

Cognitive Neuroscience and Psychology: second-round sample tasks

25 entry-level tasks

For each correct answer, the participant receives 1 point.

The maximum number of points is 25.

Theme # 1. The History of Psychology

Question 1. Choose the correct answer

What theory did Bandura propose?

1. Theory of social learning
2. Operant conditioning theory
3. Theory of self-actualization
4. Field theory of learning

Answer: 1

Question 2. Choose the correct answer

How did Freud call a halt in the development of personality at one of the stages of psychosexual development?

1. Repression
2. Fixation
3. Reactive Formation
4. Stagnation

Answer: 2

Question 3. Choose the correct answer

The integrity of perception, constancy of perception, figure, background - these are concepts belong to...

1. Psychoanalysis
2. Humanistic psychology
3. Cognitive psychology
4. Gestalt psychology

Answer: 4

Question 4. Choose the correct answer

What are metacognitive processes?

1. A person's knowledge of his cognitive system and the ability to manage it
2. The orientation of a person's consciousness to a certain object
3. Human cognition of objects and phenomena of the surrounding world
4. Good ability to memorize a large amount of information

Answer: 1

Question 5. Choose the correct answer

How many stages of psychosocial development did Erickson identify in his theory of personality development?

1. Three
2. Five
3. Eight

4. Ten

Answer: 3

Theme # 2. Cognitive processes

Question 1. Choose the correct answer

What is the name of the mental reflection in the cerebral cortex of individual features, objects and phenomena affecting the senses?

1. Sensation
2. Perception
3. Memory
4. Thinking

Answer: 1

Question 2. Choose the correct answer

Who developed the modern approach to the problem of attention, which implied that the world contains a much larger number of sensations than human perceptual and cognitive abilities allow?

1. William James
2. Donald Broadbent
3. Anne Treisman
4. Stephen LaBerge

Answer: 2

Question 3. Choose the correct answer

Who introduced the concept of primary memory?

1. William James
2. Brenda Milner
3. Carl Lashley
4. Donald O. Hebb

Answer: 1

Question 4. Choose the correct answer

What process forms new mental representations?

1. Attention
2. Perception
3. Thinking
4. Feeling

Answer: 3

Question 5. Choose the correct answer

What is NOT included in the stages of sound analysis?

1. Acoustic analysis
2. Lexical identification
3. Syntactic analysis
4. Correlation with auditory receptors

Answer: 4

Theme # 3. The psychophysiological basis of neurosciences**Question 1.** Choose the correct answer

What part of the brain regulates the activity of the heart, blood vessels and respiration?

1. Hypothalamus
2. Thalamus
3. Cerebellum
4. Medulla oblongata

Answer: 4

Question 2. Choose the correct answer

What area of the brain is responsible for the assimilation and understanding of written and oral speech?

1. Visual cortex
2. Wernicke area
3. Broca area
4. Supracranial gyrus

Answer: 2

Question 3. Choose the correct answer

What disease is caused by the degeneration of the substantia nigra?

1. Depression
2. Alzheimer's
3. Parkinsonism
4. Bipolar disorder

Answer: 3

Question 4. Choose the correct answer

What is the resting membrane potential?

1. The potential difference on the inside and outside of the membrane
2. Potential difference between cell organelles
3. The charge difference between two nerve cells
4. Change of charge on the membrane

Answer: 1

Question 5. Choose the correct answer

Errors associated with changing information after an event/false memories result from the pathology of...

1. Frontal lobes
2. Cerebellum
3. Temporal lobe
4. Brain stem

Answer: 1

Theme # 4: Experimental Psychology**Question 1.** Choose the correct answer

What hypothesis is used to compare the recorded parameters and empirical research data necessary for mathematical interpretation?

1. Theoretical hypotheses
2. Scientific hypotheses
3. Statistical hypotheses
4. Experimental hypotheses

Answer: 3

Question 2. Choose the correct answer

What is the type of experiment during which the experimenter develops the existing qualities in the subject and forms new ones?

