

An investigation of the item length in the forced-choice psychological measurement

Kyosuke Bunji

Kobe University

Takeshi Sugiyama

Recruit Management Solutions Co., Ltd.

Kensuke Okada

University of Tokyo



bunji@bear.kobe-u.ac.jp

The 13th Conference of the IASC-ARS

Dec 4, 2025

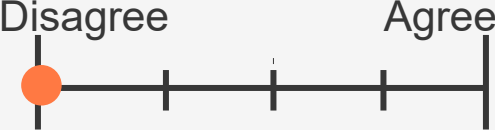
1

Introduction

Respondents are required to **choose the best option** in each block

Single-Stimulus (SS); Likert Scale

Q. To what extent do you agree with the following words about yourself?

active	
depressed	
honest	
rational	

... is frequently contaminated by systematic response biases

(4-Alternative) Forced-Choice

Q. Choose one word that best describes you.

☐	active
☐	depressed
☐	honest
☒	rational

... is designed to reduce systematic response biases

■ It would be difficult to answer each block

Ex) OPQ32

(One of the most famous assessment tools for job conduct)

	Most	Least
I like to discuss abstract concepts	☒	☐
I enjoy interpreting statistics	☒	☐
I feel that people are honest	☒	☐

Q. To what extent do you agree with the following words about yourself?

I like to discuss abstract concepts



Tourangeau et al.
(2000)'s model

Comprehension

Understand the meaning of the statement

Recall

Recall past relevant experiences

Judgment

Consider the level of agreement

Response

Select the appropriate option



"Somewhat agree"
I guess that's about it!

It would be difficult to answer each block

Ex) OPQ32

(One of the most famous assessment tools for job conduct)

	Most	Least
I like to discuss abstract concepts	☒	☐
I enjoy interpreting statistics	☒	☐
I feel that people are honest	☒	☐

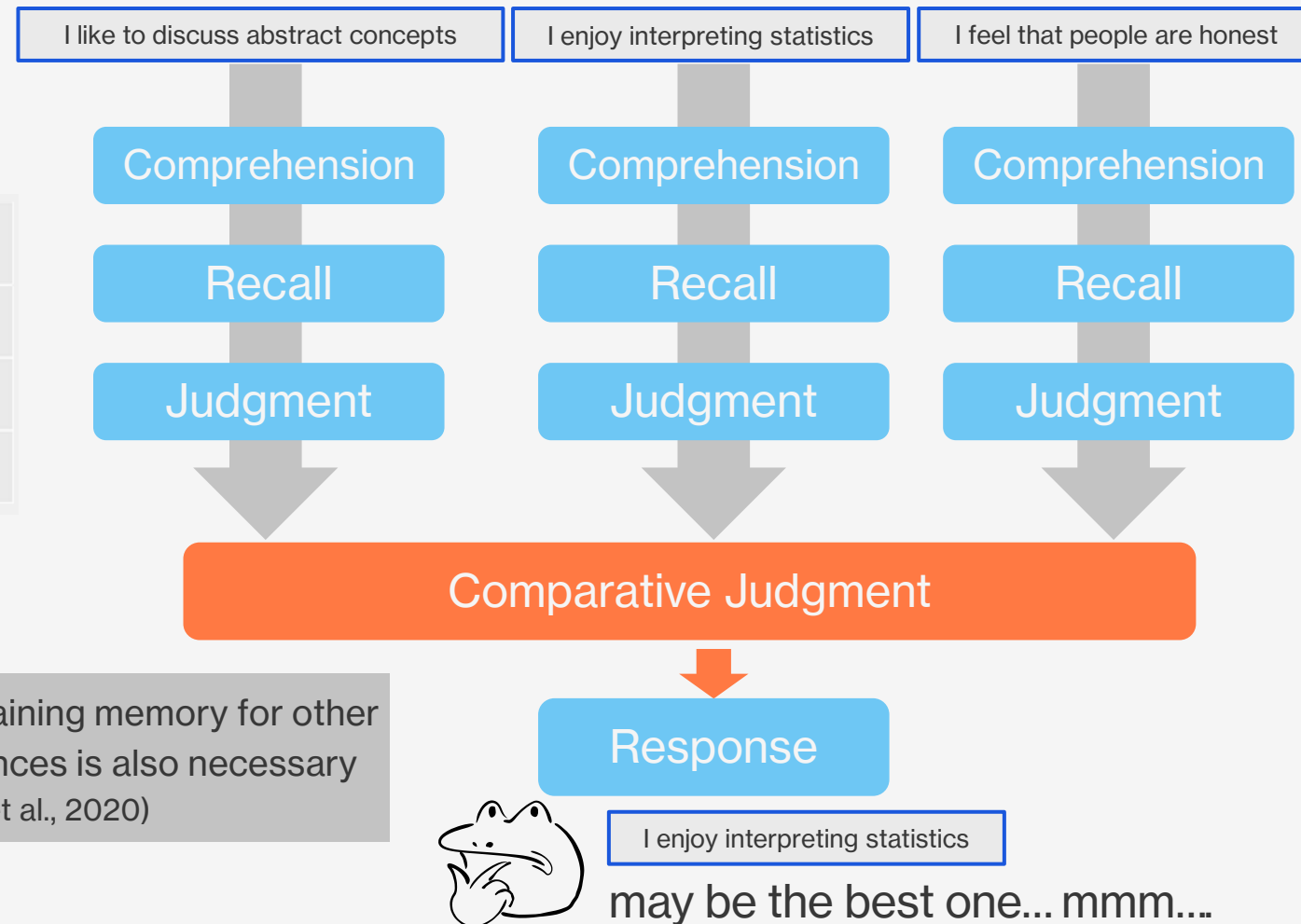
Q. To what extent do you agree with the following words about yourself?

