

17-803 Empirical Methods

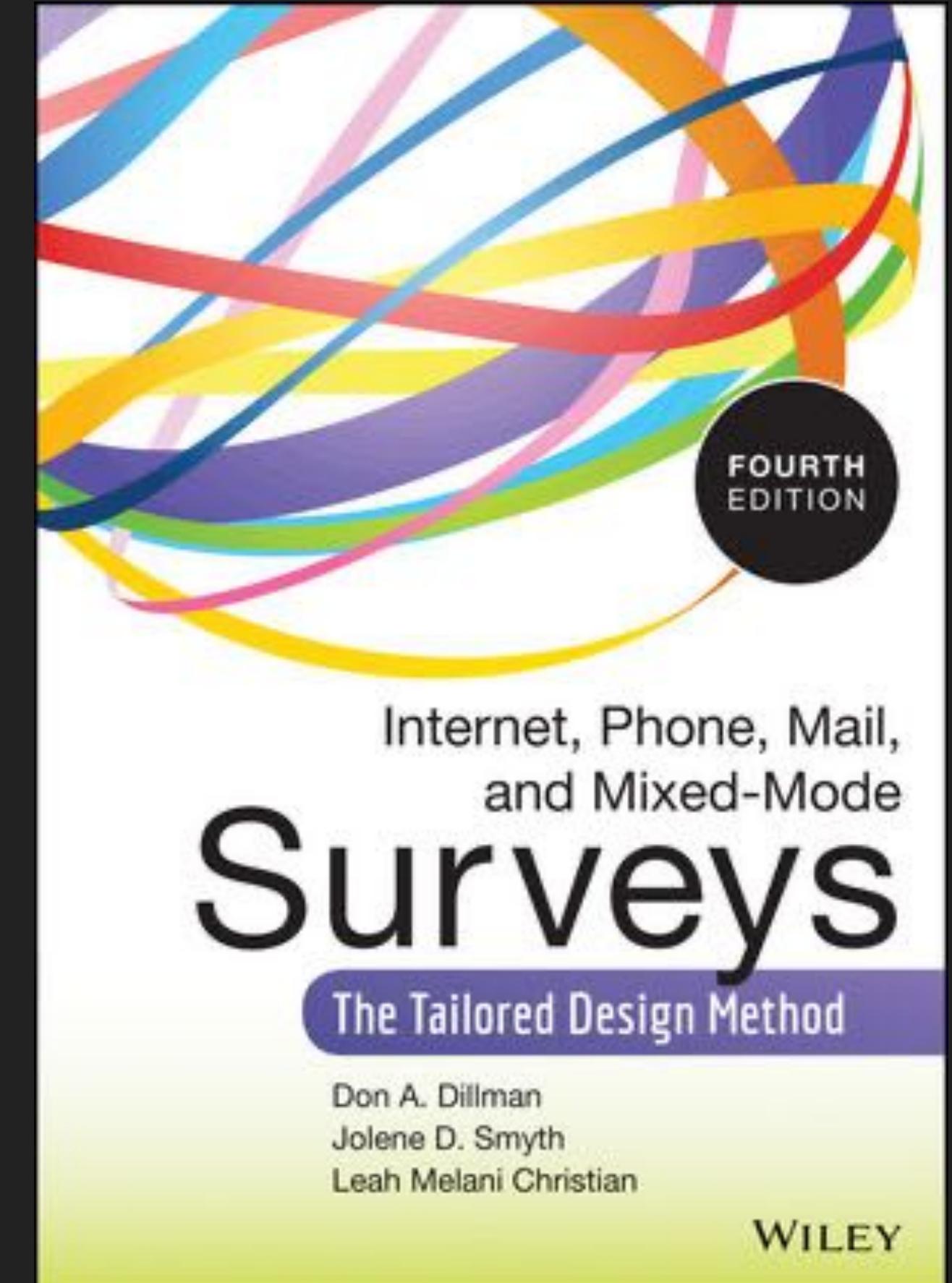
Bogdan Vasilescu, S3D

Survey Design

Tuesday, September 27, 2022

Outline for Today

- ▶ Chapters from Dillman, D., Smyth, J. D., & Christian, L. M. (2014). Internet, Phone, Mail and Mixed-Mode Surveys: The Tailored Design Method (4th ed.). Hoboken, NJ: Wiley.
 - ▶ Ch1: Sample Surveys in our Electronic World
 - ▶ Ch2: Reducing People's Reluctance to Respond to Surveys
 - ▶ Ch4: The Fundamentals of Writing Questions
 - ▶ Ch5: How to Write Open and Closed Ended Questions
- ▶ Hof, M. (2012). Questionnaire Evaluation with Factor Analysis and Cronbach's Alpha. Student project. Seminar in Methodology and Statistics. Uni. Groningen
- ▶ Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in quantitative methods for psychology*, 9(2), 79-94.
- ▶ Cairns, P. (2019). Doing better statistics in human-computer interaction. Cambridge University Press.
 - ▶ Ch15: What Makes a Good Likert Item?
 - ▶ Ch16: The Meaning of Factors
 - ▶ Ch17: Unreliable Reliability: The Problem of Cronbach's Alpha
 - ▶ Ch18: Tests for Questionnaires



What Is a Survey Good for?

- ▶ Prevalence (sort of)
- ▶ Relations between variables
- ▶ Differences among subpopulations

Probability sample survey strength:

Collect data from only a sample of the population but generalize results to the whole

Main goal when designing probability sample surveys:
Reduce survey error (the difference between an estimate that is produced using survey data and the true value of the variables in the population that one hopes to describe)

Four Types of Error To Minimize To Improve the Survey Estimates

- ▶ Sampling frame - how to construct?
 - ▶ Coverage error
- ▶ Draw sample - probability sampling?
 - ▶ Sampling error
- ▶ Administer survey - who responded?
 - ▶ Nonresponse error
- ▶ Questions as measures - valid and reliable?
 - ▶ Measurement error

Coverage Error Example

- ▶ Landline random digit dial telephone survey
 - ▶ People who have landlines are quite different from those who do not on a number of important characteristics (e.g., higher socioeconomic status).
- ▶ Context matters
 - ▶ Internet survey among US population vs CMU students



"Butler c. 1922" CC-BY-SA-4.0 Wikipedia

Sampling Error

- ▶ Surprising how few people you would need to survey to obtain estimates with acceptable levels of precision!
- ▶ CMU: 14k students
 - ▶ 95% confidence +/- 2% margin of error:
 - ▶ Random sample of 2050 students
- ▶ US population: 328 million
 - ▶ 95% confidence +/- 2% margin of error:
 - ▶ Random sample of 2384 people
 - ▶ 95% confidence +/- 10% margin of error:
 - ▶ Random sample of 96 people

Sample Size Calculator

This Sample Size Calculator is presented as a public service of Creative Research Systems [survey software](#). You can use it to determine how many people you need to interview in order to get results that reflect the target population as precisely as needed. You can also find the level of precision you have in an existing sample.

Before using the sample size calculator, there are two terms that you need to know. These are: **confidence interval** and **confidence level**. If you are not familiar with these terms, [click here](#). To learn more about the factors that affect the size of confidence intervals, [click here](#).

Enter your choices in a calculator below to find the sample size you need or the confidence interval you have. Leave the Population box blank, if the population is very large or unknown.

Determine Sample Size

Confidence Level: 95% 99%

Confidence Interval:

Population:

Sample size needed:

Find Confidence Interval

Confidence Level: 95% 99%

Sample Size:

Population:

Percentage:

Confidence Interval:

<https://www.surveysystem.com/sscalc.htm>

Aside: Confidence Level, Confidence Interval

- ▶ **Confidence interval** (aka “margin of error”):
 - ▶ Plus-or-minus figure usually reported
 - ▶ Lower is better
 - ▶ Example:
 - ▶ if confidence interval is 4 and 47% percent of sample answer X
 - ▶ then you can be "sure" that among the entire relevant population between 43% (47-4) and 51% (47+4) would have answered X.
- ▶ **Confidence level** (how sure can you be):
 - ▶ Represents how often the true percentage of the population who would answer X lies within the confidence interval.
 - ▶ Higher is better
 - ▶ Common: 95% or 99%

