Lesson 3

Procedure to elaborate measuring tools

PART II.
MEASUREMENT OF ATTITUDES

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1. Introduction

- Tests to measure cognitive variables: skills, performance, knowledge, etc.
- Scales, questionnaires or inventories to measure non-cognitive variables: personality, attitudes, interests, values, opinions, etc.
  - Main techniques to develop scales to measure attitudes (can be adapted to measure interests, values, etc.).

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1. Introduction

- Difference between attitude scales and interest or value scales:
  - Attitude scales: all the items that form the scale must refer to the same variable.
  - Interests or values scales: items can refer to different variables:
    - Interests scales: specific activities.
    - Values scales: broad categories.

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2. Thurstone scaling

- He developed procedures to elaborate scales in a psychological continuum that allow to locate the stimuli without the need to any physical operation in physical continuum.
- Differentiate between:
  - Construction process of the scale. Objective: To scale the stimuli (e.g, items) along a psychological continuum, assigning one value in the scale to each one.
  - Application. Once the scale is constructed, we have a set of items that constitute the pilot test, each one is assigned to a scalar value representing to the degree of the specific attribute it presents (psychological variable to scale). Then, individual differences among participants can be studied.

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2. Thurstone scaling

- The phases to develop one scale are basically the same that we used to develop a test, but we must add one: the 'proof of judges', in which scalar values (scores) are assigned to each item (stimulus) that forms the test.

Law of…	Method of…
Comparative judgment	Paired comparison
Categorical judgment	Ranking (the most parsimonious and accurate) Successive intervals Equal-appearing intervals (the most used)

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2. Thurstone scaling:
2.1. Basic assumptions

A. There is a psychological or subjective continuum along which the studied attribute varies.

B. Each stimulus generates a subjective process in the participant ('discriminant process'). As a consequence, the participant will assign a subjective value for that stimulus in the psychological continuum.

C. If the stimulus is presented repeatedly, the same discriminant process is not always generated in the participant, so the subjective value assigned may change.

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2. Thurstone scaling: 2.1. Basic assumptions

- D. If the number of times each stimulus is presented is very large, its assumed that the distribution obtained when assigning the subjective values is a normal distribution (discriminant distribution).
- E. The mean of this distribution is the value of the stimulus in the psychological continuum (scalar value of the stimulus). The standard deviation (discriminant dispersion) shows the ambiguity raised by the stimulus on the participant.

  The greater the standard deviation is, the higher the variation of the values assigned to the stimulus was, and vice versa.

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2. Thurstone scaling: 2.1. Basic assumptions

- F. Each stimulus has a different discriminant distribution (with its mean and standard deviation).
- G. The model is accepted if:
  - A single participant assigned numerous values to each stimulus; and
  - A sample of participants (sample of judges or experts) assigned a value to each stimulus.

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2.2. Thurstone scaling. The law of comparative judgment: method of paired comparison

- Task: to decide the favorite stimulus after comparing two (discriminant difference).

- Example:
  - Variable to study: attitude towards marriage.
  - 6 items; e.g., 'marriage restricts the freedom of the couple' (item 5); 'marriage is the foundation of the family'(item 6).
  - 100 judges.
  - Task: choose, within each pair, the item that shows a more favorable attitude towards marriage.

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2. Thurstone scaling. 2.2. The law of comparative judgment: method of paired comparison

	STEP 1. Matrix of observed frequencies					
Stimulus	**1**	**2**	**3**	**4**	**5**	**6**
1	---	70	65	45	40	80
2	30	---	60	70	30	70
3	35	40	---	60	30	60
4	55	30	40	---	55	75
5	60	70	70	45	---	65
6	20	30	40	25	35	---
Σ						

- 65 judges considered that item 6 was more favorable towards marriage than item 5; 35 considered that 5 was more favorable than 6 (65+35=100). What about items 1 and 2?

-Calculate the last line (∑).

