An Experimental Study on Relationship between Intellectual Concentration and Personal Mental Characteristics

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Introduction

- Diagnosis of mental disorders are almost depending on subjective judgement
  …doctors' diagnosis, answers for questionnaires and so on

- If there is a diagnosis using quantitative data, they can be judged from another viewpoints

- Mental disorders may influence some mental activities…?

- If there is a quantitatively measurable mental activity, it can be used as scales for mental disorders…?

Purpose

Focus on conventional studies about evaluating **intellectual concentration** quantitatively

- Investigate the relationship between quantitatively evaluated **intellectual concentration** and **mental disorders**

depression, neurosis (mental illness)

+ autism spectrum (developmental disorder)

- As factors that can influence mental state, **personal characteristics** are also investigated

Process

1. Survey **personal mental characteristics**
2. Measure **intellectual concentration**
   Quantify **intellectual concentration**
3. Analyze the relationship between them

- Participants: 236 students of Kyoto University

Method – 1. Survey

Answer these questionnaire via the internet in advance

- General Health Questionnaire (GHQ)
- Global Scale for Depression（GSD）
- Autism-spectrum Quotient（AQ）

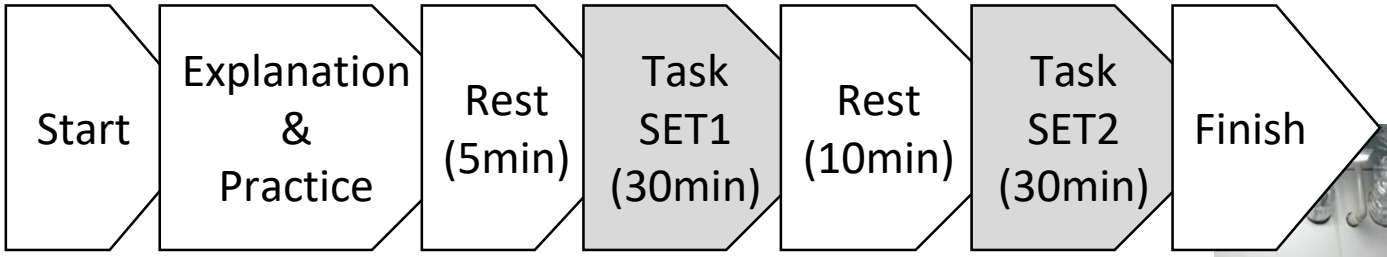
} mental disorders

- BIS/BAS scale
- Yatabe-Guilford Personality Inventory
- NEET/Hikikomori Risk Scale