Nonresponse Error

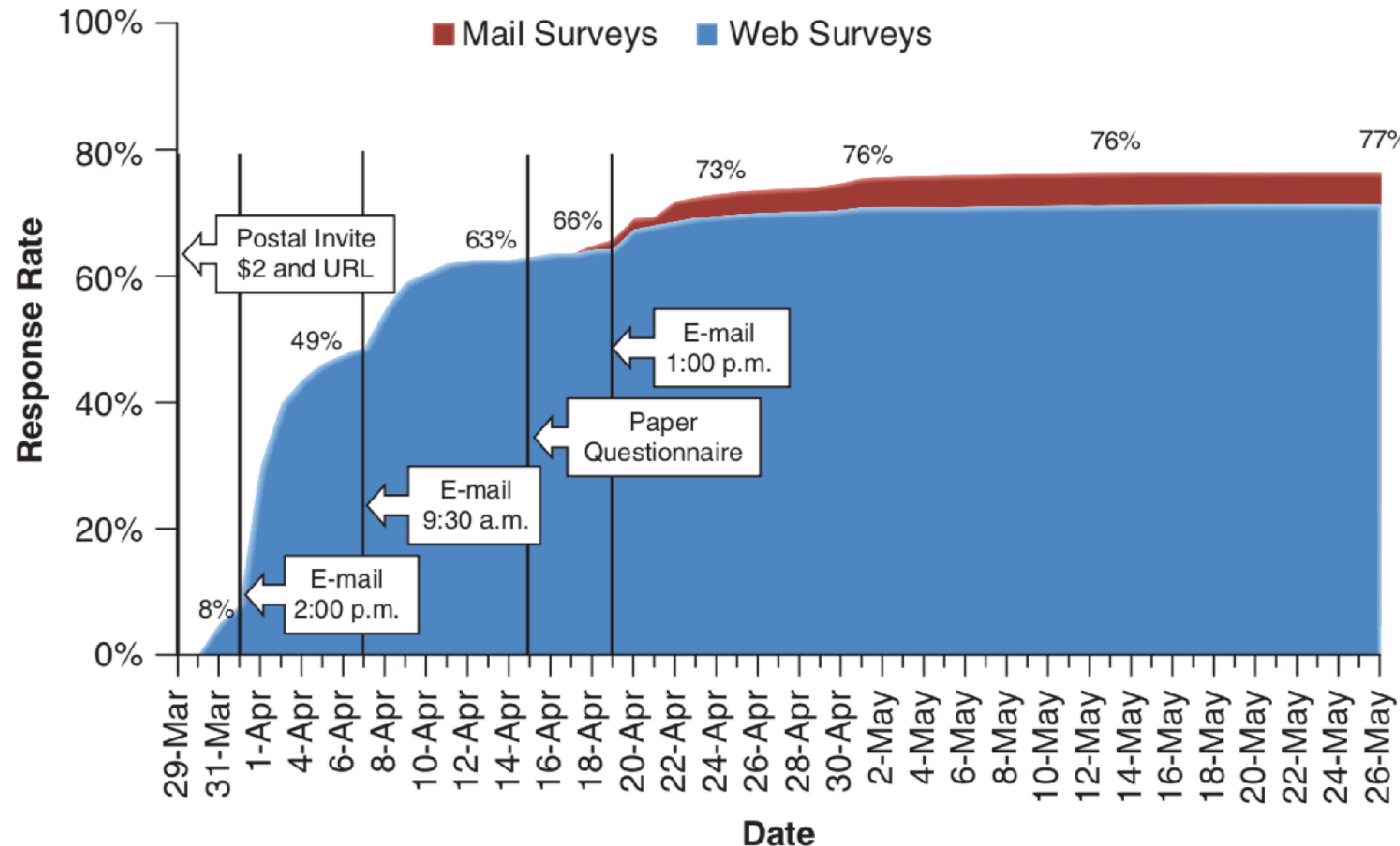
- ▶ Do the characteristics of respondents differ from those who chose not to respond in a way that is relevant to the study results?
- ▶ Higher response rates reduce the likelihood of nonresponse error.
 - ▶ But: nonresponse error may occur in surveys with higher as well as lower response rates (Groves & Peytcheva, 2008)

Measurement Error

- ▶ Asking good questions:
 - ▶ Does question adequately measure the idea or concept of interest?
 - ▶ "Construct validity"
- ▶ Example:
 - ▶ household income for the previous year as a measure of household wealth.
 - ▶ annual income decreases after retirement, but wealth may not.

Getting people to respond:
Example survey of 600 PhD students at Washington State U.
about their dissertation work and graduate training

FIGURE 2.2 Cumulative response rate by day and mode for the 2013 WSU Doctoral Student Experience Survey, showing contribution of each contact to final response rate.



Source: Adapted from *Determining Whether Research Is Interdisciplinary: An Analysis of New Indicators* (Technical Report 13-049), by M. M. Millar, 2013, Pullman: Washington State University, Social and Economic Sciences Research Center.

Initial commu- nication

Jane Doe
123 Cougar Road
Pullman, WA 99163

Dear Jane,

I am writing to ask for your help with an important survey we are conducting of WSU doctoral students. I understand that you have successfully completed your preliminary examinations and are now at the stage of needing to complete a dissertation.

My colleague, Morgan Millar, and I have been working with the National Science Foundation to better understand how the needs of doctoral training in the U.S. are changing. We are hoping you could spend a few minutes sharing some of your experiences in your doctoral program. In particular, we are interested in factors that may affect bringing the dissertation writing process to a successful conclusion.

To this end, we would greatly appreciate if you would answer a few questions for us. To do so, simply go to this website: www.opinion.wsu.edu/phdexperience

In order to begin the survey, you will need to enter this access code: «RESPID».

We think it should only take about ten minutes to complete the questionnaire.

The survey is confidential. Your individual answers will not be linked with your name or department in any reports of the data. Your participation is voluntary and if you come to any question you prefer not to answer, you are welcomed to skip it and go on to the next. Should you have any questions or comments, please contact me (dillman@wsu.edu) or Thom Allen, the study director (509) 335-1722 or ted@wsu.edu.

We very much appreciate your help with this study, and a small token of appreciation is enclosed with this letter as way of saying thank you.

Many Thanks,



Don A. Dillman
Regents Professor and Deputy Director

Reminder

Dear Jane,

Earlier this week we sent you a letter asking for your help with an important survey. We are conducting this study of WSU doctoral students to learn more about the processes they go through to complete their dissertations and finish their degrees.

I am following up with this e-mail to provide you with an electronic link to the survey website. I hope this link makes it easier for you to respond. It should only take a few minutes to complete the questionnaire.

Simply click on this link and you will automatically be logged into the survey:

<http://www.opinion.wsu.edu/phdexperience>

And enter your personal Access Code in the space provided: **<>RESPID<>**

The results of this study will help us better understand the needs and experiences of students as they work on their dissertation research. Your participation is very important, and we appreciate you considering our request.

Sincerely,



Don A. Dillman
Regents' Professor and Deputy Director
Social and Economic Sciences Research Center

The Social Reward Value of Modest Incentives With the Request (Avdeyeva & Matland, 2013)

- ▶ Control group – no incentive
- ▶ A second group – 50 rubles (~\$1.65) with survey request
- ▶ A third group – promised 300 rubles if questionnaire was returned
- ▶ Response rates:
 - ▶ no incentive – 10%
 - ▶ 50 rubles pre pay – 37%
 - ▶ 300 rubles post pay – 24%
 - ▶ Combined pre and post pay – 48%

Using social exchange concepts to motivate potential respondents:

People are more likely to comply with a request from someone else if they believe and trust that the rewards for complying with that request will eventually exceed the costs of complying

Increasing the Benefits of Survey Participation

- ▶ Make it seem valuable, important
 - ▶ How will results be useful?
 - ▶ Ask for help/advice
 - ▶ Make it interesting
 - ▶ Gamification
 - ▶ Scarcity - only some people get asked
 - ▶ Others have responded
 - ▶ Pay (a little bit) forward

Decreasing the Costs of Participation

- ▶ Make it easy
 - ▶ Keep it short!
 - ▶ Keep it simple and clear and convenient
 - ▶ Giving people a choice of modes may reduce response rates
- ▶ Be likable
 - ▶ Show respect
 - ▶ Don't use subordinate language

Establishing Trust

- ▶ Worry about malware, fake surveys
- ▶ Ways to assess your trustworthiness (contact info)
- ▶ Sponsorship
- ▶ Assure confidentiality
- ▶ Minimize requests to obtain personal information

FIGURE 2.3 Summary of ways to increase benefits, reduce costs, and establish trust.



