Chapter 17: Enhancing Questionnaire Quality in Research: Challenges, Principles, and the Acid Test

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Abstract
One of the standard procedures when conducting research is to use a questionnaire or interview to obtain data in answering the research questions. The challenge identified is that many students do not use a proper method or do not know how to compile a questionnaire and most of the time it is a heuristic method (rule of thumb). Many supervisors do not bother to ascertain if the questionnaire is acceptable. The challenge could be that the researcher discovers at the end that the research questions are not answered or that the discussion does not reflect what needs to be done. In this article, we propose a matrix that could help to solve this challenge if appropriately followed.

Keywords: Data, Proper Method, Questionnaire, Research Method, Researcher, Supervisor

Introduction and Background
Academic research enhances humanity's progress and is driven by humanity's curiosity. Humans get curious, ask questions, and focus on discovering everything to know. Without curiosity and research, humanity's progress would stall,

and the world would be completely different place. Sheridan (2024) defines academic research as an investigation into what is known about a specific topic. It requires examining and analysing academic and other sources. Gumasta (2022) adds that academic research is conducted to increase the understanding of fundamental principles in core interest areas. The main objective of academic research is thus the creation of knowledge.

Academic research can broadly be divided into qualitative and quantitative research. Tenny *et al.* (2022) describe qualitative research as a type of research that provides insights into real-world problems. Qualitative research gathers participants' experiences, perceptions, and behaviour. It could be structured as a standalone study, relying on qualitative data, or part of mixed-methods research that combines qualitative and quantitative data. Quantitative research is more positivistic and gathers numeric data (Coghlan *et al.* 2014). The collection of quantitative information allows researchers to conduct statistical analyses that aggregate the data, indicate relationships among the data or compare across aggregated data.

Academic research, irrespective of whether it is qualitative or quantitative, can be divided into primary and secondary research (Bouchrika 2024). Streefkerk (2023) describes primary research as obtaining information that provides direct evidence about the people, events, or phenomena that are being researched. Primary sources can be qualitative or quantitative data collected through interviews, surveys, experiments or sources produced by people directly involved in the topic.

In addition, Streefkerk (2023) describes secondary research as information that describes, interprets, evaluates, or analyses information from primary sources. Examples of secondary research include, amongst others, books and articles that synthesise information on a topic. Secondary research is widely used in many fields of study and industries, such as legal and market research. For instance, a systematic review is one of the most common secondary research methods. In a systematic review, scientists systematically review existing literature and studies on a specific topic, appraising available studies to synthesise their findings (Bouchrika 2024).

This chapter investigates the usage of questionnaires to obtain information as part of primary research, as there are challenges when using this instrument in academic research. The questionnaire method is a versatile and powerful tool for data collection across diverse research domains. Its structured format facilitates standardised data collection, organisation, and analysis, which is particularly advantageous for quantitative research. This method offers

researchers cost-effectiveness, accessibility, and the ability to reach a broad and diverse population, enabling the efficient gathering of comprehensive insights.

Low response rates, potential bias due to non-response, and difficulties ensuring respondent representatives could be challenges when using questionnaires. Despite these possible challenges, the questionnaire method could be valuable, providing a structured approach to gathering insights and contributing to knowledge advancement in various fields (Kupanga 2024). A questionnaire can assist in answering the research questions or prove the hypothesis.

Questionnaires are indispensable tools for collecting data across diverse research domains. Their systematic structure enables researchers to gather information on attitudes, beliefs, behaviors, and characteristics from a significant number of respondents, facilitating both quantitative and qualitative analyses (Bryman 2016). However, the efficacy of a questionnaire hinges on its design and implementation, which are often fraught with challenges.

This paper therefore synthesizes a systematic review of the literature, elucidating the key obstacles encountered in questionnaire development and proposing fundamental principles for crafting robust and effective research instruments. Furthermore, it integrates Remenyi's (2005) 'acid test' as a crucial evaluation framework for research questions underpinning questionnaire design.

Research Methodology

The research methodology employed in this chapter is a systematic review of the literature to identify the challenges faced when compiling questionnaires in research. The systematic review methodology was chosen as it is explicit, precise, and evidence based.

According to Manchester Metropolitan University (2024), it aims to minimise bias and thus enhance the reliability of any conclusions. In addition, health professionals, policymakers, and other researchers widely use systematic reviews.

The steps of a systematic review methodology is to 1. Formulate the research question asked to the literature; 2. Formulate including and excluding criteria for article searches; 3. Identify search engines and databases used, as well as the 4. The method by which the selected articles will be analysed and 5. How the data will be presented.

Systematic Review

Creating and using questionnaires in research presents specific challenges. This section performs a systematic review of questionnaires in research across different scholarly fields. It describes why questionnaires are relevant to data collection and their design is crucial to collecting the data needed to answer the research question.