Disagree

I like to discuss abstract concepts

Maintaining memory for other sentences is also necessary (Sass et al., 2020)

In the case of FC format



■ Lenzer et al. (2010)

Lengthy or complex questions may overload one's working memory

Ex) a sentence requires readers to hold a lot of information, or includes many logical operators (and/or)

■ Alwin & Beattie (2016)

Reliability decreases as the number of words in a question increases

→ KISS (Keep it simple, stupid) principle should be observed

■ Hamby and Ickes (2015)

Shorter and more "de-contextualized" items show better performance (Cronbach's α) in terms of assessing personality traits

Longer items may seem to have adverse effects to response quality

Screen image

	HEXACO (Ashton & Lee, 2009)	HEXACO adjective scale (Romano et al., 2023)
	(Short) sentence	Adjective
Likert	How well does the following describe you? I feel strong emotions when someone close to me is going away for a long time. Strongly inaccurate Inaccurate Slightly inaccurate Slightly accurate Accurate Strongly accurate	How well does the following describe you? patient Strongly inaccurate Inaccurate Slightly inaccurate Slightly accurate Accurate Strongly accurate
FC (Paired)	Which statement describes you better, and to what extent? I'm interested in learning about the history and politics of other countries. Much more More Slightly more Slightly more More Much more The first thing that I always do in a new place is to make friends. Much more More Slightly more Slightly more More Much more	Which statement describes you better, and to what extent? honest Much more More Slightly more Slightly more More Much more attentive Much more More Slightly more Slightly more More Much more

- To investigate whether the length of choice options influences cognitive load and response quality in FC vs Likert formats.

[Hypotheses]

Sentence-type items impose greater cognitive load than adjective-type ones.

1. Response stability is **lower** for sentence-type items.
2. Perceived difficulty is **higher** for sentence-type items.
3. Response time is **longer** for sentence-type items.
4. These effects are more pronounced in the FC format than the Likert format.

Data were collected via crowdsourcing platform (Prolific).