Issues to consider when drafting questions

Social Desirability Bias

- ▶ Wanting to make a good impression
- ▶ “How often do you drive a car after drinking alcoholic beverages? Frequently, Occasionally, Seldom, Never, or Don’t Know.” (Dillman & Tarnai, 1991)
 - ▶ interviewer-administered telephone survey – 63% said “never”
 - ▶ self-administered paper survey – 52% responded “never”
- ▶ “How would you describe your current health? Excellent, Good, Fair, or Poor.”
 - ▶ fewer respondents choose “excellent” in self-administered surveys compared to interviews (Biemer, 1997; Hochstim, 1967).
 - ▶ conventional American greeting “How are you?” -> always “Fine”

Social Desirability Bias

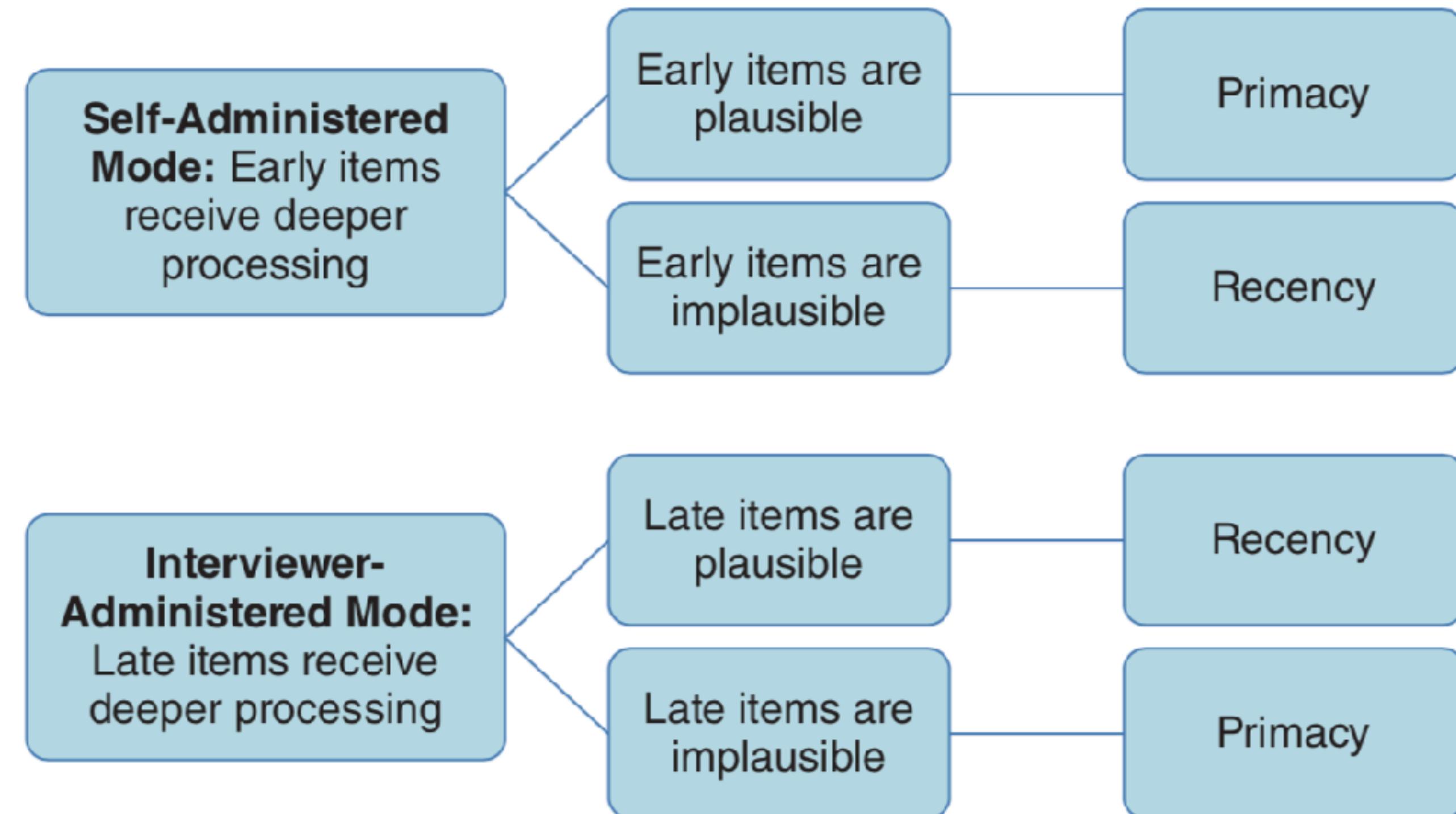
- ▶ Kreuter et al (2008):
 - ▶ 20% of web survey respondents denied having ever received a D or F in college when in fact they had received one of these grades.
- ▶ Catania et al (1996):
 - ▶ both men and women were more likely to report engaging in extramarital sex when interviewed by a same sex interviewer than when interviewed by an opposite sex interviewer.

Acquiescence

- ▶ The tendency to agree with someone rather than disagree
- ▶ Schuman and Presser (1981):
 - ▶ 60% agreed “Individuals are more to blame than social conditions for crime and lawlessness in this country.”
 - ▶ 57% of a control group agreed with the exact reverse “Social conditions are more to blame than individuals for crime and lawlessness in this country.”

Primacy and Recency

FIGURE 4.4 Cognitive elaboration model of response order effects.



Tendency to more frequently choose from among the first / last categories offered regardless of their content

Source: Adapted from "A Cognitive Model of Response Order Effects in Survey Measurement," by N. Schwarz, H. J. Hippler, and E. Noelle-Neumann, 1992, in N. Schwarz and S. Sudman (Eds.), *Context Effects in Social and Psychological Research* (pp. 187–201), New York, NY: Springer-Verlag.

Anchoring

- ▶ Occurs when an early response option forms a standard of comparison for later response options.
- ▶ Noelle-Neumann (1970): "Which food is more typically German?"
 - ▶ "potatoes" and "rice" – 30% said "potatoes"
 - ▶ "rice" and "potatoes" – 48% said "potatoes"



The anatomy of a survey question

Types of Survey Questions

Open-ended questions

Question stem **What is the most important problem facing Nebraska today?**

Answer space

Question stem
with verbal and
numeric
instructions

How many years have you lived in Nebraska?

Please report only whole numbers. For example, if you have lived in Nebraska 20 months, please round to 2 years.

Answer space
with verbal and
symbolic
instruction

Years lived in Nebraska

Closed-ended ordinal question

Question stem **Overall, how satisfied are you with living in Nebraska?**

Answer choices

- Completely satisfied
- Very satisfied
- Somewhat satisfied
- Not too satisfied
- Not at all satisfied

Types of Survey Questions

Body Height Reported by U.S. Men

As part of a comprehensive health survey, the U.S. CDC asked roughly 200,000 adult men in 2021 this question: "About how tall are you without shoes?"

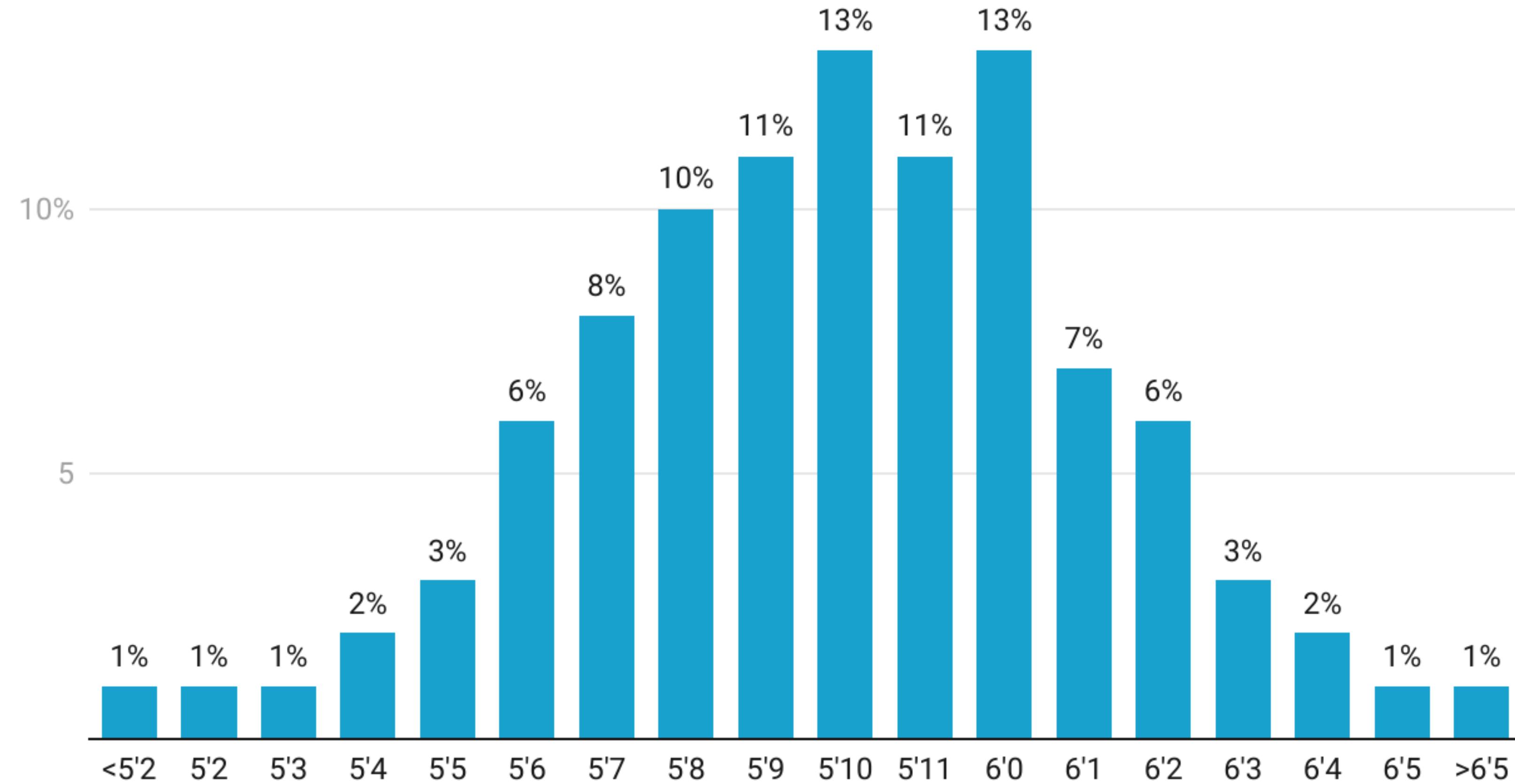


Chart: u/academiaadvice • Source: CDC

Types of Survey Questions

Closed-ended nominal question

Question stem **What is your current marital status?**

Answer choices

- Married
- Living with a partner
- Divorced
- Separated
- Widowed
- Never married