Challenges in the Design and Implementation of Questionnaires

The Foundational Role of Questionnaires in Research

Well-designed questionnaires are pivotal for obtaining pertinent data that directly addresses research questions. They allow for standardized data collection, enabling comparisons across respondents and facilitating statistical analysis. The insights gleaned from carefully constructed questionnaires can be instrumental in answering complex research inquiries and informing evidence-based conclusions across various fields of study.

Despite their widespread use, numerous challenges can undermine the effecttiveness of questionnaires. These challenges can introduce bias, reduce response rates, and ultimately compromise the validity and reliability of research findings. Table 1 consolidates these challenges as identified in the reviewed literature.

The following table details the research challenges.

Table 1: Research challenges

Author(s)	Main challenges
David (2024)	• Limited response options in a questionnaire can deter a respondent from providing correct data simply because the response options do not include it. • A low response rate may lead to inaccurate results, as the data may not accurately reflect the opinions and experiences of the intended target audience. • Survey fatigue: Respondents may be overwhelmed with too many questions. • Use of complicated language may result in some questions being unclear.

Collins *et al.* 2018)	• Respondents' willingness to participate only when its aims are clear, it is easy to complete and when it is perceived to be of ultimate benefit to respondents. • Questions are phrased in a manner that is not straightforward to understand. • Positive and correct language using euphemistic terms can confuse the respondents. • Reluctance to ask direct questions to avoid offending respondents.

Cunha *et al.* 2021)	• It takes time, consumes researcher effort, and depends on the respondents' voluntary collaboration. • Managing the balance of research goals and the need not to pursue too many and too detailed research objectives. • Questions are formatted so that the information appears too dense. • The questionnaire structure does not allow an almost automatic answer and thus does not allow the respondent to think about anything other than the item itself.

Linderman (2023)	• The potential inability to capture detailed and nuanced insights from participants. • Errors in how participants interpret and respond to questionnaire items, leading to biased results. • The downside of low response rates is the potential for non-response bias and the potential impact on the representativeness and generalisability of the collected data. • Misinterpretation can occur due to unclear wording, ambiguous phrasing, or the use of technical jargon that is unfamiliar to participants.

Geskus (2023)	• Without a sound knowledge of research methodologies and statistics, it can be difficult to create a reliable and valid questionnaire. • The questions are not relevant to the purpose of the study.

	• Open-ended questions can provide valuable insights but are more challenging to analyse than closed-ended ones. • Questionnaires that are too long may cause the respondents to end the survey early and not answer the questions thoroughly.

Principles for Enhancing Questionnaire Design

Given the challenges outlined, the literature suggests several key principles to enhance the quality and effectiveness of questionnaires.

Formulating Clear and Effective Questions

The bedrock of a good questionnaire lies in the clarity and precision of its questions. The American Society of Nephrology (2020) emphasizes the need for informative introductory statements that clearly articulate what is expected of respondents. Researchers must carefully consider whether to employ open-ended or closed-ended questions (Neuman 2014; Bryman 2016).

The American Society of Nephrology (2020) also states that all questions must be formulated with an informative introductory statement. It should be clear what is expected from respondents and to be able to reply. Having decided that a questionnaire is the most suitable method for gathering data, researchers must decide what and how to formulate questions. To formulate the questions, researchers face several decisions, including whether the questions will be open- or closed-ended.

Open-ended questions enable respondents to express themselves freely and provide any answer, whereas closed-ended questions limit respondents to choosing from the given responses. (Neuman 2014). Rephrased, open-ended questions elicit unstructured responses and closed-ended questions elicit structured responses. The choice between open- and closed-ended questions depends on the general research problem, the type of data researchers seek, and where the researcher wants to place the onus of interpretation (Bryman 2016).

Open-ended questions allow for free-form responses, providing rich, nuanced data suitable for exploratory research and brainstorming. However, they place the onus of interpretation on the researcher and can be challenging to analyze systematically.

Closed-ended questions offer predefined response options, facilitating quantitative analysis and comparison. However, they limit the scope of responses and require careful consideration of the comprehensiveness and mutual exclusivity of the options. Flawed response categories, such as overlapping income brackets (Brace 2018), can compromise data accuracy.

Examples of these include: A trade magazine might pose the following question to professionals from companies: 'What is the worst information-systems-industry job that you can imagine?' This is an open-ended question, and respondents can give any answer. The respondent is given flexibility and range in responding. This is good for problem identification and brainstorming (Neuman 2014). Since the onus of interpretation falls on the researcher, open-ended questions are unsuitable for all situations. For example, elections with open-ended questions on the ballot would most likely open-up more room for political squabbling about the correct interpretation of the results.