■ List of conditions and scales used (randomly assigned to one condition)

【format】 \ 【item type】		HEXACO (Ashton & Lee, 2009)	HEXACO adjective (Romano et al., 2023)
		(Short) sentence	Adjective
All 60 items were randomly presented.	Likert (LK)	LK_sentence ($n = 229$)	LK_adjective ($n = 233$)
Create 30 pairs in advance and present them randomly.	Paired Comparison (PC)	PC_sentence ($n = 239$)	PC_adjective ($n = 207$)

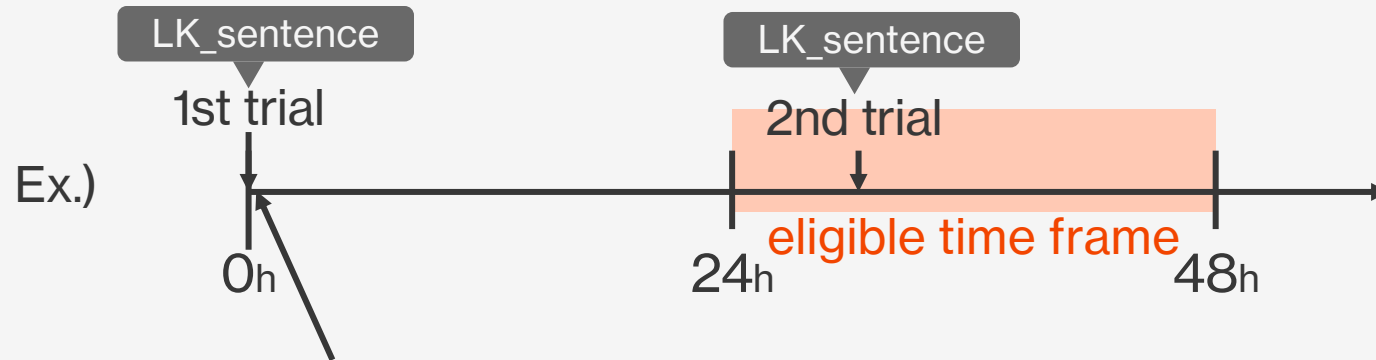
Each scale consists of 60 items

In the preliminary matching of statements, we conducted a genetic algorithm search to minimize the difference in social desirability (collected in a preliminary survey) under the following constraints:

- The number of times factor pairs appear (ensuring each of the 15 pairs appears twice)
- The combination of directions of options (ensuring at least 6 pairs with different directions appear)

■ Procedure of the data collection

Two sessions: first trial and second trial **after 24–48 hours.**



Perceived easiness was answered in a 7-point scale after 1st trial

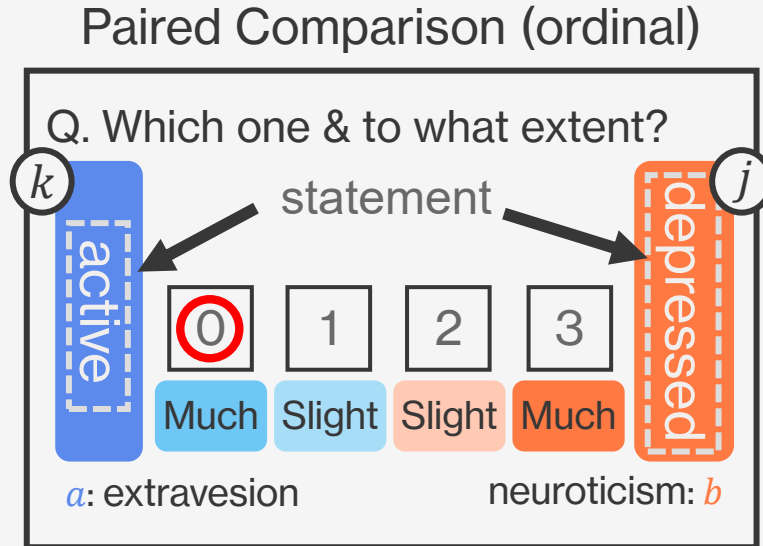
How difficult did you find the previous section?

Please use the scale below, where 1 = Very difficult and 7 = Very easy.*

- ☐ 1 (Very Difficult)
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7 (Very Easy)

One of the most common models for the FC (Paired Comparison) scale.