Partially closed-ended question

Question stem **What are your favorite women's sports at the University of Nebraska?**

Answer choices

- Basketball
- Cross Country
- Gymnastics
- Soccer
- Softball
- Swimming and Diving
- Tennis
- Volleyball
- Other: Please specify

Use Specific and Concrete Words To Specify the Concepts Clearly

- ▶ Questions may be factual, but interesting ones usually involve concepts
- ▶ What are the concepts?

FIGURE 4.11 Use specific and concrete words to specify the concepts clearly.

Question with vague concepts

How many times did you eat together as a family last week?

Number of meals

A revised question with more specific and concrete concepts

How many meals did you eat together as a family at home last week?

Number of meals

A more specific revision

How many meals did you sit down to eat at home as a family last week?

Number of meals

- ▶ Use previously-validated scales where possible

Guidelines for Forming Questions

- ▶ Choose the appropriate question format
- ▶ Make sure the question applies to the respondent
- ▶ Ask one question at a time
- ▶ Make sure the question is technically accurate
- ▶ Use simple and familiar words
- ▶ Use specific and concrete words to specify the concepts clearly
- ▶ Use as few words as possible to pose the question
- ▶ Use complete sentences that take a question form, and use simple sentence structures
- ▶ Make sure “yes” means yes and “no” means no
- ▶ Organize questions to make it easier for respondents to comprehend the response task

How to Write Open- and Closed-Ended Questions

Open Ended Questions – Wording Specificity

FIGURE 5.1 How specificity of question wording affects reports about when students began their studies.

| Question Wording (Telephone) | % Reporting Month and Year | % Reporting Season/Semester |
|---|---------------------------------------|--|
| <u>When</u> did you begin your studies at Washington State University? | 13.4 | 57.3 |
| <u>What date</u> did you begin your studies at Washington State University? | 49.5 | 32.3 |
| <u>What month and year</u> did you begin your studies at Washington State University? | 83.7 | 11.0 |

Source: "Helping Respondents Get It Right the First Time: The Influence of Words, Symbols, and Graphics in Web Surveys," by L. M. Christian, D. A. Dillman, and J. D. Smyth, 2007b, *Public Opinion Quarterly*, 71(1), pp. 113–125.

Open Ended Questions – Provide Extra Motivation To Respond

- ▶ “In your own words, how would you describe your adviser(s)?”

Vs

- ▶ “This question is very important to understanding the Washington State University student experience. Please take your time answering it.

In your own words, how would you describe your adviser(s)?”

Open Ended Questions – Use Nondirective Probes To Obtain More Information

- ▶ Smyth et al. (2007b) – “What businesses would you most like to see in the Pullman and Moscow area that are currently not available?”
 - ▶ A random half of students received a follow-up probe asking, “Are there any others?”
- ▶ No probe: average of 1.8 businesses
- ▶ Probe: average of 2.4 businesses

Open Ended Questions – the Type of Probe Used Will Strongly Impact the Amount and Type of Information Received

- ▶ Smyth et al. (2006) – “In your own words, how would you describe your adviser or advisers?”
- ▶ Probes:
 - ▶ “Is there anything else?” – 18% responded; most said “no”
 - ▶ “Can you tell me more about that?” – 82% responded with additional information, including new ideas or themes as well as elaboration on previously reported themes

Closed Ended Questions – Acquiescence

Poor Designs

Do you favor congressional term limits of four years?

- Favor
 - Oppose
-

How satisfied are you with the overall service you have received from your financial consultant?

- Very satisfied
- Somewhat satisfied
- Somewhat dissatisfied
- Very dissatisfied

Closed Ended Questions – Acquiescence

FIGURE 5.4 State both positive and negative sides in the question stem.

Poor Designs

Do you favor congressional term limits of four years?

- Favor
- Oppose

Improved Designs

Do you favor or oppose congressional term limits of four years?

- Favor
- Oppose

How satisfied are you with the overall service you have received from your financial consultant?

- Very satisfied
- Somewhat satisfied
- Somewhat dissatisfied
- Very dissatisfied

How satisfied or dissatisfied are you with the overall service you have received from your financial consultant?

- Very satisfied
- Somewhat satisfied
- Somewhat dissatisfied
- Very dissatisfied

Closed Ended Questions – Primacy

FIGURE 5.7 Subtraction effects in multiple-answer questions.

| Which of the following resources have you used at WSU? Please check all that apply. | | | |
|---|------------------|---------------------------|------------------|
| | % | | % |
| <u>Original Order</u> | <u>Endorsing</u> | <u>Reverse Order</u> | <u>Endorsing</u> |
| Libraries | 95 | Counseling Services | |
| Computer Labs | | Library Instruction | 52 |
| Student Health Center | | Campus-Sponsored Tutoring | |
| Academic Advising | | Career Services | |
| Student Recreation Center | | Internet/E-Mail Access | |
| Internet/E-Mail Access | | Student Recreation Center | |
| Career Services | | Academic Advising | |
| Campus-Sponsored Tutoring | | Student Health Center | |
| Library Instruction | 20 | Computer Labs | |
| Counseling Services | | Libraries | 93 |

Closed Ended Questions – Forced Choice

Check-all-that-apply formatted question

Which of the following items do you have? Please check all that apply.

- Desktop computer
- Laptop computer
- Cell phone
- E-reader
- Tablet computer
- iPod or MP3 player

Closed Ended Questions – Forced Choice

FIGURE 5.12 Replacing check-all-that-apply questions with a forced-choice format.

Check-all-that-apply formatted question

Which of the following items do you have? Please check all that apply.

- Desktop computer
- Laptop computer
- Cell phone
- E-reader
- Tablet computer
- iPod or MP3 player

A revision converting to the forced-choice format

Do you have each of the following items or not?

Yes No

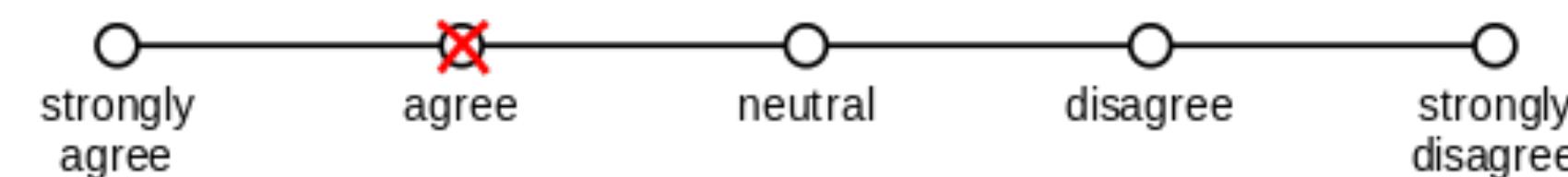
- Desktop computer
- Laptop computer
- Cell phone
- E-reader
- Tablet computer
- iPod or MP3 player

Understanding Likert scales better

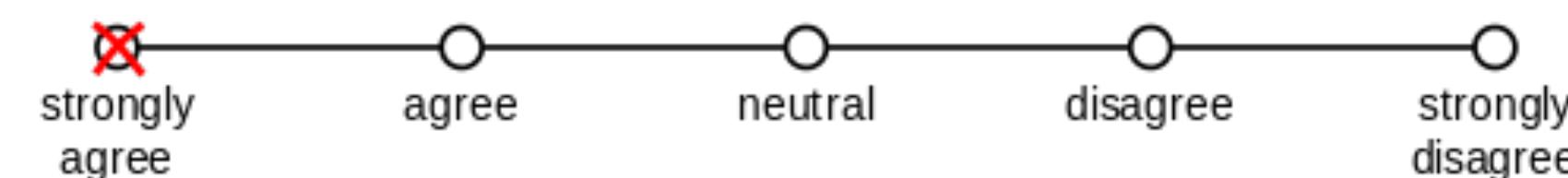
Likert Scale (Pronounced Lick-Ert)

Website User Survey

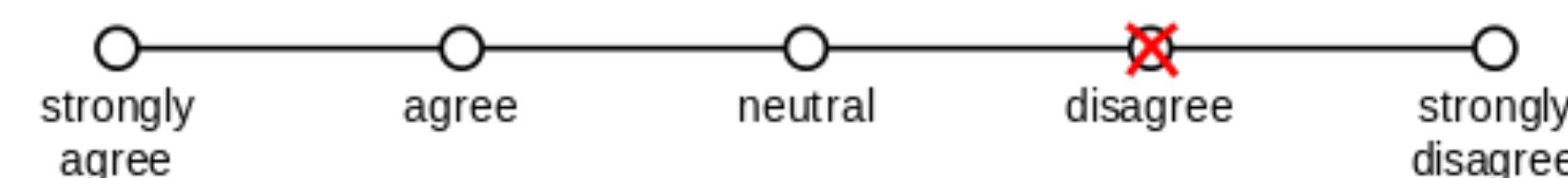
1. The website has a user friendly interface.