In contrast, if the magazine survey were to ask: 'Within the information systems industry, do you feel the programmer's occupation is?

a) the best occupation;
b) a good occupation;
c) an acceptable occupation;
d) a bad occupation; or
e) the worst occupation?

This question is closed-ended and respondents have limited choices. Furthermore, they are responsible for interpreting each answer and must decide what each answer means.

Ensuring Clarity in Language and Avoiding Bias

Norstat (2022) states that clear and comprehensible language should be used in questionnaires, which could ease the respondents' cognitive burden. Questionnaires should be based on the vocabulary and grammar of the target population being surveyed, and ambiguity, confusion, and vagueness must be avoided. Neuman (2014) noted that the terminology used must be known within the field of research. Subject jargon or unfamiliar terminology to the respondents and unnecessary abbreviations must not be used. In addition, Neuman (2017) states that it is necessary to clarify what the researcher is asking and how it should be answered. For example, if the researcher asks, 'What is your

income?' the respondent does not know whether it means weekly, monthly or annual, pre-tax or after-tax, household or individual, this year or last year, etc. The researcher should also avoid using indefinite words or response categories. For example, 'Do you jog regularly?' The respondent might not know what the word 'regularly' means. Questions must be clear and straight to the point, eliminating confusion, doubt or ambiguity (DeFranzo 2012).

The language used in questionnaires must be clear, comprehensible, and tailored to the target population's vocabulary and grammar (Norstat 2022). Ambiguity, vagueness, technical jargon, and unnecessary abbreviations should be avoided (Neuman 2014; DeFranzo 2012). Questions should be direct and unambiguous, specifying the frame of reference (e.g., time, unit of measurement) to prevent misinterpretation.

Furthermore, researchers must be vigilant in avoiding biased language. This includes:

- Emotional language and loaded words: These can evoke strong emotional responses and skew answers (Neuman 2014).
- Prestige bias: Questions that suggest a 'right' answer based on social desirability or association with respected figures can lead respondents to provide inaccurate responses (Neuman 2014).
- Leading questions: These subtly guide respondents towards a particular answer (Neuman 2014).

Emotional Language, Prestige Bias and Leading Questions

Neuman (2014) also noted that loaded words with a history of being attached to extreme situations should not be used. For example, avoid questions like 'What should be done about murderous terrorists who threaten the freedom of good citizens and the safety of children?' Watch for prestige markers that cue the respondent to give the 'right' answer. For example, 'Do you support the president's policy on Zimbobutu?' provokes 'yes' answers from people who have never even heard of Zimbobutu (and, in fact, we made the name up -- yet many people will say 'yes' to this question).

Avoid leading questions like 'I assume you would agree that the teachers do a heroic job for our children.' Avoid loading questions with extra adjectives and adverbs, like 'Should the mayor spend even more tax money trying to keep the streets in top shape?' (Neuman 2014).

Avoiding Complex Question Structures

Questions should be formulated that they are not beyond a respondent's capabilities. In addition, questions should not probe the respondents about future intentions. Questions should only be about one topic (Brace 2018). For example, do not ask, 'Does your company have pension and health insurance benefits?' because if their company has only one of those benefits, it is unclear whether the respondent will say 'yes' or 'no'.

Suppose you want to test the idea that students give better evaluations to teachers who tell many jokes in class. The wrong way to investigate this is to ask, 'Do you rate a teacher higher if the teacher tells many jokes?' because this assumes that the student is entirely conscious of everything they do and why. Instead, ask the student two separate questions.

Several structural elements can impede respondent understanding and the accuracy of their answers:

- Double-barrelled questions: These combine two distinct issues into a single question, making it impossible for respondents to answer accurately if their views differ on the two parts (Brace 2018).

- Questions with negatives and double negatives: These are cognitively challenging to process and can lead to confusion and unreliable data (DeFranzo 2012; Brace 2018).

- Hypothetical questions and questions about future intentions or past recall of minor details: These often yield unreliable responses as they do not reflect actual behavior or are beyond respondents' cognitive capabilities (Brace 2018).

People have cognitive limitations, especially regarding the memory of past events. Asking, 'How did you feel about your brother when you were six?' is useless. It is pointless to ask people about things that are not natural ways for them to think. For example, do not ask, 'How many litres of petrol did you buy for your car last year?' The same is true when asking, 'What is the most important thing one should do to stop the economy from deteriorating further?' This assumes that the economy is deteriorating. It would be better to rephrase. Hypothetical questions like 'If a new grocery store were to open down the street, would you shop there?' are unrelated to actual future behaviour.