} personal characteristics

Method – 2. Experiment for measuring concentration

- Time: about 2 hours starting from a.m. 9:00 or p.m. 2:30

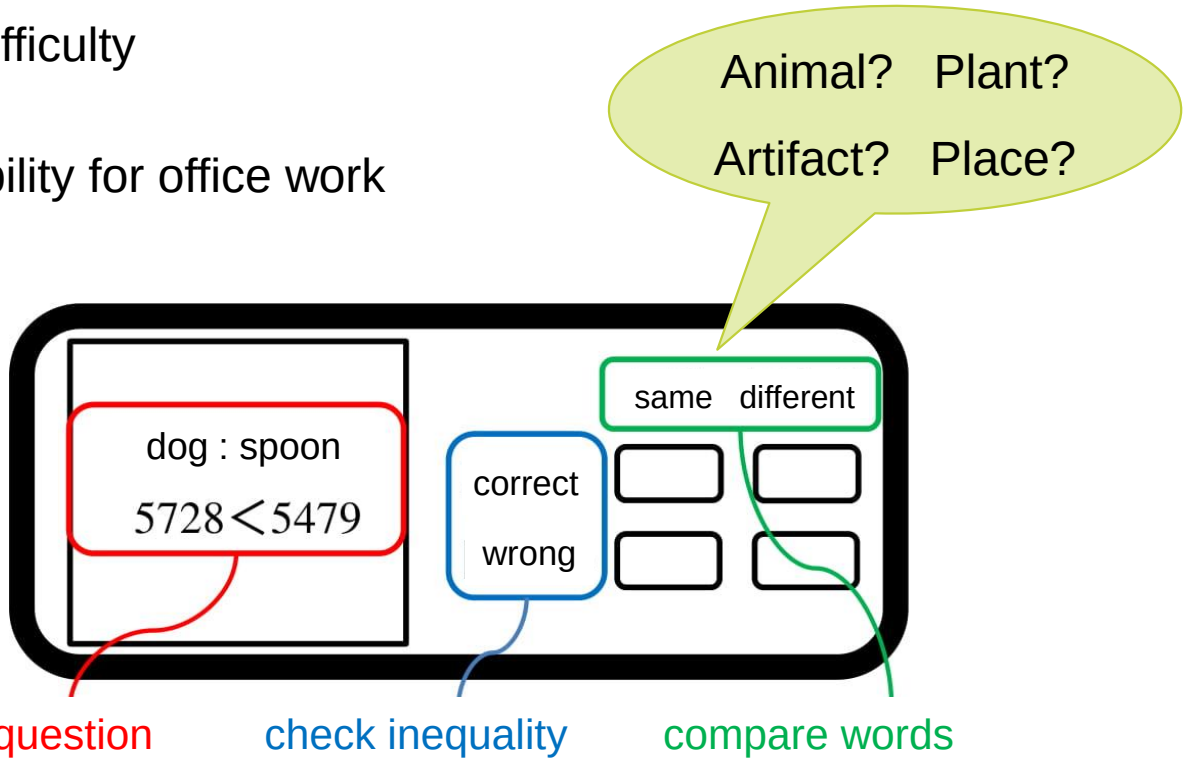


- 8 participants maximum per an experiment

- The data of 10 participants out of 236 were omitted because of sleeping

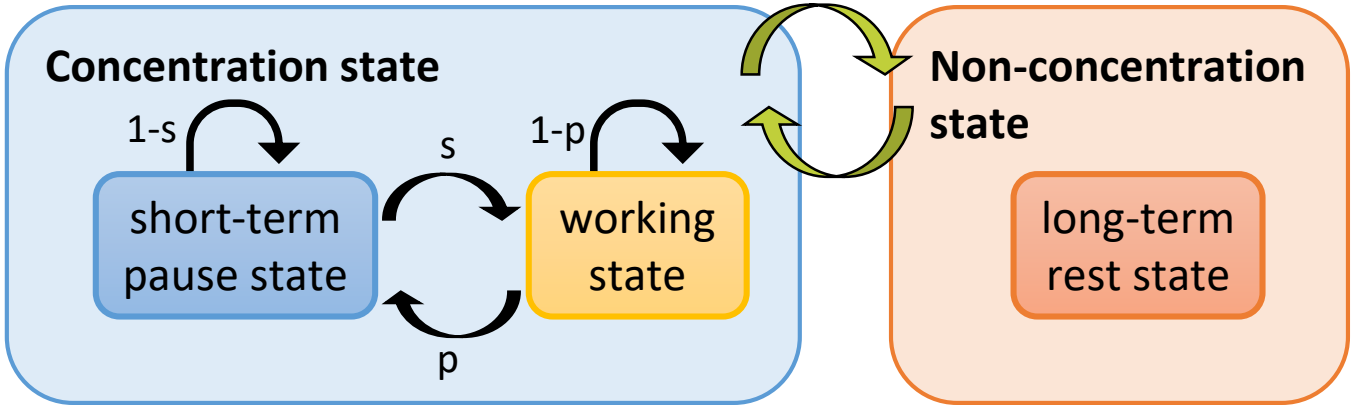
Comparison Task

- Good features
  - uniform difficulty
  - require ability for office work



Method – 2. Quantification

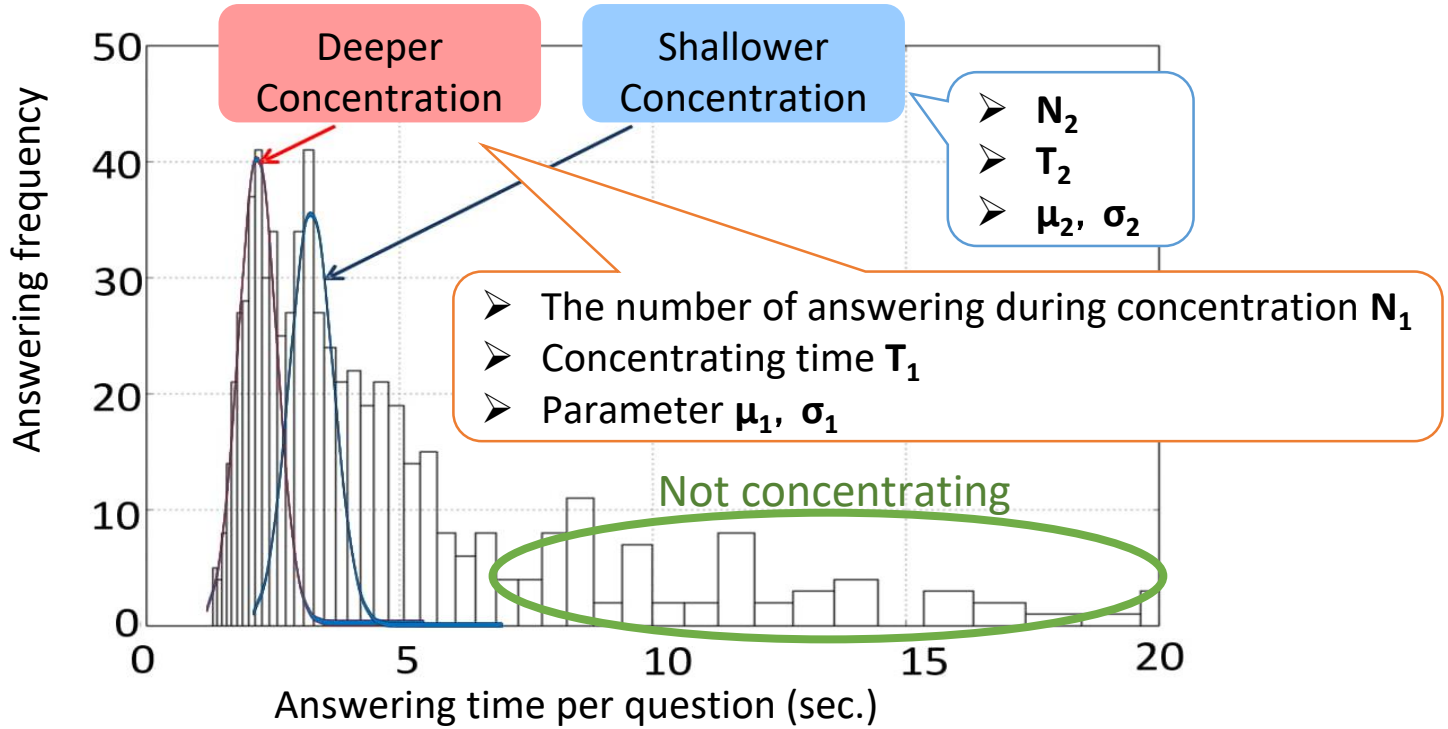
- Human states during intellectual work can be divided into 3 states



- The distribution of the answering time during concentration state can be approximated by sum of 2 lognormal distributions: deeper concentration and shallower concentration

Method – 2. Quantification

- Example of approximation
  deeper concentration & shallower concentration



- These calculated values (next slide) were used as feature values which express the **intellectual concentration**

3. Values for analysis (1)

Intellectual concentration

- The number of answers during deeper concentration
- The ratio of time in deeper concentration (CTR)
- The ratio of time in deeper concentration
  among all concentration state (CDI)

- The parameters showing lognormal distributions "μ and σ"
  ※ $\frac{1}{\sqrt{2\pi}\sigma t}\exp\left[-\frac{(\ln(t)-\mu)^2}{2\sigma^2}\right]$
- The difference between deeper and shallower concentration
  calculated from μ and σ
- The difference between SET1 and SET2