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

	STEP 1. Matrix of observed frequencies					
Stimulus	**1**	**2**	**3**	**4**	**5**	**6**
1	---	70	65	45	40	80
2	30	---	60	70	30	70
3	35	40	---	60	30	60
4	55	30	40	---	55	75
5	60	70	70	45	---	65
6	20	30	40	25	35	---
∑	**200**	**240**	**275**	**245**	**190**	**350**

-Item 6 was considered the most favorable. Which is the less favorable?

-We know the order of the items from the most to the less favorable respect to marriage, but we do not know the differences between them in the continuum.
-STEP 2. Matrix of observed frequencies ordered from the highest to the lowest.

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

	STEP 2. Matrix of observed frequencies ordered					
Stimulus	**6**	**3**	**4**	**2**	**1**	**5**
6	---	40	25	30	20	35
3	60	---	60	40	35	30
4	75	40	---	30	55	55
2	70	60	70	---	30	30
1	80	65	45	70	---	40
5	65	70	45	70	60	---
∑	**350**	**275**	**245**	**240**	**200**	**190**

-STEP 3. Matrix of proportions (i/n).
n=number of participants.

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

	STEP 3. Matrix of proportions					
Stimulus	**6**	**3**	**4**	**2**	**1**	**5**
6	---	0.40	0.25	0.30	0.20	0.35
3	0.60	---	0.60	0.40	0.35	0.30
4	0.75	0.40	---	0.30	0.55	0.55
2	0.70	0.60	0.70	---	0.30	0.30
1	0.80	0.65	0.45	0.70	---	0.40
5	0.65	0.70	0.45	0.70	0.60	---
∑	**3.50**	**2.75**	**2.45**	**2.40**	**2.00**	**1.90**

-0.35+0.65=1

-STEP 4. Matrix of standard scores (Which is the z score associated to each proportion? It could be answered using the table of the normal distribution).

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

	STEP 4. Matrix of standard scores					
Stimulus	**6**	**3**	**4**	**2**	**1**	**5**
6	---	-0.25	-0.67	-0.52	-0.84	-0.39
3	0.25	---	0.25	-0.25	-0.39	-0.52
4	0.67	-0.25	---	-0.52	0.13	0.13
2	0.52	0.25	0.52	---	-0.52	-0.52
1	0.84	0.39	-0.13	0.52	---	-0.25
5	0.39	0.52	-0.13	0.52	0.25	---
∑Z	**2.67**	**0.66**	**-0.16**	**-0.25**	**-1.37**	**-1.55**
(∑Z)/k*						

- k = number of stimuli.
- 0.39+(-0.39)=0

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

	STEP 4. Matrix of standard scores					
Stimulus	**6**	**3**	**4**	**2**	**1**	**5**
6	---	-0.25	-0.67	-0.52	-0.84	-0.39
3	0.25	---	0.25	-0.25	-0.39	-0.52
4	0.67	-0.25	---	-0.52	0.13	0.13
2	0.52	0.25	0.52	---	-0.52	-0.52
1	0.84	0.39	-0.13	0.52	---	-0.25
5	0.39	0.52	-0.13	0.52	0.25	---
∑Z	**2.67**	**0.66**	**-0.16**	**-0.25**	**-1.37**	**-1.55**
(∑Z)/k	**0.45**	**0.11**	**-0.03**	**-0.04**	**-0.23**	**-0.26**

In order to avoid negative values, we can sum the lowest value of the last line (∑Z/k) in absolute value, to each value obtained in that same line.

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

	STEP 4. Matrix of standard scores					
Stimulus	**6**	**3**	**4**	**2**	**1**	**5**
6	---	-0.25	-0.67	-0.52	-0.84	-0.39
3	0.25	---	0.25	-0.25	-0.39	-0.52
4	0.67	-0.25	---	-0.52	0.13	0.13
2	0.52	0.25	0.52	---	-0.52	-0.52
1	0.84	0.39	-0.13	0.52	---	-0.25
5	0.39	0.52	-0.13	0.52	0.25	---
∑Z	**2.67**	**0.66**	**-0.16**	**-0.25**	**-1.37**	**-1.55**
(∑Z)/k	**0.45**	**0.11**	**-0.03**	**-0.04**	**-0.23**	**-0.26**
(∑Z)/k-lowest(∑Z)/k	**0.71**	**0.37**	**0.23**	**0.22**	**0.03**	**0**

Which two items are the most similar? Which two contiguous items are the most different?