Questions with Negatives and Double Negatives

Negatives like 'Students should not be required to take a comprehensive exam to graduate' are difficult for respondents to process, especially if they agree with the predicate because they disagree with *not* doing something, which is confusing (DeFranzo 2012). Using double negatives like 'It is not a good idea not to turn in homework on time' yields unreliable data because people are unsure about whether to put a 'yes' or 'no' even if it is evident in their minds whether turning in homework on time is a good idea (Brace 2018).

Strategic Question Placement

The order in which questions are presented can also influence responses (Bryman 2016). Sensitive, embarrassing, or threatening questions should be placed towards the end of the questionnaire, after rapport has been established. First, it makes them more likely to answer, and second, if they get upset and leave, at least the researcher has covered most of the questions (Bryman 2016). Related questions should be grouped together to maintain flow and avoid appearing disorganized. Researchers must be mindful of questions that might inadvertently influence responses to subsequent questions.
For example:

- Do you think the US should let European newspaper reporters come and send back the news as they see it?
- Do you think a European country should let American newspaper reporters come in and send back the news as they see it?

Managing 'Don't Know' Responses

Filtering 'Don't Know'

Fink (2013) outlines three approaches to handling 'don't know' responses:

- **Standard format:** The 'don't know' option is not explicitly offered but recorded if volunteered.
- **Quasi-filter:** 'Don't know' is included as a response option.
- **Full filter:** Respondents are first asked if they have an opinion before the substantive question is posed.

The first is the standard format. The 'don't know' option is presented to the respondent but is recorded if the respondent volunteers to it. The second is the quasi-filter. A 'don't know' option is included among the possible responses. And lastly, the full filter**.**

Standard format. The respondents are asked if they have an opinion. Then, if yes, ask the question (Fink 2013). Example:

> Here are some questions about other countries. Do you agree or disagree with each statement?
>
> The European leaders are trying to get along with America.

Quasi-filter. Here is a statement about another country.

> The European leaders are trying to get along with America. Do you agree, disagree, or have no opinion on that?

Full filter. Here is a statement about another country. Not everyone has an opinion on this. If you do not have an opinion, just say so. Here is the statement:

> The European leaders are trying to get along with America.
> Do you have an opinion on that? [If 'YES'] Do you agree or disagree?

The choice of approach depends on the research objectives and the sensitivity of the topic.

Utilizing Appropriate Question Formats

Beyond open- and closed-ended questions, various formats can be employed:

- **Rating scales:** These allow respondents to indicate the strength of their agreement or evaluation on a continuum (Fink 2013). The number of scale points can impact data reliability and respondent burden (Brace 2018).

- **Direct magnitude scaling:** This technique allows for ratio-scaled data by asking respondents to provide numerical ratings relative to an anchor point (DeFranzo 2012).

- **Rank-ordering:** Useful for comparing a small number of items, this method asks respondents to order items based on a specific attribute (Bryman 2016).

- **Paired comparisons:** Respondents choose between two items at a time based on a given attribute (Roopa & Rani 2012).

- **Matrix questions:** These present multiple questions with the same response categories in a grid format, potentially increasing efficiency and comparability (Bryman 2016). However, care must be taken to include necessary response options like 'Don't Know' or 'Neutral.'

- **Contingency questions:** These are multi-part questions where the subsequent questions depend on the response to the initial question, ensuring that only relevant questions are answered (Brace 2018).

- **Scaled responses (e.g., Likert scales):** These measure attitudes or opinions using a series of statements with ordered response options (Fink 2013; Brace 2018).

An open-ended question is one in which the researcher does not provide any standard answers, as already discussed above and below. Here are some more examples:

1. How old are you? _____ years.
2. What do you like best about your current employment?

A closed-ended question is a question in which the researcher provides the response categories, and the respondent chooses one:

1. How old are you?

   (a) 12 - 15 years old
   (b) 16 - 25 years old
   (c) 26 - 35 years old
   (d) 36 - 45 years old
   (e) Senior citizen

2. What do you like best about your current employment?

    (a) The people.
    (b) The diversity of skills you need to do it.
    (c) The pay and/or benefits.
    (d) Other: _____ (write down)

A close-ended question is a question in which the researcher provides standard answers to choose from. For example:
This question:

3. What is your annual household income?
    (a) Less than R10 000
    (b) R10 000 to R25 000
    (c) R25 000 to R35 000
    (d) R35 000 to R50 000
    (e) R50 000 to R75 000
    (f) More than R75 000

This question is however flawed because of the overlapping answers, namely: If a person's income is exactly R25 000, which category do they use? Brace (2018) lists the advantages and disadvantages of different types of questions that can be asked.

The following table provides several advantages and disadvantages of using open-ended and closed-ended questions in research questionnaires.