1. Field experiment
2. Pathopsychological experiment
3. Ascertaining experiment
4. Formative experiment

Answer: 4

Question 3. Choose the correct answer

What is electrooculography based on?

1. Measurement of the electric field near the eye
2. Measurement of refraction of infrared color
3. Measuring the electrical activity of the eye muscles
4. Measuring the electrical resistance of the eye

Answer: 1

Question 4. Choose the correct answer

Invasive methods do NOT include

1. Electrocardiography
2. Angiography
3. Deep brain stimulation
4. Cortico-spinal biopsy

Answer: 2

Question 5. Choose the correct answer

Research data are presented by the types of temperament - sanguine, phlegmatic, choleric, and melancholic. What is this type of measurement scale called?

1. Ordinal scale
2. Nominal scale
3. Interval scale
4. Relationship scale

Answer: 2

Theme # 5. Clinical Psychology

Question 1. Choose the correct answer

Priggery is a loss of the ability of...

1. Abstract thinking
2. Distinguish the main from the secondary

3. Think purposefully
4. Concentrate attention

Answer: 3

Question 2. Choose the correct answer

What is the inability of a person to understand speech addressed to him?

1. Akinesia
2. Apraxia
3. Agnosia
4. Aphasia

Answer: 4

Question 3. Choose the correct answer

How does the World Health Organization define health?

1. The main value of life, the peak in the hierarchy of needs
2. The state of complete physical, mental, and social well-being of a person
3. One of the most important components of human happiness and one of the leading conditions for successful social and economic development
4. A set of nonspecific adaptive reactions of the body to the effects of various adverse factors that violate its homeostasis

Answer: 2

Question 4. Choose the correct answer

What is alexithymia?

1. A system of personality stabilization aimed at protecting consciousness from unpleasant, traumatic experiences
2. Synonym to distress
3. Mental disorder, the main symptoms of which are low mood and anhedonia
4. Reduced ability to perceive one's own feelings and emotions, their adequate verbalization and expressive transmission

Answer: 4

Question 5. Choose the correct answer

What is the body schema?

1. The internal representation of the body constructed by the brain, reflecting its structural organization, and performing the functions of determining the boundaries and integrity of the body, perception of its location
2. Conscious ideas about your body that arise in early childhood
3. Arbitrary control of motor skills
4. Sociocultural ideas about the norms of behavior

Answer: 1

10 intermediate-level tasks

For each correct answer, the participant receives 3 points.

The maximum number of points is 30.

Theme # 1. The History of Psychology

Question 1. Choose several correct answers

What are the main subjects of analysis in humanistic psychology?

1. Self-actualization of personality
2. Interpersonal communication
3. Individual differences due to heredity and environmental conditions
4. Mental health

Answers: 1, 2, 4

Question 2. Choose several correct answers

What are the historical precursors of modern cognitive psychology?

1. Greek philosophy
2. 17th-century empiricism
3. 19th-century structuralism
4. Neocognitive revolution

Answer: 1, 2, 3, 4

Theme # 2. Cognitive processes**Question 1.** Choose several correct answers

Which of these are memory types?

1. Short-term and long-term
2. False and true
3. Motor, emotional, figurative, verbal, and logical
4. Voluntary and involuntary

Answer: 1, 3, 4

Question 2. Choose several correct answers

What are the types of perception disorders while maintaining sensitivity and consciousness?

1. Disorder of recognition of parts of one's own body
2. Disorder of recognition of familiar objects without visual control
3. Disorder of recognition of sounds and speech, while maintaining the functions of the auditory analyzer
4. Disorder of purposeful movements and actions with the preservation of its constituent elementary movements

Answers: 1, 2, 3

Theme # 3. The psychophysiological basis of neurosciences**Question 1.** Choose several correct answers

What parts are isolated in the thalamic brain?

