of time and under the same conditions and with the same working method, which is measured by the reprotoability, reproducibility of the results [21]. In other words, reliability consists of three different parts. These three parts include stability, equivalence, and homogeneity. Stability means getting the same results in the same people if the test is repeated; Equivalence is achieved when the test is used by different researchers. The same results are obtained, and homogeneity is an indicator that all The test sections used must be internally compatible. Therefore, to determine homogeneity, a number of different operational definitions of similar concepts are tested on similar individuals with a specific method in data collection method, and the results obtained must be strongly interdependent [21-23]. This confirms that reliability is a prerequisite for validity.

Cronbach's alpha method

In 1951, Cronbach at Stanford University developed the statistical method of alpha coefficient to solve the problem of determining the reliability of multiple-choice tests. This method is the most common reliability coefficient of internal stability that is used in most studies [24]. In this method, it is sufficient to perform the test only once to provide an estimate of the reliability of the test. Cronbach's alpha method is used to measure the internal stability of questions on a Likert scale with a minimum alpha value of 0.7. Questions from the test that do not have a good reliability need to be removed to increase the reliability of the test. For this purpose, the data of the questionnaire, which was completed by 300 workers of 300 rolling mill workshop and compared with spss software, were compared internally (even and odd) and Cronbach's alpha for each item was calculated separately and in general.

RESULTS

In this study, a preliminary questionnaire consisting of 50 questions was designed with the help of scientific resources and the opinion of experts. In the study of qualitative Validity validity, 23 questions were removed and 5 questions were edited and changed. There are six areas, including visual processing (4 questions), auditory processing (4 questions), sequential / logical processing (7 questions), conceptual / abstract processing (4 questions), processing speed (4 questions) and attention (4 questions). The number of questions deleted at each validation step is shown in Figure 1.

1) Investigate validity

Questions removed from the initial questionnaire were performed based on the content validity index and content validity ratio, the results of the content validity index and the introduction of the final questionnaire: In the recent study, one dimension (orientation) and 23 questions were removed after validation. Finally, 27 questions remain. As a result, the content validity index for the questionnaire was calculated according to the total (22.75) CVR and the remaining items (36): The value of the content validity index was obtained using the following equation:

Formula No. 3

$$CVI = \frac{\sum_n^1 CVR}{RETAINED\ NUMBERS} = \frac{22.75}{27} = 0.84$$

CVI: Content Validity Index

CVR: Content validity ratio

Retained number: The number of items remaining

In this method, questions with a score higher than 0.79 are appropriate, between 0.70 and 0.79 need to be corrected, and less than 0.70 are unacceptable and should be deleted [25]. Therefore, in the designed CPI questionnaire, the CVI value or acceptable content validity index is 0.84.

CVR values of the average number of judgments and results of accepting or rejecting the questions of CPI questionnaire. Comparing the judgments and finally the result of accepting or not accepting each question is given in Table 3.

Formula No. 4

$$CVR = \frac{ne - \frac{N}{2}}{\frac{N}{2}}$$

CVR: Content validity ratio

ne: The number of experts who have selected the important and relevant option for each question

N: The total number of specialists.

2) Check reliability

Internal consistency: In this study, after completing the questionnaires by 300 employees, the Cronbach's alpha coefficient was 0.86, which indicates that the questionnaire has strong internal consistency. Reproducibility: In order to estimate the repeatability, the retesting method and ICC index were used. The value of this index was 0.996 (p <0.001), which indicates its high repeatability.

In this study, the mean of mind processing was obtained in 68.82 visual questions, 58.35 hearing, 55.56 consecutive / logical processing, 64.5 conceptual / abstract processing, 77.8 processing speed and 67.80 attention, respectively. . Among

the mentioned factors, the work experience factor affected all subscales. Among the demographic variables, the factor of education and shift worked significantly on almost all subscales except conceptual / abstract processing and the age factor on the subscales of auditory processing, sequential / logical processing, processing speed and attention span. It was significant (p <0.05).