Table 2: Advantages and disadvantages of using closed-ended and open-ended questions

	Advantages	Disadvantages
Closed-ended	• Easy and quick to answer • Responses easy to compare • Response choices make questions clearer • Easy to replicate the study	• May lead the respondents' answers • Respondents with no opinion are forced to answer • Respondents can feel constrained and or frustrated • Too many choices can be confusing for the respondent • Fine distinctions may be lost • Mistakes can occur easily • May force respondents into simple responses
Open-ended	• Permit an unlimited number of answers • Respondents can qualify and clarify responses • Can find the unanticipated • Reveals respondents' thinking processes	• Respondents may provide answers at different levels of detail • Answers can be irrelevant • Inarticulate respondents are at a disadvantage • Coding is tedious • Requires time and effort • Intimidates respondents • When a respondent omits a response, we cannot tell whether the omission is because of belief or just forgetfulness

Source: Brace (2018)

Rating Format Questions

In this format, researchers require respondents to rate their answers (Fink 2013). For example:

Children must be allowed to make their own mistakes.

1) Disagree strongly
2) Disagree somewhat
3) Neither agree nor disagree
4) Agree somewhat
5) Strongly agree

The result of a rating question is an ordinal-level variable, which is treated as an interval in data analysis.

Odd or Even Number of Steps in the Response Scale

A researcher may use an odd number of steps to allow the respondent to express a middling or neutral strength of opinion (Fink 2013). This could be problematic with respondents who provide the middle category for all questions. However, the alternative can be even worse: respondents with no or neutral opinions are forced to choose negative or positive and do it randomly.

Steps in the Response Scale

The statistical reliability of the data increases sharply with the number of scales up to about seven steps, then it increases more slowly, leveling off around 11. After 20 steps, it decreases sharply (Brace 2018). However, the more steps there are, the more difficult it is for the respondent and possibly the less valid the responses.

Suppose variables are combined additively, such as when the researcher creates a scale or index. In that case, the number of steps is not problematic in terms of the reliability of the answers.

Direct Magnitude Scaling

Magnitude scaling is a method of obtaining ratio-scaled data from respondents. The reason is to give respondents an anchor point and then ask them to answer the questions relative to that anchor point (DeFranzo 2012).

For example, suppose the researcher is interested in the severity of crimes. Start by assigning a number to one crime. For example, take 'felony' and tell the respondent that the severity of a felony is 100 units. Now say: 'Okay, if the felony is 100 points, how many points is 'murder'? If you think murder is ten times as bad as a felony, then write down 1000. If it is twice as bad as a felony, write down 200. Then you ask about every other crime.

Rank-Ordering

Rank ordering is an efficient method with a small number of objects, such as 10 (Bryman 2016). For example, instead of rating how serious each set of organisational problems is, the researcher could ask the respondent to sort them in order of most to least severe.

Paired Comparisons

In this method, the researcher presents items two at a time and asks the respondent to choose which has the same attributes (Roopa & Rani 2012).

Principles for Questions

Neuman (2014) argue that writing is more of an art than a science. It takes skill, practice, and creativity. The following are considered principles for survey research.

The questions asked should be relevant to the research problem (Neuman 2014):

1. Questionnaires should be as short as possible.
2. Avoid ambiguity, confusion, and vagueness.
3. Avoid prestige bias.
4. This way of stating a professional's position might easily sway people who want to align with the ACM organisation.
5. Avoid double-barrelled questions.
6. Avoid leading questions.
7. Avoid asking questions that are beyond the respondents' capabilities.

Contingency Questions

Certain questions in questionnaires will be relevant to some respondents and irrelevant to others. Researchers should avoid asking irrelevant questions. This will reduce respondents' frustration and increase the quality of information in their responses (Brace 2018). A contingency question is a two-part (or more) question. Properly using contingency questions can facilitate the respondents' completion of the questionnaire.

There are several formats for contingency questions. The following is probably a frequently applied format:

1. Have you ever used computer-aided instruction software?
   [ ] No (Go to question 2)

2. [ ] Yes]

   If yes, how many hours per week?