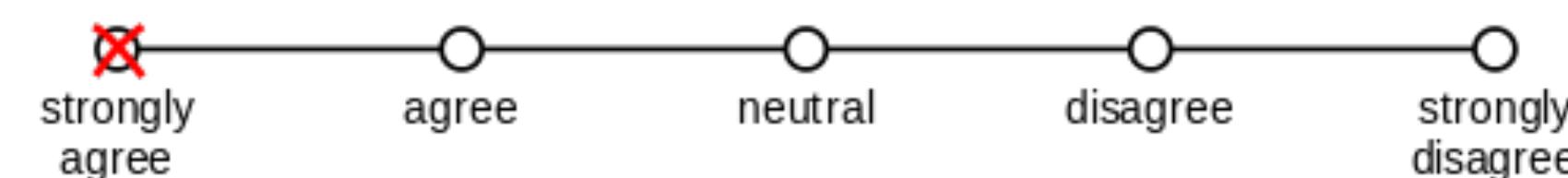
2. The website is easy to navigate.



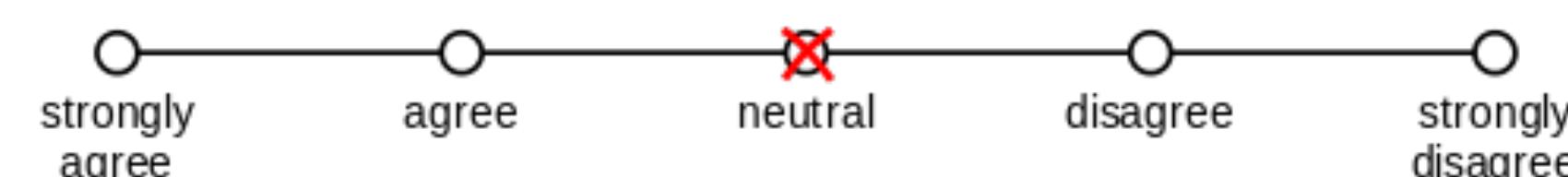
3. The website's pages generally have good images.



4. The website allows users to upload pictures easily.



5. The website has a pleasing color scheme.



"Example Likert Scale using five Likert Items pertaining to Wikipedia" CC-BY-SA-3.0 Wikipedia

Likert Scale (Pronounced Lick-Ert)

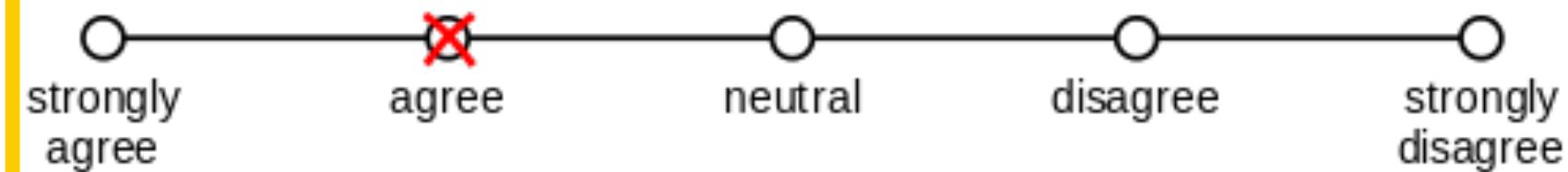
"strongly disagree" = 1

...

"strongly agree" = 5

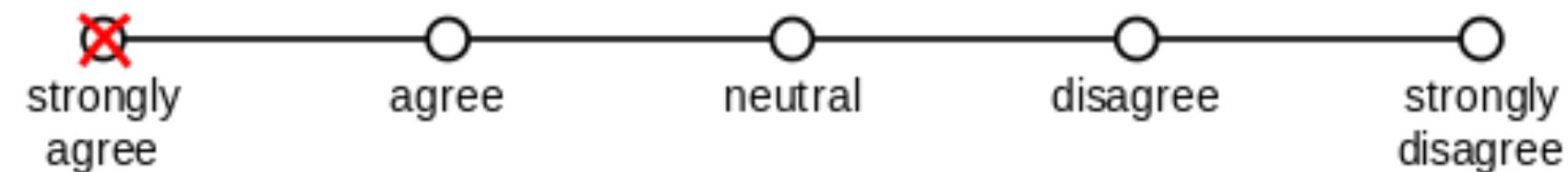
Website User Survey

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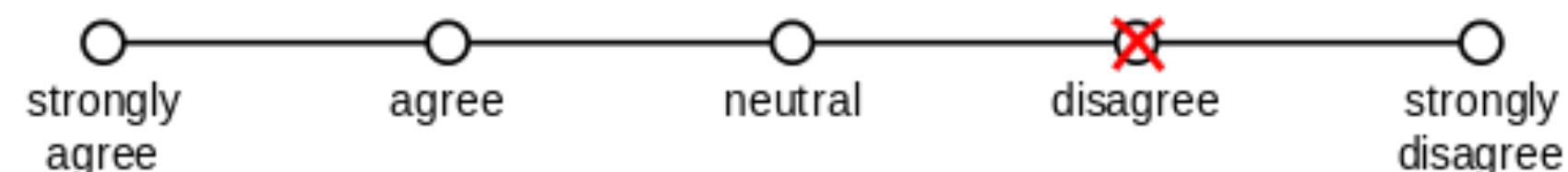
Likert item

2. The website is easy to navigate.

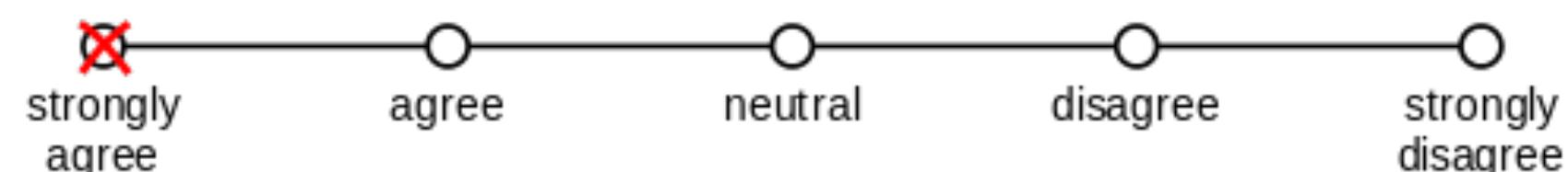


Likert Scale

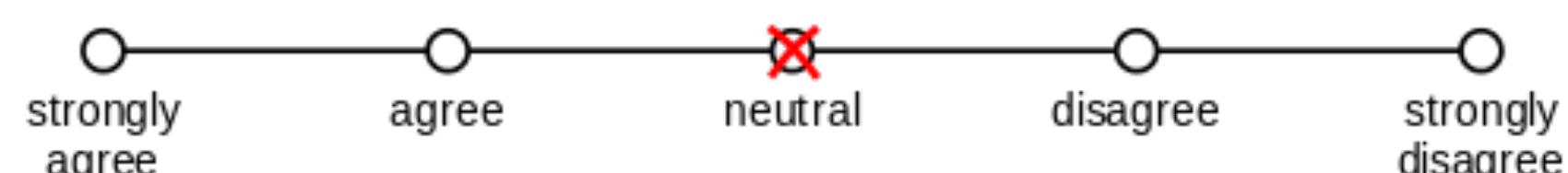
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Concerns: Reliability - Is Whatever Is Being Measured Reliably Found?

- ▶ Statistical or internal reliability (aka “**consistency**”):
 - ▶ The extent to which the items of a scale are consistent with each other.
 - ▶ Typically evaluated using Cronbach’s α
 - ▶ A good scale should have a good split-half correlation.
 - ▶ Cronbach’s α is effectively the average of all the possible split-half correlations.
- ▶ Reliability over time (aka “**stability**”)
 - ▶ Over time, people should answer the same items the same way.
 - ▶ Especially for stable attributes like attitude or personality

Concerns: Validity - Does Whatever Is Being Measured Correspond to the Concept That We Say It Does?