1. Metathalamus
2. Hypothalamus
3. Epithalamiums
4. Thalamus

Answers: 1, 3, 4

Question 2. Choose several correct answers

Which neurotransmitters are responsible for the emotional sphere?

1. Glutamic acid
2. Dopamine
3. Norepinephrine
4. Serotonin

Answer: 2, 3, 4

Theme # 4. Experimental Psychology

Question 1. Choose several correct answers

What statistical methods allow testing the hypothesis of the existence of relationships between the studied indicators?

1. Correlation analysis (Pearson's criterion)
2. Correlation analysis (Student's criterion)
3. Regression analysis
4. The Mann-Whitney Criterion

Answers: 1, 2, 3

Question 2. Choose several correct answers

What sections must necessarily be present in a scientific publication based on the results of a psychological study, according to the APA rules?

1. Discussion of the results
2. Methods
3. Diagrams and drawings
4. Introduction

Answers: 1, 2, 4

Theme # 5. Clinical Psychology

Question 1. Choose several correct answers

What are the three stages of stress identified by H. Selye?

1. The stage of the final impulse
2. The stage of shock and countershock
3. The stage of resistance
4. Stage of exhaustion

Answers: 2, 3, 4

Question 2. Choose several correct answers

What are the three stages of the formation of a personal reaction to a somatic disease?

1. Sensological stage
2. Evaluation stage
3. The stage of the formed attitude of the individual to the disease
4. The stage of denial of the disease

Answers: 1, 2, 3

5 tasks of a difficult level.

For each correct answer, the participant receives 9 points.

The maximum number of points is 45.

Evaluation criteria	
The composition of the criterion and the main assessment	Criteria score
1. Read the part of the scientific article. Formulate the research hypothesis and justify your answer.	
The answer clearly describes the hypothesis that the analyzed study aims to test. All formulations are precise and reasoned.	9 points
The answer partially describes the hypothesis that the analyzed study aims to test. There are some shortcomings in the wording and argumentation.	6 points
The hypothesis is not interpreted correctly and there is no argumentation.	3 points
2. Write down the dependent and independent variables of the study and justify your answer.	
All dependent and independent variables are identified correctly, and there is an explanation of the choice.	9 points
All dependent and independent variables are defined correctly, but there is no explanation of the choice. Or the dependent and independent variables are partially defined and there is no explanation of the choice.	6 points
Dependent and independent variables are defined with gross errors	3 points
3. Describe the research design (general plan of the study, describe how the study was conducted (when, where, with which participants the measurements of certain parameters were performed)).	
The general plan of the study is described. There is also a detailed description of how the study was organized (time, place, participants, types of measurements, and parameters).	9 points
The answer only partly describes the study design or not describes all aspects of data collection, measurement procedures and the frequency of given measurements.	6 points
The answer describes the design of the study but does not describe the data collection procedure, including how the parameters are measured and how often these measurements are taken.	3 points
4. Suggest the statistical methods that can be used to test the hypothesis and justify your choice	

The proposed statistical processing methods for testing the hypothesis are correct and justified.	9 points
Not all methods of statistical data processing for testing the hypothesis are given, but there is a rationale for the presented methods.	6 points
There is no substantiation of the proposed methods of statistical data processing.	3 points
5. Analyze the results of the study and formulate THREE main points for the conclusion.	
Three relevant conclusions are made. All conclusions correspond to the objectives of the study. The participant demonstrates a high level of linguistic and stylistic literacy. There are no spelling and stylistic mistakes in the work. The author is fluent in a business style of speech.	9 points
Conclusions are based on the results of the study, but they are not always reasoned. The conclusions generally correspond to the objectives of the study. There are some stylistic mistakes, however, the participant demonstrates a good command of the academic language.	6 points
The conclusions do not reflect the results of the study. Some of them are erroneous and not always in line with the research objectives. There are some stylistic and spelling errors, and the author has a poor command of the academic language.	3 points

1. Read the part of the scientific article. Formulate the research hypothesis and justify your answer.

Answer:

1. The change in the level of excitation of the autonomic system will be associated with the level of cognitive load.
2. When solving tasks on working memory, the cognitive load will be associated with the predominance of the sympathetic nervous system (SNS). This relationship is due to the need to mobilize resources.