   [ ] Less than one
   [ ] one
   [ ] 2 to 5 hours
   [ ] 6 to 10 hours
   [ ] 11 to 20 hours
   [ ] more than 20 hours

Scaled Responses

There are various scaled response designs, so the researcher needs to consider the design options (Brace 2018). One of the standard scaled-response formats is the Likert scale. It is typically a five-point scale, shown in the following format:

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__Strongly Agree __Agree __Neutral __Disagree __Strongly Disagree

Another type of scale, a rating scale, asks respondents to rate some item or quality on a specific scale (Fink 2013). For example, a user magazine might ask readers to describe each of the desktop and laptop or notebook PCs that they used in the past two years, telling the manufacturer and chip type of each and

ask each respondent to use the following scale, ranging from 1 (worst) to 10 (best) to rate each on:

Overall Reliability	1 2 3 4 5 6 7 8 9 10
Satisfaction with repair experience	1 2 3 4 5 6 7 8 9 10

An alternate way to represent a five-point Likert scale is **Strongly Agree _ _ _ _ _ _ _ Strongly Disagree**. If you use words instead of dashes to indicate stages on the Likert Scale continuum, do not include 'Uncertain' or any other neutral term as a response option. Do not provide respondents with a fence to sit on. Use trend-line graphs or scatterplots rather than bar charts or pie charts to represent continuous data results visually. Use the 'I do not want to answer this question' response option only when surveying respondents about susceptible topics like *criminality, sexual preferences* or forms of socially deviant behaviour. Limit **Yes – No** response options, because they have limited usefulness in statistical analysis. One, for instance, cannot correlate the absence of something (No responses) with anything else and can only compare them with **Yes** responses. Use pie charts or bar graphs to represent **Yes – No** results.

Matrix Questions

Researchers often want to ask several questions with the same set of answer categories (Bryman 2016). It is possible to construct a matrix of items and answers, as explained below.

Table 2: Example of a Matrix questionnaire

Statement	Disagree Strongly	Disagree Some-what	Agree Some-what	Agree Strongly
Changing current methods should be considered carefully to realise all ramifications before trying something new.				

Having diverse experience at several companies is preferable to having in-depth expertise at one company.				
It is usually worth the risk to try a technological innovation if it has the potential to give you a competitive advantage over proven technology.				

A potential problem with this specific question matrix is the lack of a 'Don't Know,' 'Neutral,' or 'Undecided' response category. This is an easy addition. The matrix format has several advantages. Respondents will probably find it faster to complete a set of questions presented in this fashion, and this format may increase the comparability of responses (Bryman 2016).

Response Biases

The Halo Effect

Researchers need to be careful about questionnaire response bias. Studies, as far back as 1920, have revealed a response bias called the Halo effect that can occur with rating scales (Thorndike 1920). Respondents rate people whom they like or respect high on all scales, regardless of the person's actual performance.

The Pitchfork Effect

Researchers in computer science need to be careful about response bias in a negative direction caused by the 'pitchfork' effect (Eddy 2023). People will pick up subtle cues when evaluating things, especially products, and respond more negatively than they might. To guard against the pitchfork effect, ensure that a questionnaire does not direct towards negative responses.

When constructing your research plan, prospectus, and Chapter 1 of the dissertation or thesis, one of the most important factors to consider is the

alignment between your problem statement, purpose statement, and research questions. While this may seem like something insignificant and easy to remember, this is often the very thing that holds dissertation students back when trying to progress to the next level. Many chairs will focus specifically on supervising to create your study. If one little thing does not align between the above-mentioned components, they will not hesitate to send you back to the drawing board.

To quote Al Pacino from The Godfather Part III, 'Just when I thought I was out, they pull me back in' (Statistical Solutions). They argue that just as a general tip, it helps to map out these components before committing them to the page. One of the best ways to do this is to write out each one on a separate notecard: one for problem, one for purpose, and one for research questions. Line them up, side by side, and ask yourself, 'Is this a natural progression from one to the next?' If the problem and research questions make sense, but the purpose is shaky, you will know that the purpose is the spot to focus your edits. This can occur in any combination.

Then, narrow the topic by asking open-ended 'how' and 'why' questions. For example, a researcher may want to consider the factors contributing to childhood obesity or the success rate of intervention programs. Create a list of potential questions for consideration and choose one that interests you and provides an opportunity for exploration.

- **Too simple:** How are school systems addressing childhood obesity?
  This information can be obtained without the need to collect unique data. The question could be answered with a simple online search, but it does not provide an opportunity for analysis.

- **More subjective:** What is the relationship between physical activity levels and childhood obesity?
  This is a more subjective question that may lead to the formation of an argument based on the results and analysis of the data.

- **More focused:** How does childhood obesity correlate with academic performance in elementary school children?
  This question focuses on which data can be collected, analysed, and discussed (Brace 2018).

Using an Alignment Matrix to visualise all items in a row. Remember that the lack of something is not a problem. It is what is happening because of that lack; that is the problem (Fink 2013). Data Collection Instrument or Method (What instruments or artefacts will be used to answer each RQ? Give the name of the survey and interview instrument or describe the documents.) The item on that Instrument (What specific question on the instrument in the column to the left will be used to answer each RQ? You do not have to write the questions down, just identify them by number. For example, 'Survey Question 3 and 9' or 'Interview Question 2'.