- ▶ Do scales with different response formats agree with each other?
 - ▶ e.g., similar mean values with different items
- ▶ Do items correlate with reference criteria of what the concept means?

Should Items Have a Midpoint?

1. I like massively multiplayer online role-playing games (MMORPG)

Strongly
Disagree

Disagree

Neither

Agree

Strongly
Agree

Should Items Have a Midpoint?

Really ambivalent about their attitude or simply do not have an opinion?

1. I like massively multiplayer online role-playing games (MMORPG)

| | | | | |
|----------------------|----------|---------|-------|-------------------|
| Strongly Disagree | Disagree | Neither | Agree | Strongly Agree |
|----------------------|----------|---------|-------|-------------------|

2. I like massively multiplayer online role-playing games (MMORPG)

| | | | |
|----------------------|----------|-------|-------------------|
| Strongly Disagree | Disagree | Agree | Strongly Agree |
|----------------------|----------|-------|-------------------|

3. I like massively multiplayer online role-playing games (MMORPG)

| | | | | |
|----------------------|----------|-------|-------------------|---------------|
| Strongly Disagree | Disagree | Agree | Strongly Agree | No Opinion |
|----------------------|----------|-------|-------------------|---------------|

Figure 15.2 Three formats of Likert item: 1. with midpoint; 2. no midpoint; 3. no midpoint but option to have no opinion

One Problem of Having a Midpoint Is That of Acquiescence Bias

- ▶ A neutral option means respondents can comfortably avoid disagreeing even if they do actually disagree.
- ▶ Garland (1991) experiment:
 - ▶ 4-point (no midpoint) vs 5-point items
 - ▶ scale scores were higher for the 5-point items
 - ▶ But Nadler et al (2015) found no statistically significant differences

But Bias Could Also Occur in the Opposite Direction

- ▶ 4-point item: Forcing people to respond in a way that they did not truly feel would introduce an element of randomness into the answers.

Likert Item Design Summary

- ▶ Likert items are pretty robust to variations in response format.
 - ▶ Midpoint vs not
 - ▶ 5 vs 7 options
 - ▶ Strongly disagree, Disagree, Neither, Agree, Strongly agree
 - ▶ Strongly disagree, Moderately disagree, Slightly disagree, Neither, Slightly agree, Moderately agree, Strongly agree
- ▶ All-labeled vs just end-points labeled
 - ▶ Strongly Disagree, Disagree, Neither, Agree, Strongly Agree
 - ▶ Strongly Disagree, 1, 2, 3, 4, 5, Strongly Agree
- ▶ Use larger scales over single items.

Example: Questionnaire to Seventh' Graders Pleasure in Writing

- ▶ I love writing.
- ▶ Writing is my favorite school subject.
- ▶ When I write, I feel well.
- ▶ I hate writing.
- ▶ I write as soon as I get the chance.
- ▶ I make sure that I have to write as less as possible.
- ▶ I write more than my class mates.
- ▶ When I write, I prefer to do something different.
- ▶ Writing gives me pleasure.
- ▶ I just write, when I can get a good grade for it.
- ▶ Writing is boring.
- ▶ I like different kinds of writing.
- ▶ When I have the opportunity to determine on my own what I do in the Dutch class, I usual do a writing task.
- ▶ I write even if the teacher does not assign a writing task.
- ▶ I would like to spend more time on writing.
- ▶ Writing is a waste of time.
- ▶ I always look forward to writing lessons.
- ▶ I write because I have to at school.
- ▶ I like it to write down my thoughts.
- ▶ I would like to write more at school.

Example: Questionnaire to Seventh' Graders Pleasure in Writing

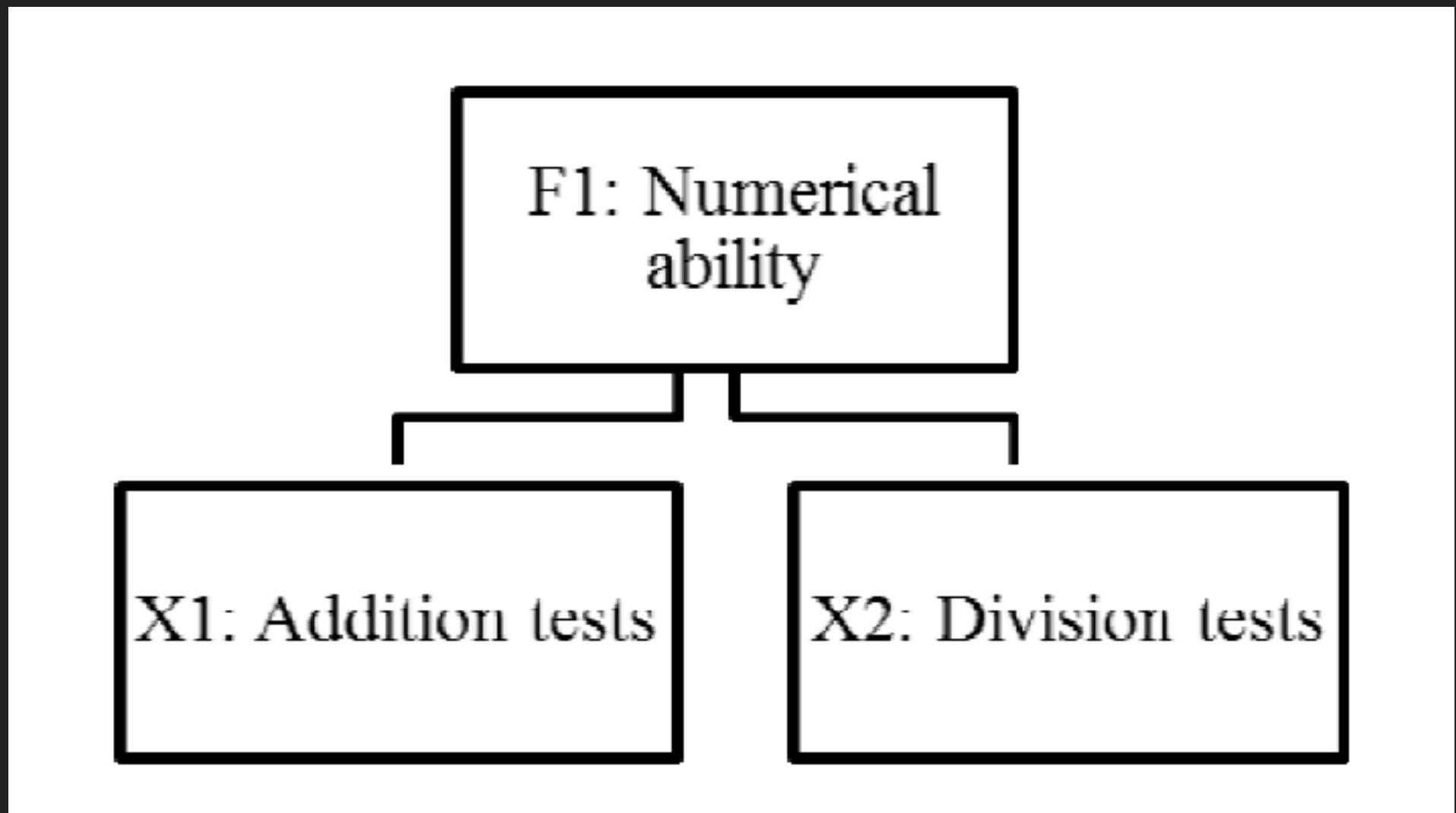
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Example: Questionnaire to Seventh' Graders Pleasure in Writing

- ▶ I love writing.
- ▶ Writing is my favorite school subject.
- ▶ When I write, I feel well.
- ▶ I hate writing.
- ▶ I write as soon as I get the chance.
- ▶ I make sure that I have to write as less as possible.
- ▶ I write more than my class mates.
- ▶ When I write, I prefer to do something different.
- ▶ Writing gives me pleasure.
- ▶ I just write, when I can get a good grade for it.
- ▶ Writing is boring.
- ▶ I like different kinds of writing.
- ▶ When I have the opportunity to determine on my own what I do in the Dutch class, I usual do a writing task.
- ▶ I write even if the teacher does not assign a writing task.
- ▶ I would like to spend more time on writing.
- ▶ Writing is a waste of time.
- ▶ I always look forward to writing lessons.
- ▶ I write because I have to at school.
- ▶ I like it to write down my thoughts.
- ▶ I would like to write more at school.