etc…　　36 feature values in total

3. Values for analysis (2)

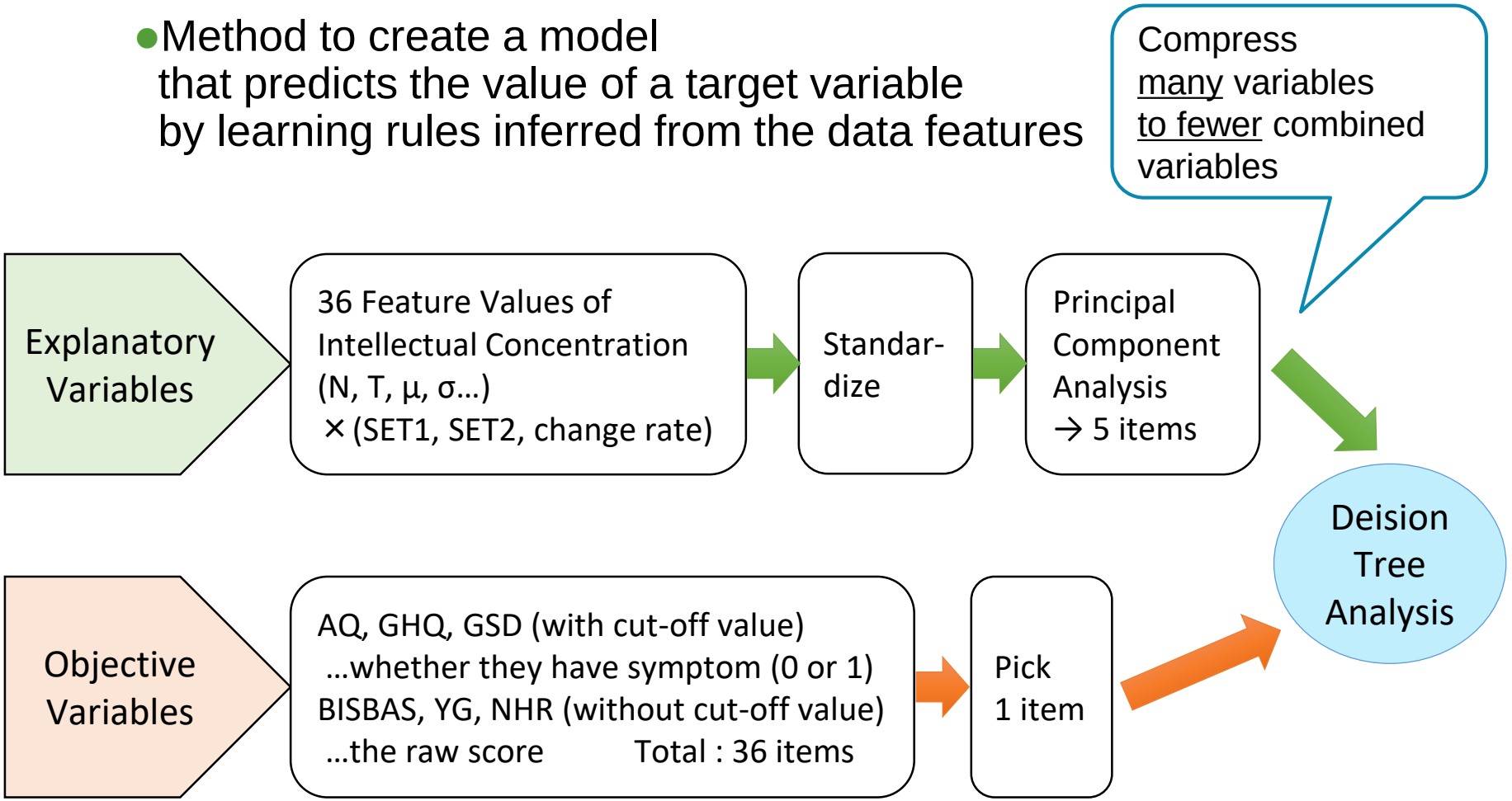
Personal mental characteristics

• General Health Questionnaire	6 factors and total score
• Global Scale for Depression	2 factors
• Autism-spectrum Quotient	5 factors and total score
• BIS/BAS scale	6 factors
• Yatabe-Guilford Personality Inventory	12 factors
• NEET/Hikikomori Risk Scale	3 factors