The Acid Test for Research Questions

Before embarking on questionnaire design, it is crucial to evaluate the underlying research questions. Remenyi (2005) proposes an 'acid test' comprising six key questions to determine the suitability of a research question:

1. **How would you describe the topic you are interested in researching?** This probes the clarity and focus of the research area.

2. **What is your main research question?** This assesses whether a clear and concise central question has been formulated.

3. **List any subsidiary research questions.** This examines the logical breakdown of the main question into smaller, manageable components.

4. **What resources will you need to answer your research question?** This evaluates the feasibility of the research in terms of required materials and information.

5. **Who will you need to have access to be able to answer your research question?** This considers the accessibility of the target population or relevant individuals.

6. **How will answering your research question enhance your career prospects?** While seemingly pragmatic, this question encourages researchers to consider the significance and potential impact of their work.

Remenyi's (2005) acid test provides a critical evaluation framework for researchers to assess the viability and focus of their research questions before proceeding with data collection and analysis, including questionnaire design. The test comprises six key questions designed to ensure the research is well-defined, feasible, and impactful. The first question asks the researcher to **describe their topic of interest**, prompting them to articulate the core area of investigation with clarity. The second step requires stating the **main research question**, emphasizing the need for a central, focused inquiry that the research aims to answer. The third step involves listing any **subsidiary research questions**, which should logically stem from and support the main question, breaking down the broader inquiry into more manageable components.

The subsequent three steps of the acid test focus on the practical aspects and significance of the research. The fourth question asks about the **resources needed** to answer the research question, forcing the researcher to consider the feasibility of their study in terms of required materials, data, and tools. The fifth step inquires about **who the researcher needs access to**, highlighting the importance of identifying and ensuring access to the target population or relevant individuals for data collection. Finally, the sixth question asks **how answering the research question will enhance the researcher's career prospects**, encouraging a reflection on the potential impact and value of the research beyond academic contribution, considering its relevance to professional development and future opportunities. Successfully addressing all six components of Remenyi's acid test offers a strong indication that the research questions are robust and the research endeavor is likely to be fruitful.

Weintraub (2017) argued that creating questions to answer the research questions is the time to design (or use another's) instrument or data to get quantitative or qualitative data needed. However, you must have alignment between the Problem Statement, Purpose Statement, Research Questions, and Instrument Questions or Artefact Items; if not, that is the problem (Weintraub 2017).

The Questionnaire Development Matrix

Klopper and Lubbe (2013) argue that one should read their document in conjunction with Klopper and Lubbe (2012). This document explains how, after one's literature survey, one should develop a questionnaire to conduct a quantitative empirical research survey.

At the end of the literature survey, one must decide whether to implement a quantitative, qualitative, or dual-mode empirical data gathering procedure. If one decides on a quantitative procedure, one must develop a *Questionnaire Development Matrix*, like the one shown below, which decomposes the research questions into questionnaire questions.

Read this Figure below in conjunction with Klopper and Lubbe 2012 (Using Matrix Analysis to Achieve Traction, Coherence, Progression and Closure in Problem-Solution Oriented Research, in Conference Proceedings, 2012 International Conference on Information Resources Management (Conf IRM 2012), Vienna University, Austria. Editors: Roman Brandtweiner & Lech Janczewski. ISBN: 978-0-473-21262-9). The CM article explains how one should conduct a literature survey. This document explains how, subsequent to one's literature survey, one should develop a questionnaire to conduct a quantitative empirical research survey. At the end of your literature survey, you have to decide whether to implement a quantitative or a qualitative or a dual mode empirical data gathering procedure. If you decide on a quantitative procedure, you may have to develop a Questionnaire Development Matrix, like the one shown below, which decomposes your research questions into questionnaire questions.

Procedure:

1. Formulate a general research problem.

2. Decompose it into subproblems.

3. Formulate a research question that is properly aligned with each sub-problem.

4. Decompose each research question into a section containing thematically interrelated questionnaire questions.

5. Determine the appropriate quantification scales for each question.

6. Determine the data type of each set of response options.

7. Determine the appropriate data measure for each question.

8. Determine the appropriate statistical test for the specific data types.

This procedure is based on the same alignment principles as the literature survey procedure of Klopper and Lubbe (2012), in 'The Matrix Method of Literature Review'.