- Consider a pair of statements (j , k) that reflect different factors (a , b)



$$x_{jk}^* = u_j - u_k \quad x_{jk} = \begin{cases} C-1 & \text{if } x_{jk}^* \geq \tau_{C-1} \\ C-2 & \text{if } \tau_{C-1} \geq x_{jk}^* \geq \tau_2 \\ \dots & \\ 1 & \text{if } \tau_2 \geq x_{jk}^* \geq \tau_1 \\ 0 & \text{if } x_{jk}^* \leq \tau_1 \end{cases}$$

- The latent utility for one statement j is given as:

$$u_j = \mu_j + \beta_j \eta_a + \varepsilon_j \quad \varepsilon_j \sim N(0, 0.5) \quad \text{fixed to 0.5 for PC scale}$$

- The probability $P(x_{jk} = c | \boldsymbol{\eta})$ is:

Normal ogive model

$$P(x_{jk} \geq c | \boldsymbol{\eta}_i) = \Phi[(\mu_j + \beta_j \eta_a) - (\mu_k + \beta_k \eta_b) - \tau_c]$$

$$P(x_{jk} = c | \boldsymbol{\eta}_i) = P(x_{jk} \geq c | \boldsymbol{\eta}_i) - P(x_{jk} \geq c + 1 | \boldsymbol{\eta}_i)$$

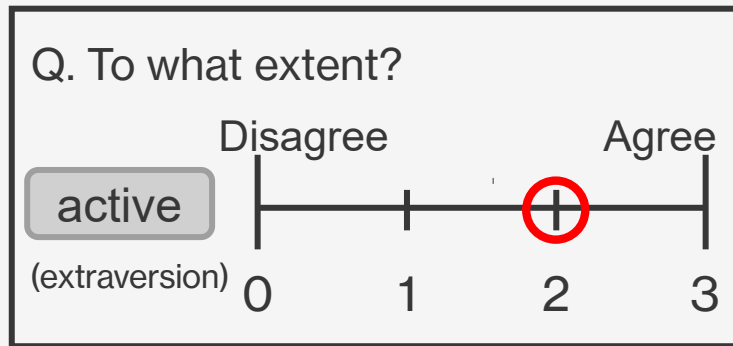
μ : mean utility of the statement

β : factor loading

η : factor score (trait)

One of the most common models for the Likert scale.

Likert scale



- Consider a statement j that reflect one factor a

$$x_j^* = u_j \quad x_j = \begin{cases} C-1 & \text{if } x_j^* \geq \tau_{C-1} \\ C-2 & \text{if } \tau_{C-1} \geq x_j^* \geq \tau_2 \\ \dots & \\ 1 & \text{if } \tau_2 \geq x_j^* \geq \tau_1 \\ 0 & \text{if } x_j^* \leq \tau_1 \end{cases}$$

- The latent utility for the statement j is given as:

$$u_j = \mu_j + \beta_j \eta_a + \varepsilon_j \quad \varepsilon_j \sim N(0, \sigma_j^2)$$

- The probability $P(x_j = c | \boldsymbol{\eta})$ is:

Normal ogive model

$$P(x_j \geq c | \boldsymbol{\eta}_i) = \Phi[\mu_j + \beta_j \eta_a - \tau_c]$$

$$P(x_j = c | \boldsymbol{\eta}_i) = P(x_j \geq c | \boldsymbol{\eta}_i) - P(x_j \geq c + 1 | \boldsymbol{\eta}_i)$$

μ : mean utility of the statement

β : factor loading

η : factor score (trait)

■ Analysis plan (within a Bayesian framework)

1. Test-retest reliability -> Inspect the posterior distributions of $\rho \rightarrow$ Explain later
2. Perceived easiness -> Bayesian ANOVA & visually compare distributions
3. Item-wise response-time -> Bayesian ANOVA & visually compare distributions