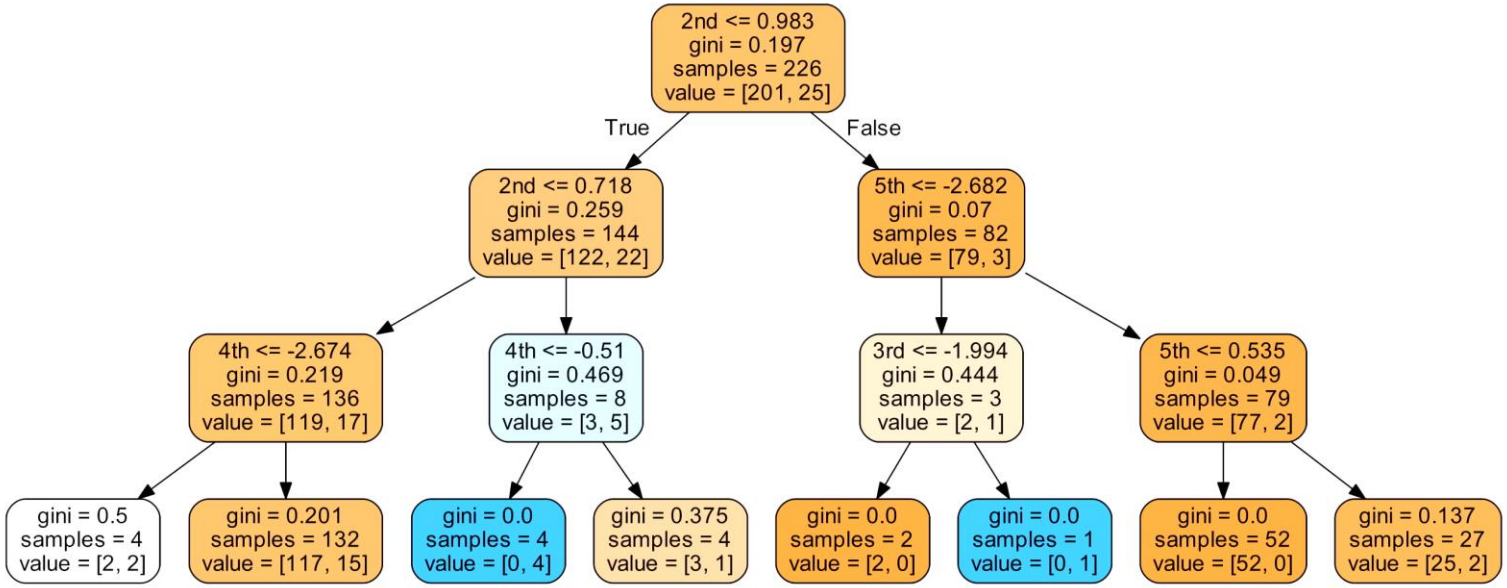
36 items in total

3. Analysis – Decision tree

- Method to create a model
  that predicts the value of a target variable
  by learning rules inferred from the data features