There is a problem of classifying the level of cognitive load on the basis of vegetative indicators; complex studies of the physiological correlates of overload of cognitive processes have not been studied enough. Accordingly, it remains unclear how a change in the level of excitation of the autonomic system will be associated with the level of cognitive load.

2. Write down the dependent and independent variables of the study and justify your answer.

Answer:

- 1) Independent variables: the length of the list of digits and the number of elements.
An independent variable is a variable that is changed or controlled in an experiment to test the effect on the dependent variable. The length of the list of digits and the number of elements for answers are variables that are given by the experimenter and will affect the dependent variable - the correctness of the answer, heart rate, a change in the pupil diameter and the average reaction time.
 - 2) Dependent variables: correct answers, heart rate, a change in the pupil diameter and mean reaction time. A dependent variable is a measured variable in an experiment. Changes in the dependent variables are caused by those in the independent variables.
- 3. Describe the research design (general plan of the study, describe how the study was conducted (when, where, with which participants the measurements of certain parameters were performed)).**

Answer:

The design of the study is a replicated (repeated) cohort study of psychophysiological characteristics using instrumental methods. The study involved 86 people (74 women, 12 men; mean age 20.5 years, and age 18–44 years).

The experimental procedure included the following research methods: single-channel electrocardiogram (ECG), photoplethysmogram (PPG), and eye-tracking. NASA-TLX, the index of subjective assessment of cognitive load, was also determined.

Participants in the study were played a pre-recorded audio recording containing a sequence of digits (5 digits, 9 digits, and 13 digits). The digits had to be either memorized or simply listened to (a voice command was given). After that, a microphone sign appeared on the screen. Participants were asked to pronounce the digits that they remembered, or it was not necessary to say them aloud. At the end of each series of digits, the voice command "end of the series" was given. After the instruction and during the oral presentation of the digits, a fixation cross appeared on the screen, which was necessary to hold attention in order to record the data of the eye tracker. Subjective evaluation of the cognitive load was performed using the NASA-TLX task load index, which was completed after every third series. There were 9 series in total.

- 4. Suggest the statistical methods that can be used to test the hypothesis and justify your choice.**

Answer:

1. Correlation analysis of physiological indicators (Correlation analysis allows for determining the strength and nature of the stochastic relationship between variables (random variables).

In this study, the researcher should perform a correlation analysis of the relationships between the productivity of working memory (the number of correctly reproduced digits) and the average heart rate measured using an ECG, and changes in the PPG / pupil diameter measured using an eye tracker.

2. ANOVA analysis of variance.

A change in the heart rate upon presentation of each new digit.

Before the variance analysis, it is necessary to assess

- independent samples;
- the normal distribution of the trait in the statistical aggregates from which the samples were extracted;
- equality (homogeneity) of the variances of the studied trait in the statistical aggregates using the Levene criterion;
- independent observations in each of the samples.

5. Analyze the results of the study and formulate **THREE** main points for the conclusion.

Answer:

1. The study showed that the heart rate responded to the presentation of every digit. This may indicate the excitation of the sympathetic nervous system during the perception of new information.
2. The analysis showed the sensitivity of the heart rate to cognitive load (the highest heart rate was registered during memory tasks), but not to cognitive overload.
3. The pupil expanded with an increase in the length of the presented series of digits in short-term memory tasks, after reaching a peak during the retention of 7 digits in the memory. The pupil diameter did not change. Consequently, there is a correlation between changes in the level of excitation of the HNS and the degree of cognitive load.