■ Bayesian ANOVA

A Bayesian analysis to compute Bayes factor between different models

Format	$y = \mu + \beta_{\text{format}} \times \text{format} + e$	$= BF$
null	$y = \mu + e$	

→ When $\left\{ \begin{array}{l} BF > 1, \text{ the main effect of format will be supported.} \\ BF < 1, \text{ the main effect of format will be rejected.} \end{array} \right.$

■ List of estimated parameters and prior distributions

[Respondent i 's factor scores]

$$\boldsymbol{\eta} = \begin{bmatrix} \boldsymbol{\eta}^{(1)} \\ \boldsymbol{\eta}^{(2)} \end{bmatrix} \sim MVN \left(\begin{bmatrix} \mathbf{0} \\ \mathbf{0} \end{bmatrix}, \begin{bmatrix} \boldsymbol{\Sigma}^{(1,1)} & \boldsymbol{\Sigma}^{(1,2)} \\ \boldsymbol{\Sigma}^{(1,2)} & \boldsymbol{\Sigma}^{(2,2)} \end{bmatrix} \right) \quad \begin{bmatrix} \boldsymbol{\Sigma}^{(1,1)} & \boldsymbol{\Sigma}^{(1,2)} \\ \boldsymbol{\Sigma}^{(1,2)} & \boldsymbol{\Sigma}^{(2,2)} \end{bmatrix} = \boldsymbol{\Sigma} \sim LKJ(1)$$

[mean utility of the statement (or pair)]

$$\left. \begin{array}{ll} \text{(TIRT)} & \alpha (= \mu_j - \mu_k) \sim \text{normal}(0, 5) \\ \text{(GRM)} & \mu_j \sim \text{normal}(0, 5) \end{array} \right\} \begin{array}{l} \text{with ordered constraint} \\ \text{for each statement (or pair)} \end{array}$$

[factor loadings]

$$\beta_j \sim \text{normal}(1, 3)$$

■ η were estimated as $6 \times 2 = 12$ -dimensional parameter

Same trait was estimated separately (to observe the change between trials)

(⚠ Item parameters were common between trials)

$$\eta = \begin{bmatrix} \eta^{(1)} \\ \eta^{(2)} \end{bmatrix} \sim MVN \left(\begin{bmatrix} \mathbf{0} \\ \mathbf{0} \end{bmatrix}, \begin{bmatrix} \Sigma^{(1,1)} & \Sigma^{(1,2)} \\ \Sigma^{(1,2)} & \Sigma^{(2,2)} \end{bmatrix} \right)$$

$$\begin{bmatrix} \Sigma^{(1,1)} & \Sigma^{(1,2)} \\ \Sigma^{(1,2)} & \Sigma^{(2,2)} \end{bmatrix} = \Sigma \sim LKJ(1)$$

Diagonal elements in the off-diagonal block matrix can be seen as test-retest reliability (ρ)

	Trial 1						Trial 2					
	$\eta_1^{(1)}$	$\eta_2^{(1)}$	$\eta_3^{(1)}$	$\eta_4^{(1)}$	$\eta_5^{(1)}$	$\eta_6^{(1)}$	$\eta_1^{(2)}$	$\eta_2^{(2)}$	$\eta_3^{(2)}$	$\eta_4^{(2)}$	$\eta_5^{(2)}$	$\eta_6^{(2)}$
Trial 1	$\eta_1^{(1)}$	$\eta_2^{(1)}$	$\eta_3^{(1)}$	$\eta_4^{(1)}$	$\eta_5^{(1)}$	$\eta_6^{(1)}$	$\eta_1^{(2)}$	$\eta_2^{(2)}$	$\eta_3^{(2)}$	$\eta_4^{(2)}$	$\eta_5^{(2)}$	$\eta_6^{(2)}$
	1											
		1										
			1									
				1								
					1							
						1						
Trial 2	$\eta_1^{(2)}$	$\eta_2^{(2)}$	$\eta_3^{(2)}$	$\eta_4^{(2)}$	$\eta_5^{(2)}$	$\eta_6^{(2)}$	1					
	ρ_1							1				
		ρ_2							1			
			ρ_3							1		
				ρ_4							1	
					ρ_5							1
						ρ_6						1