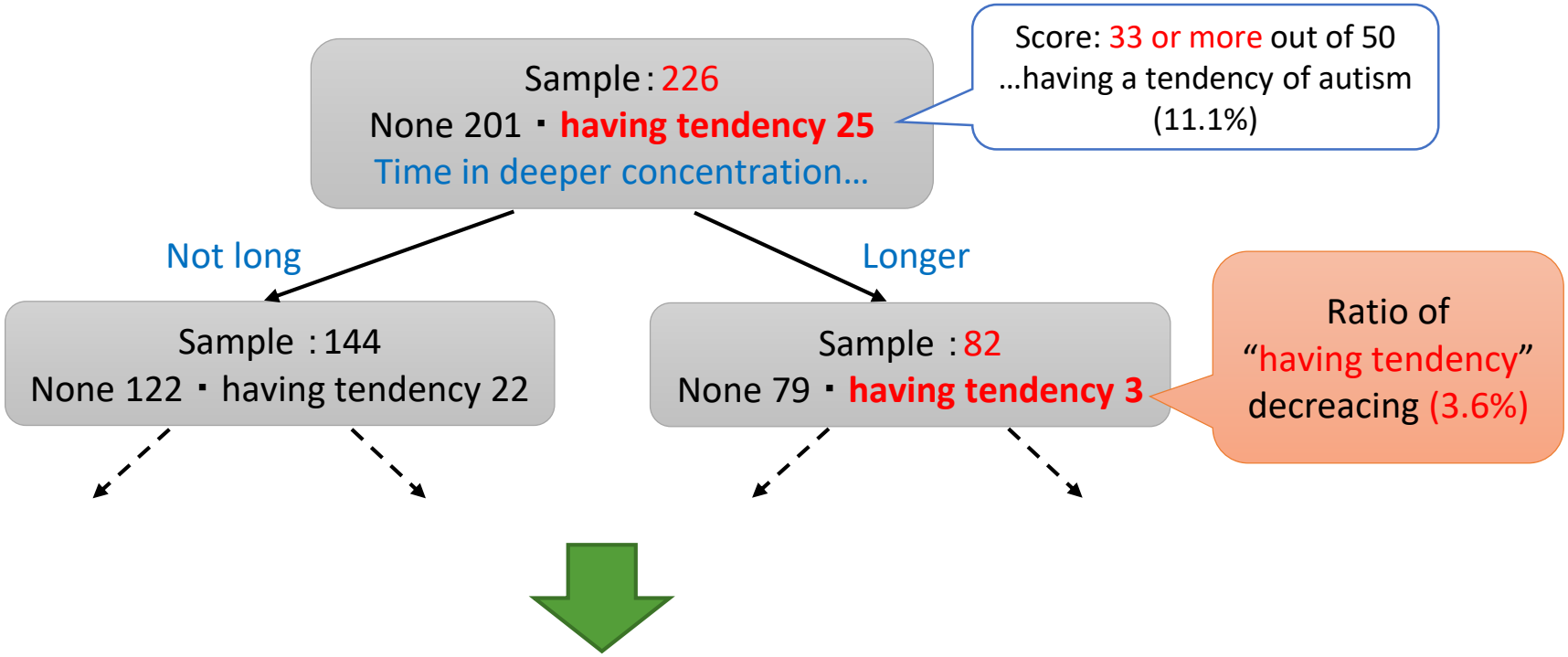
Example of analysis result



- Pick up points where the objective variable greatly differs before and after the branch
- Compare it with the explanatory variable set as the branching condition

→ Relationship

Result – example of autism spectrum (simplified)