PART OF THE SCIENTIFIC ARTICLE

Description of the empirical research plan and basic procedures

The purpose of the study is to determine the relationship between the level of excitation of the autonomic nervous system under cognitive load.

Sample Description: The study involved 86 people (74 women, 12 men; average age 20.5 years, age range 18-44 years).

Research methods: To measure the psychophysiological data of cognitive load, methods of recording the cardiac activity of ECG and FPG and pupil diameter were used. The experiment used the digit span problem (a series of digits) for working memory and passive listening to digits of 3 levels of difficulty (5, 9, or 13 digits).

Cognitive load is the use of cognitive resources (attention, working memory, etc.) during tasks, including processing and perception of information. Excessive use of cognitive resources results in cognitive overload, which can lead to reduced academic and operator performance, etc.

Heart variability (HCP) and pupillary diameter are objective indicators of the activity of the autonomic nervous system (ANS) reflecting a person's psychological state. The review of the literature has shown that empirical studies exploring the relationship between cognitive functions, cardiac activity and pupillary diameter are contradictory.

Experiment procedure:

The experiment was reproduced by Peavler (Peavler, 1974) and Granholm (Granholm et al., 1996) [41, 81], and was implemented with PsychoPy in the Python programming language. The test procedure included the following research methods: EKG, FGF and eye tracking.

During the experiment, there was a digit span (series of digits) problem testing working memory and a passive numeric listening task. The digital range problem was first used for memory research by Ebbinghaus, and later in the Wexler test battery, where it was noted that the range of digits is also an indicator of attention retention. The task involves the experimenter reading a sequence of numbers and then reproducing this range to the test subject [55]. During the experiment, a pre-recorded audio tape containing a sequence of digits was played.

The experiment started with an exclamation mark icon lasting 0.5s and the recorded voice command "start". This was followed by one of the instructions: 1) "memorize successive digits", meaning to memorize as many digits as possible, starting with the first one and repeating them in the correct sequence; or 2) listen to a series of digits (without memorizing then). The task had

three levels of difficulty: the subjects were audibly presented with 5 digits (an easy task which could be completed by almost everybody), 9 digits (a moderate difficulty task which is more difficult to complete) or 13 digits (a high level of difficulty which is almost impossible to cope with). Digits from 0 to 9 were used, lasting for 664 ms. (min: 462ms, max: 813ms). The appearance of a "microphone" icon on the screen signaled the subjects that their answers were being recorded (the recording duration of the answers was 7, 11, and 15 sec. respectively with the complexity of the numerical sequence being presented). At the end of each series, a voice command "end of series" was given. After the instruction and during the verbal presentation of the digits, a fixation cross was displayed on the screen. It was necessary to fixate attention to record the data of the eye-tracker. The interval between the series was 5 sec.

Subjective assessment of cognitive load was made using the NASA-TLX task load index, which was filled in after every third series (three times in total). The NASA-TLX task load index revealed only the total level of cognitive load regardless of the preceding stimuli (i.e., the load level did not vary with time).

Study results

A HR response to each digit was recorded, which had not been seen before in other studies. The analysis showed sensitivity of HR to cognitive load, but not to cognitive overload. Thus, the response to cognitive overload may have been delayed and the length of the recording did not allow its detection with the method used, or HR was not sensitive to cognitive overload in general.

In our study, the pupil diameter began to decrease after peaking at an average retention level of 7 digits. After the presentation of 13 digits, the pupil diameter no longer differed from that after the presentation of 5 digits ($t(78) = 0.226$, $p = .82$, $BF_{01} = 5.77$). The overall effect of cognitive load was highly significant ($F(2, 130) = 9.04$, $p < .001$, $\eta^2 = .10$), as was the interaction of cognitive load (the pupil diameter at holding 5, 9 or 13 digits) and the difficulty of the task (remembering or passive listening) factors $F(2, 156) = 11.53$, $p < .001$, $\eta^2 = .13$.