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

- Resulting scale (along the continuum):

5…1……..2.4……..3……..6

0 0.03 0.22 0.23 0.37 0.71

- The most similar are the items 2 and 4 (0.23-0.22=0.01).
- The most different contiguous items are 3 and 6 (0.71-0.37=0.34).
- Characteristics of the scale:
  - Subjective.
  - One-dimensional: it measures attitude towards marriage.

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2. Thurstone scaling.
2.2. The law of comparative judgment: method of paired comparison

- Disadvantage:
  - If there are lot of stimuli, the procedure is too long. This is the reason why it is not one of the most used methods.

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2. Thurstone scaling.
2.2. The Law of categorical judgment:

- It is assumed that the psychological continuum can be divided into ordered categories.
- The participants assign each stimulus to one of the categories.
- There are 3 methods:
  - **Ranking** (recommended; the most parsimonious –easy- and accurate).
  - Successive intervals.
  - **Equal-appearing intervals** (the most used).

Sanduvete, S., Barbero, M. I., Chacón, S., Pérez-Gil, J. A., Holgado, F. P., Sánchez-Martín, M., & Lozano, J. A. (2009). Métodos de escalamiento aplicados a la priorización de necesidades de formación en organizaciones. *Psicothema, 21*(4), 509-514.

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.1.Method of ranking

- E.g.: Which is the most useful course to improve your ability in your job? (1=the most useful; 4=the less useful).

STEP 1. Matrix of data				
	Word	**Openoffice**	**Arc View**	**Wordperfect**
Participant 1	4	3	2	1
Participant 2	3	4	2	1
Participant 3	4	3	2	1
Participant 4	3	4	2	1
Participant 5	1	3	2	4
Participant 6	3	4	2	1
Participant 7	3	4	2	1
Participant 8	1	2	4	3
Participant 9	4	3	2	1

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.1.Method of ranking

STEP 2. Sum of orders				
	Word	Openoffice	Arc View	Wordperfect
Participant 1	4	3	2	1
Participant 2	3	4	2	1
Participant 3	4	3	2	1
Participant 4	3	4	2	1
Participant 5	1	3	2	4
Participant 6	3	4	2	1
Participant 7	3	4	2	1
Participant 8	1	2	4	3
Participant 9	4	3	2	1
Σ				

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.1.Method of ranking

STEP 2. Sum of orders				
	Word	Openoffice	Arc View	Wordperfect
Participant 1	4	3	2	1
Participant 2	3	4	2	1
Participant 3	4	3	2	1
Participant 4	3	4	2	1
Participant 5	1	3	2	4
Participant 6	3	4	2	1
Participant 7	3	4	2	1
Participant 8	1	2	4	3
Participant 9	4	3	2	1
Σ	**26**	**30**	**20**	**14**

STEP 3. Ordering stimuli.

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.1.Method of ranking

STEP 3. Ordering stimuli (from most to less useful):

1. Wordperfect (14).
2. Arc View (20).
3. Word (26).
4. Openoffice (30).

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

- Each judge imagines one scale divided into ordered categories, being 1 the most negative degree.
- The central category corresponds to the neutral point.
- It is supposed that the categories have the same size (there is the same distance between them).
- If the first category has the value 1, the limits of this category ranges from 0.5 to 1.5.
- The graphic representation of the continuum is…

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

- Graphic representation of the continuum:

|.....|.....|.....|.....|.....|

0.5 1.5 2.5 3.5 4.5 5.5

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

- Example: the following 2 items have been evaluated by 300 judges on a scale of 11 categories.
  - 'Marriage restricts the freedom of the couple' (item 5).
  - 'Marriage is the foundation of the family'(item 6).