Following this study, the questionnaire was distributed among 300 personnel of male employees of the rolling unit, who were 30.3% single and 69.7% married among the participants. Participants in the study also received 2.2% undergraduate, 61.8% undergraduate, 20.2% postgraduate, 14.5% bachelor's degree and 1.3% master's degree. In this study, 35.5% had one child, 7.9% had two children and 2.2% had more than two children. In terms of age, 7.5% were under 25 years old, 87.7% were between 26 and 40 years old, and 4.8% were over 40 years old. There was no significant difference in age and marital status (p-value > 0.05), but the distribution of education and shift between people was significantly different (p-value <0.05). There is also work experience in the control group (13.70 ± 6.90) (p-value <0.001). In terms of work experience, 29% had less than 5 years of experience, 56.2% had between 5 and 10 years, 8.3% had between 1 and 15 years, and 6.6% had more than 15 years of work experience. Meanwhile, the average age of the participants was 32.8 and 30, respectively, with a standard deviation of 4.9 years. The mean and mean years of experience in the 7.4 and 7 rolling units were obtained with a standard deviation of 4.8 years. Table 2 examines the relationship between each of the subscales in the whole questionnaire and found that there is the least relationship between the two subscales of vision and attention and also the highest correlation was observed in the processing speed scale. In this questionnaire, all scales except the attention scale have a strong correlation with (0.56 or 0.79 r = and P <0.0001) of the whole questionnaire.

The reliability of the CPI questionnaire designed by Cronbach's alpha method was 0.86 and the validity of the validity was assessed through the content validation method and 0.84 was obtained. Predictive validity with 12% positive prediction error and 10% negative prediction error was also reported as 0.78. This information confirms that the questionnaire has a very strong validity and reliability (Table 3).

The internal correlation between the whole questionnaire and the scales is presented in Table 1. As can be seen, all scales, except the scale of facts, have a strong correlation with (p <0 / and 0001 r = 0.0 to 79 / the whole questionnaire)56

DISCUSSION

According to studies of harmful physical factors in the workplace, noise has been proven to be a risky job, affecting millions of workers around the world [25]. Noise has a variety of effects, including physiological and psychological disorders caused by physical stressors in the body. Voice-

induced psychological disorders include anxiety, stress, restlessness, sleep disturbances, and impaired mental function and information processing (stimulus identification, response selection, and response planning ^[7]).

Cognitive processing represents a state that involves receiving, comparing, and changing or not changing information as it occurs through cognitive activities in the individual's brain ^[14]. Disruption of any of the information processing factors leads to impaired ability to use the information collected through the senses ^[26]. The findings of the present study confirmed the psychometric characterization of the CPI questionnaire in a sample of the employed population and showed that the CPI questionnaire is a reliable and reliable tool for measuring mental processing. The internal consistency of the CPI questionnaire and the subscales of this test were calculated and confirmed in terms of Cronbach's alpha coefficients. The results of structural validity with the main component analysis method confirmed the existence of six factors related to the CPI questionnaire as in previous studies. This finding is consistent with the results of research by Habibi ^[12], Kharazi ^[27], Kathleen and fuller ^[28] and Saremi ^[29] in terms of the impact of harmful factors in the workplace on cognitive parameters such as accuracy, speed and attention. The results of Alexander F. Lubitz's study also showed that the rate of depression can be effective in changing the speed of mental processing, which is in line with the study of cognitive processing in employees on shifts and working days ^[30]. Another study by Hodgson looked at behavioral differences in management between men and women, and found that female managers were stronger in communication skills and mental processing than men, and that the study was consistent with the study. Is not present ^[31]. The CPI has been widely used since its inception in 1957. According to the report, since the test was first published. Researchers and clinical psychologists have used it for many obvious purposes of psychological testing, such as predicting academic achievement, graduating from high school or college, and performing in specific areas such as English and mathematics. The speed of work in the industries and the importance of the employees in examining this questionnaire in the Iranian industries seemed necessary ^[32]. One of the major features of the Psychological Questionnaire (CPI) in terms of the number of scales and features studied to assess mood and social interaction styles and this individual is a subject that is highly noteworthy by psychologists ^[33]. Since