Factor Analysis To Assess Construct Validity

- ▶ Factor analysis:
 - ▶ A common data summarization technique.
 - ▶ Used to regroup variables into a limited set of clusters based on shared variance.
 - ▶ Helps to isolate constructs and concepts.
- ▶ In this context:
 - ▶ Exploratory factor analysis detects the constructs - i.e. factors - that underlie a dataset based on the correlations between questionnaire items.
 - ▶ The factors that explain the highest proportion of variance the questionnaire items share are expected to represent the underlying constructs.



Factor Extraction

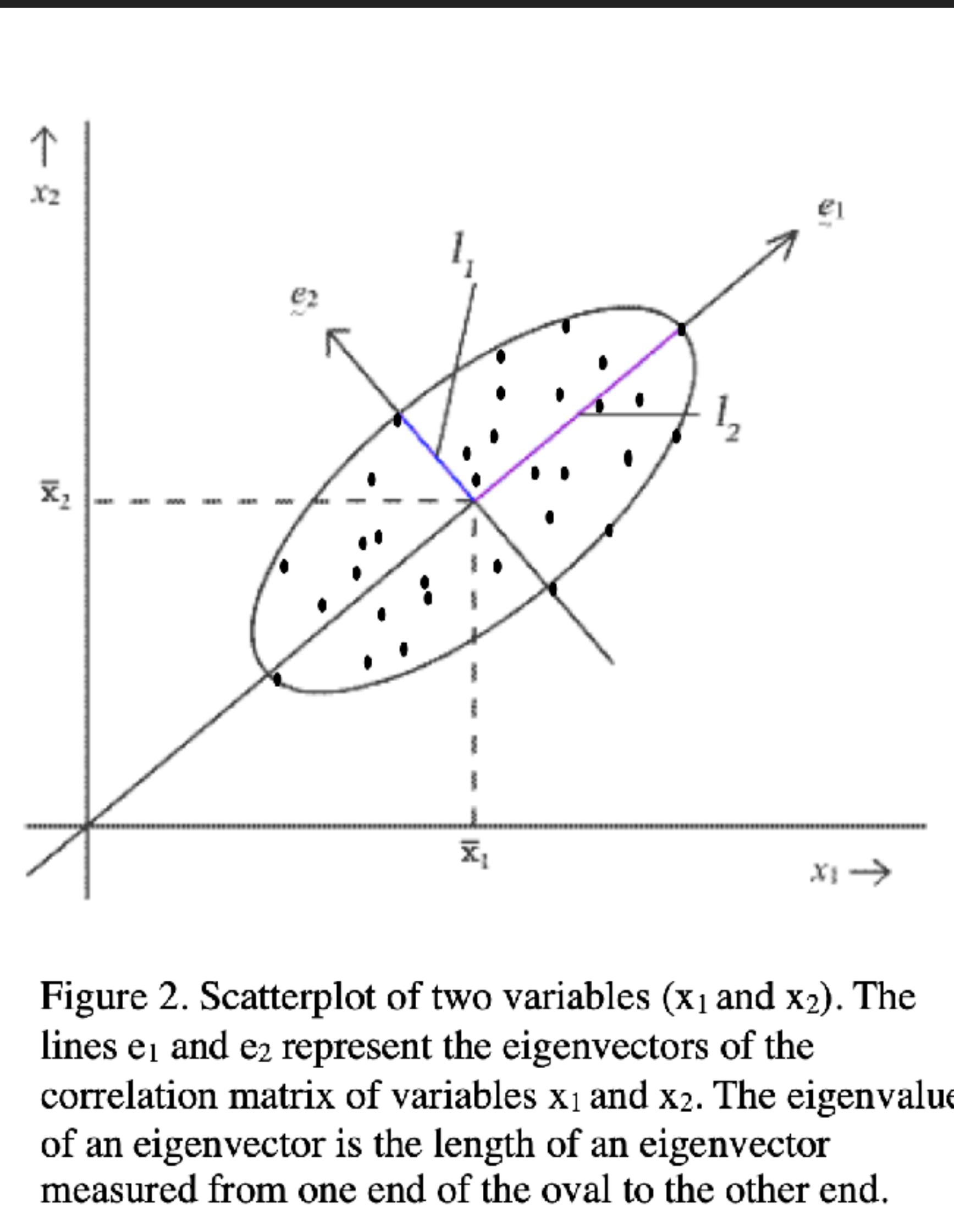


Figure 2. Scatterplot of two variables (x_1 and x_2). The lines e_1 and e_2 represent the eigenvectors of the correlation matrix of variables x_1 and x_2 . The eigenvalue of an eigenvector is the length of an eigenvector measured from one end of the oval to the other end.

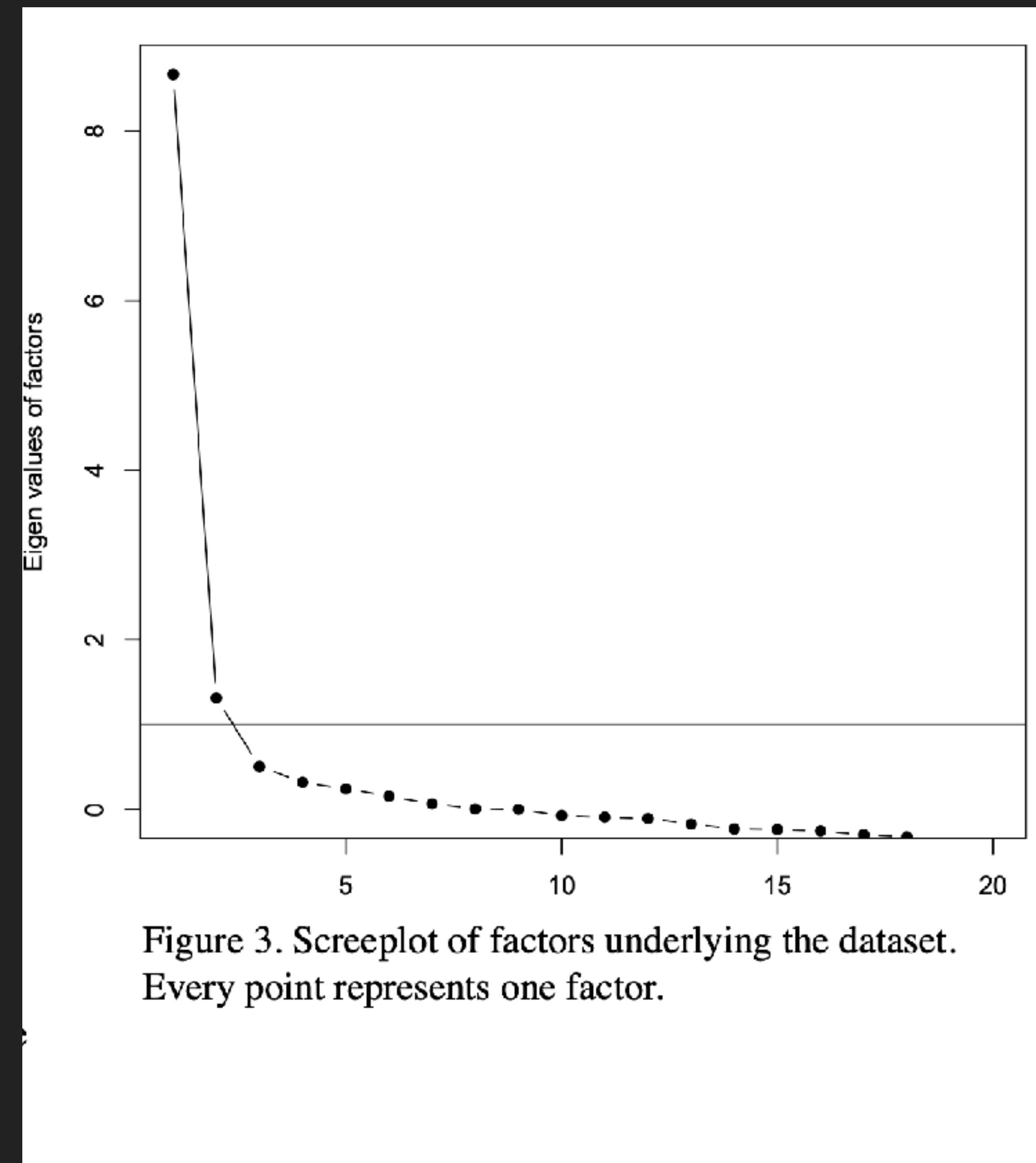


Figure 3. Screeplot of factors underlying the dataset. Every point represents one factor.

The Positively Formulated Items in This Questionnaire Make Up the First Factor and the Negatively Formulated Items the Second Factor.