	Categories										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Item 5	50	100	60	40	25	15	10	0	0	0	0
Item 6	0	0	0	0	10	15	25	40	60	100	50

To find the scalar value of the stimuli, calculate the median of its distribution.

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

Steps to calculate the median:

1. Calculate F_i: cumulative frequencies
2. Calculate n/2
3. Determine L_i: the lower exact limit from the interval that includes n/2 (the 50% of the observed data)

   Exact limits = value of the category ± 0.5 x measurement unit
4. Determine the f_i in that interval
5. Determine the F_i before that interval
6. Calculate the interval amplitude:

I = max – min (exact limits of the interval)

7. Calculate the formula:

$$Mdn = L_i + \frac{I}{f_i}\left(\frac{n}{2} - F_i\right)$$

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

1. F_i (cumulative frequencies):

	Categories										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Item 5	50	100	60	40	25	15	10	0	0	0	0
Item 6	0	0	0	0	10	15	25	40	60	100	50
F_i (5)	50	150	210	250	275	290	300	300	300	300	300
F_i (6)	0	0	0	0	10	25	50	90	150	250	300

2. n/2=300/2=150.
3. L_i(5): 2–0.5x1=1.5

   L_i(6): 9–0.5x1=8.5

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

4. $f_2(5)=100$

   $f_9(6)=60$

5. $F_1(5)=50$

   $F_8(6)=90$

6. I(5)= 2.5 – 1.5 = 1

   I(6)= 9.5 – 8.5 = 1

7. Item 5: $Mdn = 1.5 + \frac{1}{100}(150 - 50) = 2.5$

   Item 6: $Mdn = 8.5 + \frac{1}{60}(150 - 90) = 9.5$

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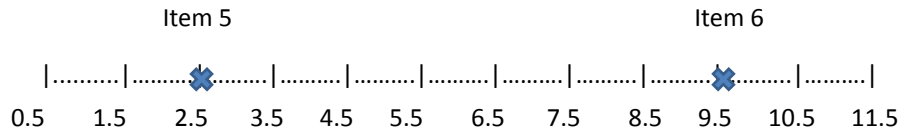
2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals



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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

- The items selected to form the scale are going to be those with more agreement between judges. We are going to use the **ambiguity coefficient** (**A.C.**) to measure the degree of agreement:

$$A.C. = Q_3 - Q_1$$

$$Q_3 = L_i + \frac{I}{f_i}\left(\frac{3n}{4} - F_i\right)$$

$$Q_1 = L_i + \frac{I}{f_i}\left(\frac{n}{4} - F_i\right)$$

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

- If A.C. >2, the item will be considered ambiguous and it should be removed from the scale.
- In items located in the central category, A.C. >3 to be considered ambiguous.
- Example: calculate A.C. for items 5 and 6 and interpret the results.

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

ITEM 5

1. F_i (cumulative frequencies):

Categories											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Item 5	50	100	60	40	25	15	10	0	0	0	0
F_i (5)	50	150	210	250	275	290	300	300	300	300	300

2. Q_3: 3n/4=3x300/4=900/4=225
   Q_1: n/4=300/4=75
3. $L_i(Q_3)$: 4–0.5x1=3.5
   $L_i(Q_1)$: 2–0.5x1=1.5

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

ITEM 5

4. $f_4(Q_3)=40$
   $f_2(Q_1)=100$
5. $F_3(Q_3)=210$
   $F_1(Q_1)=50$
6. $I(Q_3)= 4.5 – 3.5 = 1$
   $I(Q_1)= 2.5 – 1.5 = 1$

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

ITEM 5

7. $$Q_3 = L_i + \frac{I}{f_i}\left(\frac{3*n}{4} - F_i\right) = 3.5 + \frac{1}{40}\left(\frac{3*300}{4} - 210\right) = 3.88$$

$$Q_1 = L_i + \frac{I}{f_i}\left(\frac{n}{4} - F_i\right) = 1.5 + \frac{1}{100}\left(\frac{300}{4} - 50\right) = 1.75$$

$$A.C. = Q_3 - Q_1 = 3.88 - 1.75 = 2.13$$

- Item 5 is not located in the central category (6), so if A.C.>2, the item should be removed.
- 2.13>2, so item 5 should be removed (if we are strict).