Posterior distributions and EAP



format	scale	EAP
FC	Sentence	[0.955, 0.972]
	Adjective	[0.940, 0.956]
LK	Sentence	[0.993, 0.987]
	Adjective	[0.980, 0.986]

[Summary]

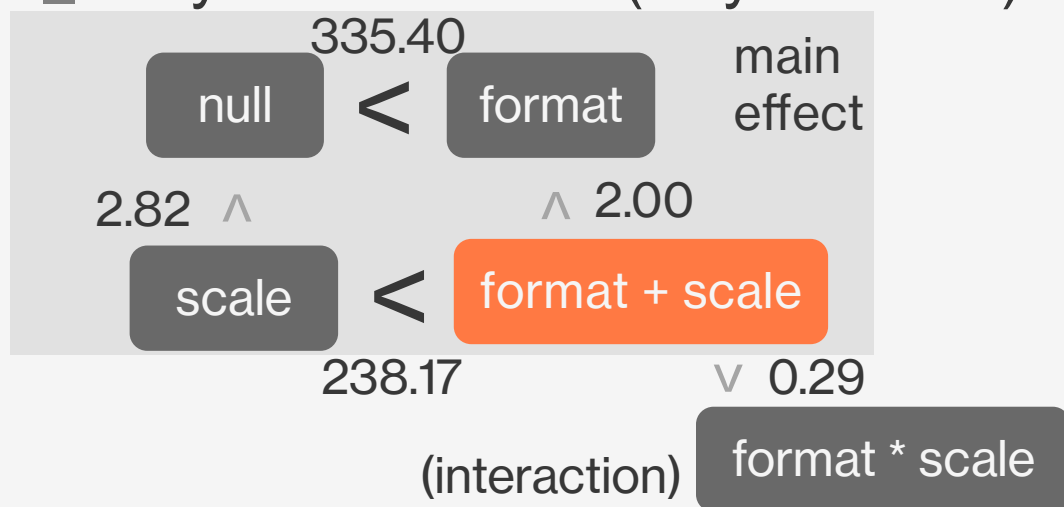
- FC reliability is lower than LK but keep $\rho > .8$ (acceptable)
- Sentence-type tends to show higher reliability than adjective

Consists with e.g., Goldberg's (1999) argument

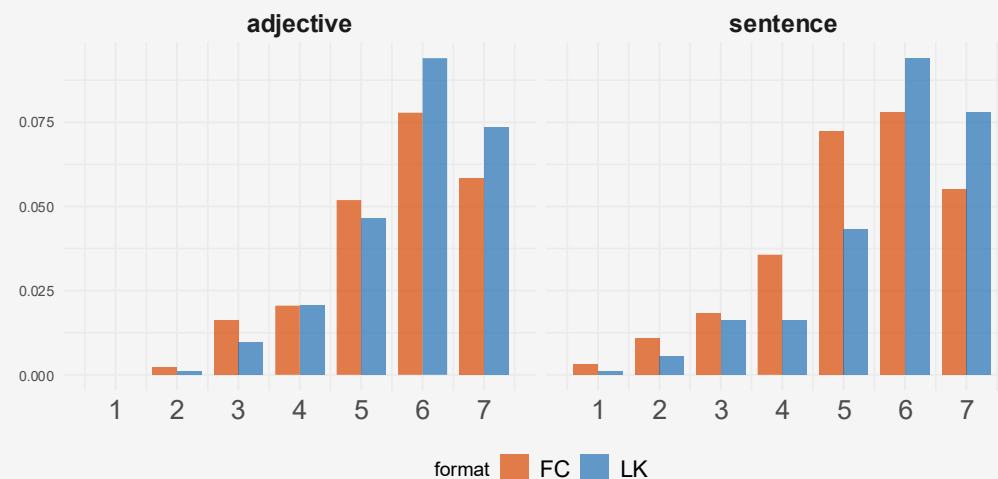
Descriptive statistics

format	scale	mean (SD)
FC	Sentence	5.26 (1.41)
	Adjective	5.60 (1.22)
LK	Sentence	5.71 (1.29)
	Adjective	5.81 (1.29)