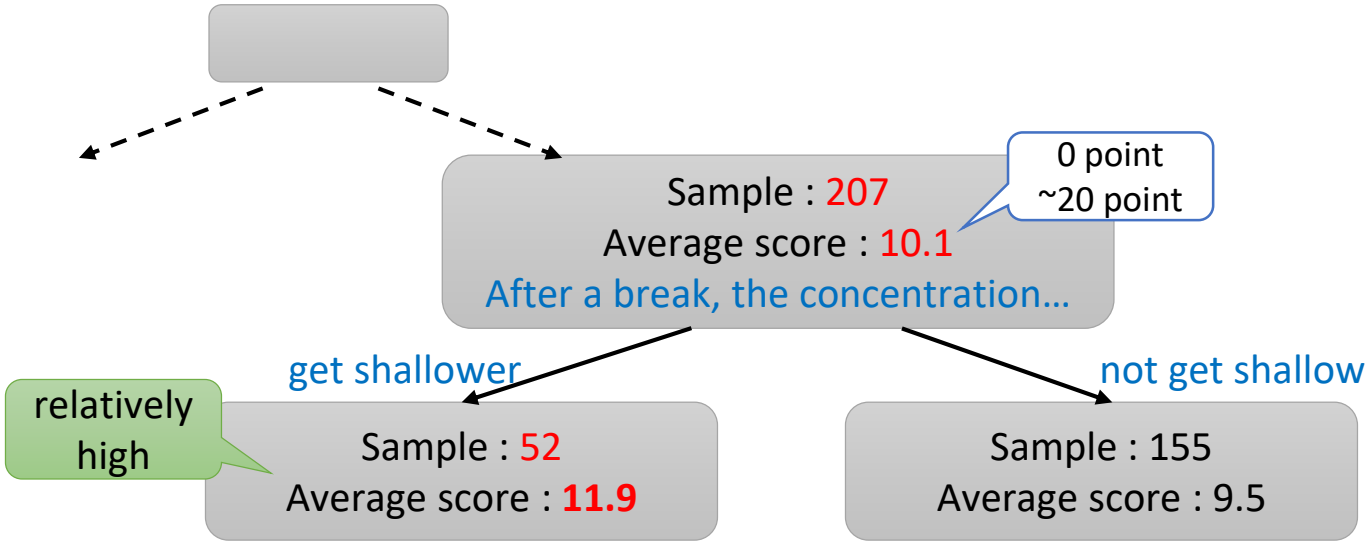


It is supposed that…

a person who has relatively more time in deeper concentration is likely not to have an autistic tendency

Result – example of personality inventory (simplified)

- The result about a factor in Yatabe-Guilford Personality Inventory, “recurrence”

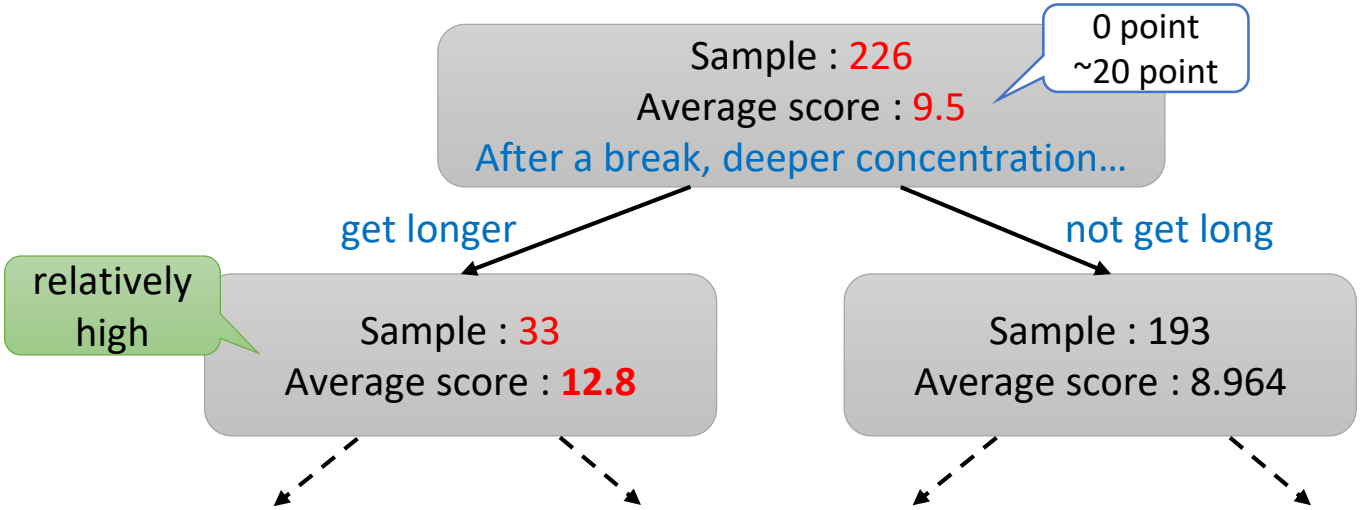


It is supposed that…

a person who’s concentration get shallower after a break is likely to be emotional

Result – example of personality inventory (simplified)

- The result about a factor in Yatabe-Guilford Personality Inventory, “social extroversion”



It is supposed that…

a person who’s deeper concentration get more after a break is likely to be outgoing

All notable results

Scale	Condition	Tendency
Autism-spectrum Quotient	Long deeper concentration	No autism spectrum
BIS/BAS scale	Deeper concentration getting longer after a break	Active
NEET/Hikikomori Risk Scale	Short deeper concentration	Temperament like job-hopping part-timers
Yatabe-Guilford Personality Inventory	Concentration getting shallower after a break	Emotional
	Deeper concentration getting longer after a break	Confident
	Long deeper concentration	Obedient
	Deeper concentration getting longer after a break	Outgoing

- no notable relationship was found concerning neurosis and depression

Future study

- Discuss the validity of the results with experts on medicine or psychology

- Spread the perticipants for experiment (ex. the elderly)
  - The participants were limited to university students

- Try another method of analysis except for decision tree