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

ITEM 6

1. F_i (cumulative frequencies):

	Categories										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Item 6	0	0	0	0	10	15	25	40	60	100	50
F_i (6)	0	0	0	0	10	25	50	90	150	250	300

2. Q_3: 3n/4=3x300/4=900/4=225
   Q_1: n/4=300/4=75
3. $L_i(Q_3)$: 10–0.5x1=9.5
   $L_i(Q_1)$: 8–0.5x1=7.5

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

ITEM 6

4. $f_{10}(Q_3)=100$

   $f_8(Q_1)=40$

5. $F_9(Q_3)=150$

   $F_7(Q_1)=50$

6. $I(Q_3)= 10.5 – 9.5 = 1$

   $I(Q_1)= 8.5 – 7.5 = 1$

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2. Thurstone scaling.
2.2. The Law of categorical judgment:
2.2.2.Method of Equal-appearing intervals

ITEM 6

7.

$$Q_3 = L_i + \frac{I}{f_i}\left(\frac{3*n}{4} - F_i\right) = 9.5 + \frac{1}{100}\left(\frac{3*300}{4} - 150\right) = 10.25$$

$$Q_1 = L_i + \frac{I}{f_i}\left(\frac{n}{4} - F_i\right) = 7.5 + \frac{1}{40}\left(\frac{300}{4} - 50\right) = 8.13$$

$$A.C. = Q_3 - Q_1 = 10.25 - 8.13 = 2.12$$

- Item 6 is not located in the central category (6), so if A.C.>2, the item should be removed.
- 2.13>2, so item 6 should be removed (if we are strict).

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3. Likert technique

- Scales simpler than Thurstone's methods and equally reliable.
- It is the summative model most commonly used to measure individual differences about psychological traits.
- It assumes that as the amount of trait expressed by the subjects increases or decreases, so does their score on the item.
- Advantage: easy to elaborate, very reliable, can be adapted to measure any kind of attitude.

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3. Likert technique

- Characteristics:
  - It assumes an ordinal level of measurement.
  - It measures one single dimension.
  - The participant can be placed in each item from the point of view most favorable to the most unfavorable. His/her value in the scale will be the sum of scores obtained in the different items.
  - It assumes that the more favorable the attitude of the participant is, the greater the probability that he/she chooses the category that indicates that position is.
  - Items should allow participants to make value judgments instead of factual judgments (participants should express what it should be, instead of what is actually).

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3. Likert technique: example

- The family should spend more time together.
  - A) completely agree
  - B) agree
  - C) indifferent
  - D) disagree
  - E) completely disagree

- By assigning scores to the alternatives, the researcher must ensure that the highest value indicates the most positive attitude towards what is being measured.

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3. Likert technique: example

- Different ways of assigning scores:

	ASSIGNMENT 1	ASSIGNMENT 2
completely disagree	1	-2
disagree	2	-1
indifferent	3	0
agree	4	1
completely agree	5	2

- The total score of a participant in the scale is the sum of the numerical values chosen in all the items.

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4. Osgood's semantic differential

- Aim: to measure the connotative or subjective meaning of stimuli: the emotional reaction that words produce in participants.
- In Psychology, it is usually applied in four areas:
  - Clinic.
  - Measurement of attitudes.
  - Transcultural research.
  - Social research.