Bayesian ANOVA (Bayes factor)



Response distribution (bar plot)



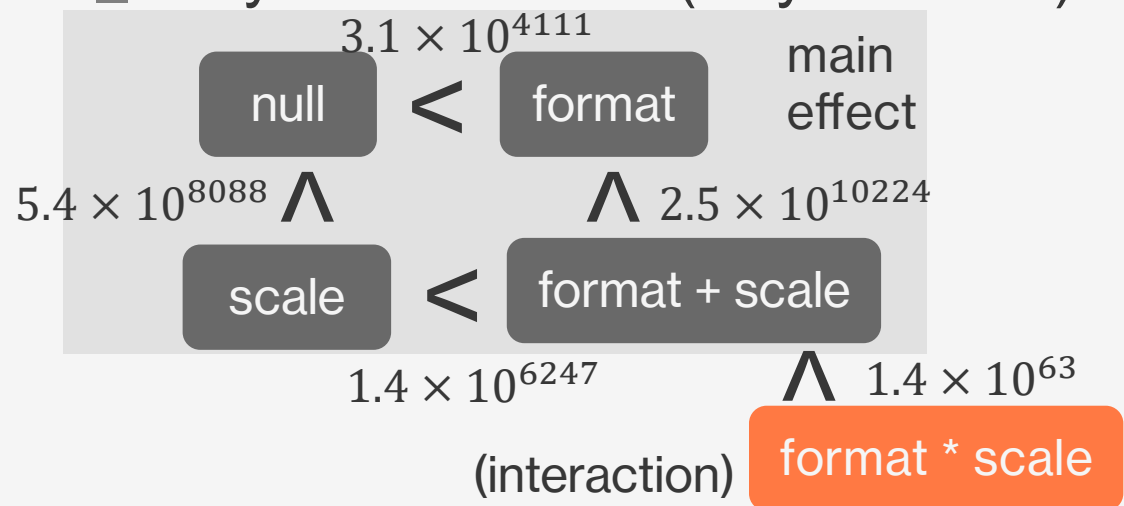
[Summary]

- FC is perceived relatively difficult than LK
- Sentence-type is slightly difficult than Adjective (but the difference is almost negligible)
- No interaction was observed

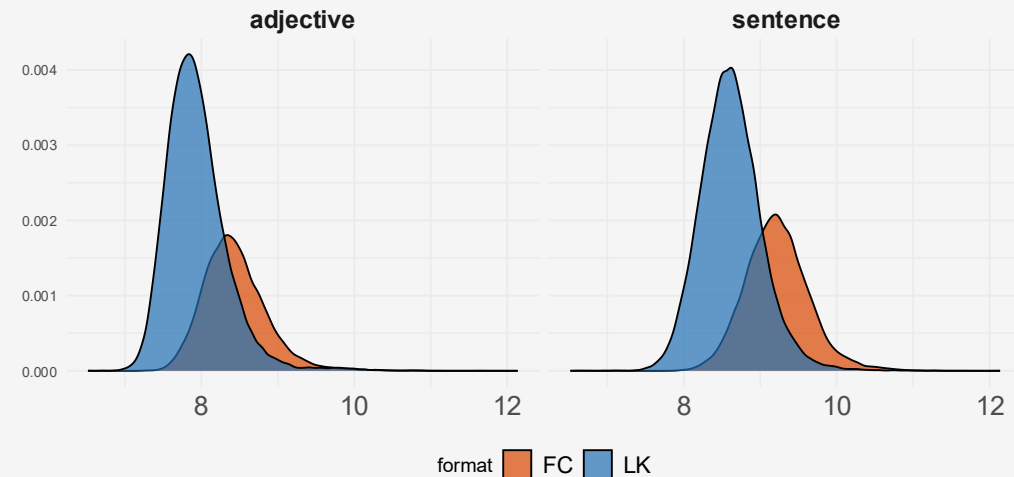
■ Descriptive statistics (raw RT; sec)

format	scale	median (SD)
FC	Sentence	9.93 (5.87)
	Adjective	4.43 (3.22)
LK	Sentence	5.42 (3.06)
	Adjective	2.66 (2.04)