- ▶ p01. I love writing.
- ▶ p02. Writing is my favorite school subject.
- ▶ p03. When I write, I feel well.
- ▶ p04. I hate writing.
- ▶ p05. I write as soon as I get the chance.
- ▶ p06. I make sure that I have to write as less as possible.
- ▶ p07. I write more than my class mates.
- ▶ p08. When I write, I prefer to do something different.
- ▶ p09. Writing gives me pleasure.
- ▶ p10. I just write, when I can get a good grade for it.
- ▶ p11. Writing is boring.
- ▶ p12. I like different kinds of writing.
- ▶ p13. When I have the opportunity to determine on my own what I do in the Dutch class, I usual do a writing task.
- ▶ p14. I write even if the teacher does not assign a writing task.
- ▶ p15. I would like to spend more time on writing.
- ▶ p16. Writing is a waste of time.
- ▶ p17. I always look forward to writing lessons.
- ▶ p18. I write because I have to at school.
- ▶ p19. I like it to write down my thoughts.
- ▶ p20. I would like to write more at school.

```
Call:  
factanal(x = na.omit(passion), factors = 2, rotation = "oblimin")  
  
Loadings:  
          Factor1 Factor2  
p01     0.547 -0.289  
p02     0.747  
p03     0.727  
p04           0.802  
p05     0.625  
p06           0.641  
p07     0.463  
p08    -0.133  0.558  
p09     0.702 -0.115  
p10           0.597  
p11           0.680  
p12     0.412 -0.243  
p13     0.719  0.122  
p14     0.739  
p15     0.758  
p16           0.771  
p17     0.917  
p18           0.739  
p19     0.623  
p20     0.771  
  
SS loadings      Factor1 Factor2  
Proportion Var  0.307   0.177  
Cumulative Var  0.307   0.484  
  
Factor Correlations:  
          Factor1 Factor2  
Factor1    1.000 -0.642  
Factor2   -0.642  1.000  
  
Test of the hypothesis that 2 factors are sufficient.  
The chi square statistic is 197.76 on 151 degrees of freedom.  
The p-value is 0.00636
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Common pattern that reverse-phrased items
load on a different factor (Schmitt & Stults, 1985)

Cronbach's Alpha Analysis

| Reliability analysis | | | | | |
|------------------------------------|-----------|-----------|-------|------|------|
| Call: alpha(x = passion) | | | | | |
| alpha | average_r | mean | sd | | |
| 0.93 | 0.42 | 3.3 | 0.36 | | |
| Reliability if an item is dropped: | | | | | |
| | alpha | average_r | | | |
| p01 | 0.93 | 0.41 | | | |
| p02 | 0.93 | 0.42 | | | |
| p03 | 0.93 | 0.41 | | | |
| p04- | 0.93 | 0.42 | | | |
| p05 | 0.93 | 0.43 | | | |
| p06- | 0.93 | 0.42 | | | |
| p07 | 0.93 | 0.43 | | | |
| p08- | 0.93 | 0.42 | | | |
| p09 | 0.93 | 0.41 | | | |
| p10- | 0.93 | 0.43 | | | |
| p11- | 0.93 | 0.42 | | | |
| p12 | 0.93 | 0.42 | | | |
| p13 | 0.93 | 0.42 | | | |
| p14 | 0.93 | 0.42 | | | |
| p15 | 0.93 | 0.42 | | | |
| p16- | 0.93 | 0.42 | | | |
| p17 | 0.93 | 0.41 | | | |
| p18- | 0.93 | 0.42 | | | |
| p19 | 0.93 | 0.42 | | | |
| p20 | 0.93 | 0.41 | | | |
| Item statistics | | | | | |
| | n | r | r.cor | mean | sd |
| p01 | 114 | 0.77 | 0.76 | 3.5 | 1.19 |
| p02 | 114 | 0.68 | 0.67 | 3.9 | 1.07 |
| p03 | 114 | 0.77 | 0.76 | 3.6 | 1.06 |
| p04- | 114 | 0.70 | 0.69 | 3.3 | 1.29 |
| p05 | 113 | 0.57 | 0.55 | 3.8 | 0.90 |
| p06- | 114 | 0.61 | 0.59 | 3.0 | 1.19 |
| p07 | 114 | 0.55 | 0.52 | 3.4 | 0.82 |
| p08- | 114 | 0.63 | 0.60 | 2.6 | 1.18 |
| p09 | 114 | 0.78 | 0.77 | 3.6 | 0.98 |
| p10- | 114 | 0.59 | 0.57 | 2.5 | 1.23 |
| p11- | 114 | 0.60 | 0.58 | 3.1 | 1.26 |
| p12 | 114 | 0.62 | 0.59 | 3.0 | 1.00 |
| p13 | 114 | 0.60 | 0.57 | 3.4 | 1.08 |
| p14 | 114 | 0.71 | 0.70 | 3.7 | 1.01 |
| p15 | 114 | 0.71 | 0.70 | 3.8 | 0.95 |
| p16- | 113 | 0.63 | 0.62 | 3.4 | 1.12 |
| p17 | 113 | 0.80 | 0.80 | 3.8 | 0.85 |
| p18- | 114 | 0.62 | 0.61 | 2.6 | 1.17 |
| p19 | 114 | 0.67 | 0.66 | 3.2 | 1.06 |
| p20 | 114 | 0.77 | 0.76 | 3.8 | 0.94 |

Table 4. Output of a Cronbach's alpha analysis in R

Example: Multi-Item Scale for Brainstorming

1. The group aimed to generate as many ideas as possible.
2. All ideas were welcome, no matter how unconventional they were.
3. The group tried to combine similar ideas into one.
4. The group aimed to build on the ideas generated.
5. Ideas were generated first individually, then discussed as a group.
6. An organizer or group leader facilitated brainstorming for my session/group.
7. Group members criticized ideas proposed during the group/session. (R)

Responses on 5-point Likert scale, asked to what extent the statement reflected the way their group decided to work, from "not at all" to "completely."

Analyzed inter-item reliability (Cronbach's α), had to drop #7

From: Filippova, A., Trainer, E., & Herbsleb, J. D. (2017). *From diversity by numbers to diversity as process: supporting inclusiveness in software development teams with brainstorming*. Paper presented at the International Conference on Software Engineering, Buenos Aires, Argentina.

Survey Examples

- ▶ Ecosystem survey

http://cmu.ca1.qualtrics.com/jfe/form/SV_d4M66VwPlZYd5kh

- ▶ Results: <http://breakingapis.org/survey/>

- ▶ GitHub open source survey

<https://github.com/github/open-source-survey>

- ▶ Results: <http://opensourcesurvey.org/2017/>

Readings

► https://drive.google.com/drive/folders/1ISOQlbw-cRmT47_itplJkTZua_IASNgB?usp=sharing

| ▼ | surveys |
|---|---|
| | Dillman - Internet, Phone, Mail, and Mixed-Mode Surveys.pdf |
| | factoranalysis - A Beginner's Guide to Factor Analysis/ Focusing on Exploratory Factor Analysis.pdf |
| | factoranalysis - MHof-QuestionnaireEvaluation-2012-Cronbach-FactAnalysis.pdf |
| | surveys - Cairns Ch 15 - What Makes a Good Likert Item?.pdf |
| | surveys - Cairns Ch 16 - The Meaning of Factors.pdf |
| | surveys - Cairns Ch 17 - Unreliable Reliability/ The Problem of Cronbach's Alpha.pdf |
| | surveys - Cairns Ch 18 - Tests for Questionnaires.pdf |
| | surveys01 Why respondents may not complete surveys.pdf |
| | surveys02 letter.pdf |
| | surveys03 email.pdf |
| | surveys04 open-source-survey/survey-instrumentation.md at master · github/open-source-survey.pdf |
| | surveys05 reference on when to ask background info.pdf |
| | surveys06 Academic Research_ Moving Between Projects on GitHub - Google Forms.pdf |
| | surveys07 Google Docs.pdf |

Credits

- ▶ **Graphics:**
 - ▶ Dave DiCello photography (cover)
- ▶ **Content:**
 - ▶ Chapters from Dillman, D., Smyth, J. D., & Christian, L. M. (2014). Internet, Phone, Mail and Mixed-Mode Surveys: The Tailored Design Method (4th ed.). Hoboken, NJ: Wiley.
 - ▶ Ch1: Sample Surveys in our Electronic World
 - ▶ Ch2: Reducing People's Reluctance to Respond to Surveys
 - ▶ Ch4: The Fundamentals of Writing Questions
 - ▶ Ch5: How to Write Open and Closed Ended Questions
 - ▶ Hof, M. (2012). Questionnaire Evaluation with Factor Analysis and Cronbach's Alpha. Student project. Seminar in Methodology and Statistics. University of Groningen
 - ▶ Yong, A. G., & Pearce, S. (2013). A beginner's guide to factor analysis: Focusing on exploratory factor analysis. *Tutorials in quantitative methods for psychology*, 9(2), 79-94.
 - ▶ Cairns, P. (2019). Doing better statistics in human-computer interaction. Cambridge University Press.
 - ▶ Ch15: What Makes a Good Likert Item?
 - ▶ Ch16: The Meaning of Factors
 - ▶ Ch17: Unreliable Reliability: The Problem of Cronbach's Alpha
 - ▶ Ch18: Tests for Questionnaires