the CPI's main focus is on the practical benefit and effort to develop appropriate, comprehensible, and accurate descriptions of behavioral insights, and how its basic concepts are understood, it is more important than everyday social interaction. And since it is related to the current aspects of behavior, its interpretation is also indirect and is understandable for the subject ^[34]. In order to determine the validity of the questionnaire, formal validity and content validity were used. The formal validity was examined by experts and the necessary omissions and corrections were applied. In order to determine the validity of the content, the opinions of experts were applied and a number of questions were edited. The content validity index in the present study is 0.84, which is close to the results of the study of Waltz and Basel, which recommend the average standard of the content validity index as 0.90, with a difference of 0.06 ^[35]. In reviewing the reliability of the questionnaire, Cronbach's alpha coefficient was determined by the internal consistency method and the results showed that all items have the appropriate Cronbach's alpha coefficient, so that the Cronbach's total alpha for this questionnaire was 0.86 and According to the study of bronze, which introduced the appropriate reliability number as 0.70, it can be said that the reliability of the questionnaire designed to work in employees of different industries is practical and appropriate ^[36]. This study, because the CPI questionnaire is the first to be examined in the sample of Iranian employees, needs to be repeated in different samples, especially more process jobs. Overall, the present study data showed that the CPI questionnaire is a valid and valid tool for measuring mental processing and according to the research literature that emphasizes the study of processing and speed of mental performance using appropriate and specific tools, this questionnaire can be in Studies and research related to this field were used.

The present study showed that the Persian version of the CPI questionnaire is a reliable and reliable tool for measuring various aspects of cognitive function and mental processing in the working population and can be used in other epidemiological studies. Using this tool, researchers can take an important step in the process of screening cognitive processing in employees and, if necessary, to solve problems properly and provide the right interventions in a timely manner.

Figures and Tables

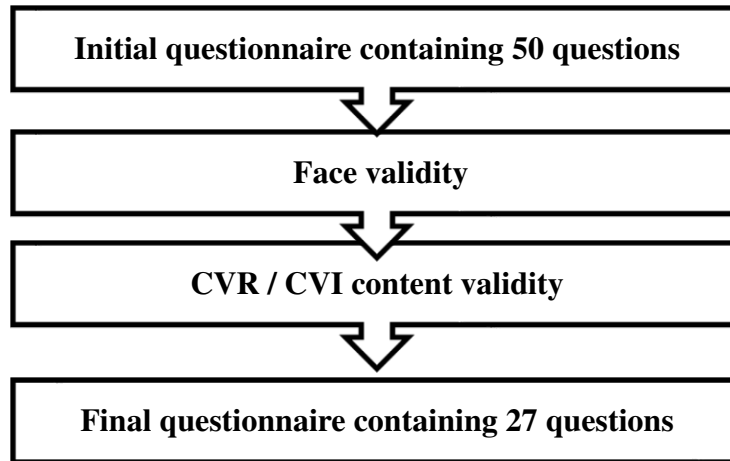


Figure 1: The number of questions removed in the Validity steps

Table 1: Assess the reliability of CPI questionnaire subscales

Cronbach's alpha	Number of questions in this area	Standard deviation	Subscales
0.908	4	68.82±24.53	Visual processing
0.84	4	58.35±34.42	Hearing processing
0.876	7	55.56±23.38	Sequential / logical processing
0.84	4	64.5±21.14	Processing Conceptual / Abstract
0.869	4	7.8±20.26	Processing speed
0.81	4	67.8±22.05	Attention

Table 2: correlation coefficients and internal consistency between scales and the whole questionnaire

Attention	Processing speed	Conceptual / abstract processing	Sequential / logical processing	Hearing	Vision	The whole questionnaire	CPI Questionnaire
-	-	-	-	-	-	-	The whole questionnaire
0.12	0.21	0.25	0.34	0.51	0.57	0.61	Vision
0.17	0.25	0.27	0.33	0.40	0.47	0.65	Hearing
0.16	0.23	0.25	0.27	0.31	0.33	0.63	Sequential / logical processing
0.18	0.21	0.27	0.32	.44	0.58	0.63	Conceptual / abstract processing
0.19	0.20	0.23	0.30	0.41	0.56	0.69	Processing speed
0.15	0.18	0.22	0.28	0.39	0.51	0.53	Attention
0.81	0.87	0.84	0.88	0.84	0.91	0.86	Alpha coefficient
0.82	0.88	0.85	0.87	0.85	0.90	0.87	Alpha recovery rate

P<0.0001

Table 3: Cronbach's alpha value of the scales used based on the CPI Cognitive Processing Questionnaire

Scale	Attention	Processing speed	Conceptual / abstract processing	Sequential / logical processing	Hearing processing	Visual processing	Total
Cronbach's alpha coefficients	0.81	0.87	0.84	0.88	0.84	0.91	0.86

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