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4. Osgood's semantic differential

- Example:

POLITICS		
Bad	.....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Good
Useless	.....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Useful
Dishonest	.....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Honest
Unfair	.....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Fair
Stupid	.....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Wise

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4. Osgood's semantic differential

- Two elements:
  1. Concept:
     - Stimulus to evaluate (e.g., politics).
     - They are nouns in most of occasions (sometimes, adjectives).
     - Recommendations when choosing them:
       - Representative from the area that is measured.
       - Useful to discriminate across participants.
       - Clear meaning.
       - Common.

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4. Osgood's semantic differential

- Two elements:
  2. Bipolar scales:
     - Each one represents an affective reaction (e.g., bad-good).
     - The extremes are antonymous adjectives.
     - Usually, 7 categories are used.
     - When a participant chooses the central category, it implies that he/she does not consider relationship between the concept and the bipolar scale.

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4. Osgood's semantic differential

- Two elements:

2. Bipolar scales:
    - Criteria to choose them:
        - Factorial composition.
            - » 3 dimensions: evaluative (e.g., good-bad); of power (e.g., strong-weak); and of movement: (e.g., fast-slowly).
            - » 6 scales are considered enough to measure each dimension.
        - Degree of relevance; e.g., to evaluate aesthetically a photograph, the scale pretty-ugly can be more relevant than the scale big-small.
        - Semantic stability referred to the concepts and the participants; e.g., the scale big-small would be denotative when the concept is "mountain" and connotative when the concept to measure is "god".

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4. Osgood's semantic differential

- Pilot test and application:
    1. Elaborate list of concepts.
    2. A sample applies adjectives to these concepts.
    3. The most frequent adjectives are chosen (preselection).
    4. The antonymous of each preselected adjective is written.
    5. A final selection is carried out following one of the 3 criteria previously mentioned.

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4. Osgood's semantic differential

- Pilot test and application:
  6. Presentation:
     a. Instructions (fast answer).
     b. One page for each concept.
     c. The smallest score represents the more negative assessment; the highest one, the most positive.

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4. Osgood's semantic differential

- Pilot test and application:
  7. Possible data analysis:
     a. Scalar scores: e.g.,
        - The score of a participant in the different scales.
        - The mean of a sample in a scale.
        - The mean of all the scales that evaluate a concept.

     b. Factorial scores: to calculate the mean in each factor or dimension. E.g.,

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4. Osgood's semantic differential

- Example:

MARRIAGE		
Passive	**Number of participants in each category** 4 6 8 10 12 30 50 .....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Active
Slow	**Number of participants in each category** 6 4 10 8 50 30 12 .....|.....|.....|.....|.....|.....|..... 1 2 3 4 5 6 7	Fast
Tender	**Number of participants in each category** 10 30 50 12 4 6 8 .....|.....|.....|.....|.....|.....|..... 7 6 5 4 3 2 1	Hard

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4. Osgood's semantic differential

- STEP 1. Calculate the mean for each scale.

$$\overline{X} = \frac{\sum f * X}{N}$$

$$\overline{X}_{passive-active} = \frac{\sum f * X}{N} =$$

$$= \frac{(4*1)+(6*2)+(8*3)+(10*4)+(12*5)+(30*6)+(50*7)}{120} =$$

$$= \frac{670}{120} = 5.58$$

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4. Osgood's semantic differential

- STEP 1. Calculate the mean for each scale.

$$\overline{X}_{slow-fast} = \frac{\sum f * X}{N} =$$

$$= \frac{(6*1)+(4*2)+(10*3)+(8*4)+(50*5)+(30*6)+(12*7)}{120} =$$

$$= \frac{590}{120} = 4.92$$

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4. Osgood's semantic differential

- STEP 1. Calculate the mean for each scale.

$$\overline{X}_{tender-hard} = \frac{\sum f * X}{N} =$$

$$= \frac{(10*7)+(30*6)+(50*5)+(12*4)+(4*3)+(6*2)+(8*1)}{120} =$$

$$= \frac{580}{120} = 4.83$$

- STEP 2. Calculate the factorial score (mean of means).