■ Bayesian ANOVA (Bayes factor)



■ Response distribution (log-RT)



[Summary]

- FC takes longer than LK (but shorter than 2 times of LK format)
- Sentence-type takes longer than Adjective the difference was more salient in FC format

4

Summary and Discussion

■ Main findings summary

Although item length (Scale) slightly affects test-retest reliability, the reliability keeps $\rho > 0.8$

→ People can complete the cognitive processes required to answer PC items.

FC seems more difficult than LK, whereas item length does not affect the perception.

Response time per item (block) becomes longer according to the number of words in the item.

■ Future work

Examine more than 2-alternative FC format

Examine generalizability (with different scales and UIs)

	Most	Least
I like to discuss abstract concepts	☒	☐
I enjoy interpreting statistics	☒	☐
I feel that people are honest	☒	☐

Thank you for your attention!

An investigation of the item length
in the forced-choice psychological measurement

Kyosuke Bunji

Kobe University

Takeshi Sugiyama

Recruit Management Solutions Co., Ltd.

Kensuke Okada

University of Tokyo



bunji@bear.kobe-u.ac.jp

The 13th Conference of the IASC-ARS

Dec 4, 2025

References

- Alwin, D. F., & Beattie, B. A. (2016). The KISS principle in survey design: Question length and data quality. *Sociological Methodology*, 46(1), 121–152. <https://doi.org/10.1177/0081175016641714>
- Ashton, M., & Lee, K. (2009). The HEXACO-60: A short measure of the major dimensions of personality. *Journal of Personality Assessment*, 91(4), 340–345. <https://doi.org/10.1080/00223890902935878>
- Brown, A., & Maydeu-Olivares, A. (2018). Ordinal factor analysis of graded-preference questionnaire data. *Structural Equation Modeling: A Multidisciplinary Journal*, 25(4), 516–529. <https://doi.org/10.1080/10705511.2017.1392247>
- Goldberg, L. R. (1999). A broad-bandwidth, public domain personality inventory measuring the lower-level facets of several five-factor models. In I. Mervielde, I. Deary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe* (Vol. 7, pp. 7–28). European Conference on Personality, Tilburg. Tilburg Univ. Press.
- Hamby, T., & Ickes, W. (2015). Do the readability and average item length of personality scales affect their reliability? Some meta-analytic answers. *Journal of Individual Differences*, 36(1), 54–63. <https://doi.org/10.1027/1614-0001/a000154>
- Lenzner, T., Kaczmirek, L., & Lenzner, A. (2010). Cognitive burden of survey questions and response times: A psycholinguistic experiment. *Applied Cognitive Psychology*, 24(7), 1003–1020. <https://doi.org/10.1002/acp.1602>
- Romano, D., Costantini, G., Richetin, J., & Perugini, M. (2023). The HEXACO adjective scales and its psychometric properties. *Assessment*, 30(8), 2510–2532. <https://doi.org/10.1177/10731911231153833>
- Samejima, F. (1969). Estimation of latent ability using a response pattern of graded scores. *Psychometrika*, 34(S1), 1–97. <https://doi.org/10.1007/BF03372160>
- Sass, R., Frick, S., Reips, U.-D., & Wetzel, E. (2020). Taking the test taker's perspective: Response process and test motivation in multidimensional forced-choice versus rating scale instruments. *Assessment*, 27(3), 572–584. <https://doi.org/10.1177/1073191118762049>
- Tourangeau, R., Rips, L. J., & Rasinski, K. A. (2000). *The psychology of survey response*. Cambridge University Press.