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4. Osgood's semantic differential

- STEP 2. Calculate the factorial score (mean of means).

$$FS = \frac{5.58 + 4.92 + 4.83}{3} = 5.11$$

Conclusion: participants consider the concept "marriage" lightly positive (the point in the middle is 4).

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5. Guttman scale

- Technique alternative to Thurstone and Likert techniques to measure attitudes, although it also can be used to elaborate tests with correct-incorrect items.
- Participants and items are ordered (from less to more score/agreement/difficulty, or vice versa).
- One-dimensional.
- Dichotomous items.

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5. Guttman scale

	Items					
Participants	**1**	**2**	**3**	**4**	**5**	**6**
1	1	1	1	1	1	1
2	0	0	1	1	1	1
3	0	1	1	0	1	0
4	0	0	0	0	1	1
5	0	0	0	1	1	1

0=unfavorable attitude; 1=favorable attitude

STEP 1. Calculate the sum of rows and columns.

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5. Guttman scale

STEP 1. Calculate the sum of rows and columns.

	Items						
Participants	**1**	**2**	**3**	**4**	**5**	**6**	**∑**
1	1	1	1	1	1	1	**6**
2	0	0	1	1	1	1	**4**
3	0	1	1	0	1	0	**3**
4	0	0	0	0	1	1	**2**
5	0	0	0	1	1	1	**3**
∑	**1**	**2**	**3**	**3**	**5**	**4**	

STEP 2. Order the columns.

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5. Guttman scale

STEP 2. Order the columns.

	Items						
Participants	**1**	**2**	**3**	**4**	**6**	**5**	**∑**
1	1	1	1	1	1	1	**6**
2	0	0	1	1	1	1	**4**
3	0	1	1	0	0	1	**3**
4	0	0	0	0	1	1	**2**
5	0	0	0	1	1	1	**3**
∑	**1**	**2**	**3**	**3**	**4**	**5**	

STEP 3. Order the rows.

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5. Guttman scale

STEP 3. Order the rows.

	Items						
Participants	**1**	**2**	**3**	**4**	**6**	**5**	**∑**
1	1	1	1	1	1	1	**6**
2	0	0	1	1	1	1	**4**
3	0	1	1	0	0	1	**3**
5	0	0	0	1	1	1	**3**
4	0	0	0	0	1	1	**2**
∑	**1**	**2**	**3**	**3**	**4**	**5**	

STEP 4. Find the errors (the "1" should be on the right of the line; the "0", on the left).

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5. Guttman scale

STEP 4. Find the errors.

	Items						
Participants	**1**	**2**	**3**	**4**	**6**	**5**	**∑**
1	1	1	1	1	1	1	**6**
2	0	0	1	1	1	1	**4**
3	0	1	1	0	0	1	**3**
5	0	0	0	1	1	1	**3**
4	0	0	0	0	1	1	**2**
∑	**1**	**2**	**3**	**3**	**4**	**5**	

STEP 5. Calculate de reproductivity coefficient

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5. Guttman scale

STEP 5. Calculate de reproductibility coefficient.

$$R.C. = 1 - \frac{errors}{answers} = 1 - \frac{errors}{items * participants}$$

- Empirical data fit Guttman model when R.C. ≥ 0.9

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5. Guttman scale

STEP 5. Calculate de reproductibility coefficient.

$$R.C. = 1 - \frac{4}{6*5} = 1 - \frac{4}{30} = 0.87$$

- 0.87 < 0.9 → These empirical data do not fit Guttman model

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6. Differences between techniques

- In semantic differential, items are concepts and scales present adjectives in their extremes; in Thurstone, Likert and Guttman techniques, items are statements.
- In Likert, items included present extreme scores; in Thurstone and Guttman, moderate items have to be also included.
- Guttman scale are accumulative; Thurstone ones are not.

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6. Differences between techniques

- Thurstone assumes interval scale; Likert and Guttman, ordinal scales.
- In Thurstone, participants are judges; in Likert and Guttman, they have to be a representative sample.
- Likert is the most commonly used. Its main disadvantage is that participants can give socially desirable answers easily.

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