The Matrix Method of Literature Review

Questionnaire Section	Types of Research Question	Question Nr.	Appropriate ways of visually representing data	Nominal Measures: Pie charts and count bar graphs		Ordinal Measures: Bar charts and histograms		Scalar Measures: Bar charts and trend lines
			Survey Question/ Statements	Response Options	Data Type	Appropriate Data Measure	Appropriate Statistical Test & Graphs
Section 1	Demographic Questions	1.1	Please tick your age group in the appropriate block:	21-30, 31-40, 41-50, 51-60, 60+	Discrete	Ordinal	Basic descriptive statistics, single group t test, the z proportions test the X^2 test. (Use demographic data to characterise your respondents)
		1.2	What is your gender?	Male - Female	Dichotomous	Nominal	
		1.3	How long have you been working at SANBS?	1-2, 3-4, 5-6, 7-8, 9-10, 10+	Discrete	Ordinal	
		1.4	Was your involvement in Project eMerge from an IT or a Business perspective?	IT - Business	Dichotomous	Nominal	
		1.5	How many Enterprise Resource Planning implementations (such as SAP) have you been involved in including this one?	1, 2 , 3 , 4 , 5+	Discrete	Ordinal	
		1.6	What type of post are you in at work?	Managerial - Non-Managerial	Dichotomous	Nominal	

Section 2	Project Implementation Questions	2.1	Your functional area of Project eMerge was implemented within the timelines originally stipulated by the project plan.	Strongly Agree -Agree- Disagree-Strongly Disagree [1]	Continuum (= Cline)	Scalar (Likert Scale)	
		2.2	The budget assigned to the project was appropriate.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		2.3	Project eMerge had enough people resources assigned to it in your functional area.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	Any member of the X^2 family or correlation tests, e.g., Phi coefficient, the contingency coefficient and Cramer's V, the lambda coefficient or the uncertainty coefficient (U) or the Pearson significance test.
		2.4	Your functional area received sufficient and timeous training.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		2.5	There adequate management support and commitment throughout the project i.e. Was the management buy-in to the project suitable.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		2.6	Satisfactory accountability was placed on the IT team for their function in the project.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	(Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes)
		2.7	Satisfactory accountability was placed on the business for their function in the project.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		2.8	Project team leaders were sufficiently monitored to ensure that they were fulfilling their functions.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		2.9	An appropriate planning measure was implemented for Project eMerge.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		2.10	The original business case adhered to for project eMerge.	Strongly Agree -Agree- Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	

Section 3	Change Management Questions	3.1	Sufficient change management was performed throughout the phases or Project eMerge.	Strongly Agree -Agree- Dis-agree-Strongly Disagree	Continuum	Scalar (Likert Scale)	Any member of the X^2 family or correlation tests …
		3.2	Did you participate in any change management event?	Yes - No[3]	Dichotomous	Nominal	Basic descriptive statistics, single group t test, the z proportions test the X^2 test.
		3.3	Were you part of a change management team?	Yes - No	Dichotomous	Nominal	
Section 4	Business and IT Strategy Alignment Statements	4.1	Do you know what the SANBS Business	Yes - No	Dichotomous	Ordinal	Any member of the X^2 Any member of the X^2 family or correlation tests, e.g., Phi co-efficient, the contingency coefficient and Cramer's V, the lambda co-efficient or the uncertainty coefficient (U) or the Pearson significance test. (Continuous data reveal attributes of whatever one studies, allow one to determine general trends and establish significant correlations = co-relation trends between two attributes)
		4.2	The IT strategy was aligned to the business strategy for the 2011/2012 financial year, i.e. the ERP implementation was appropriate to the SANBS business strategy.	Strongly Agree -Agree-Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		4.3	The concurrent restructuring and centralisation process at SANBS had a negative effect on the SAP implementation.	Strongly Agree -Agree-Disagree-Strongly Disagree	Continuum	Scalar (Likert Scale)	
		4.4	……				
		4.5	……				

Figure 1: Questionnaire Development Matrix: An example (working papers Lubbe and Klopper)

An alternate way to represent a five-point Likert scale is Strongly Agree_Strongly Disagree. If you use words instead of dashes to indicate stages on the Likert Scale continuum, do not include 'Uncertain' or any other neutral term as a response option. Don't provide your respondents with a fence to sit on. Use trend-line graphs or scatterplots rather than bar charts or pie charts to visually represent continuous data results. Use the 'I do not want to answer this question' response option only when surveying respondents about extremely sensitive topics like criminality, sexual preferences or forms of socially deviant behaviour. Limit Yes – No response options because they have limited usefulness in statistical analysis. One for instance cannot correlate the absence of something (No responses) with anything else, and can only compare them with Yes responses. Use pie charts or bar graphs to represent Yes – No results.

Conclusion

In conclusion, the systematic literature review has illuminated several critical issues in designing and compiling research questionnaires. These issues include the risk of ambiguity in question-wording, the potential for respondent bias, and the challenges of ensuring comprehensiveness. By identifying these common pitfalls, researchers can better navigate the complexities of questionnaire design, leading to more accurate and reliable data collection.

Future studies should continue refining best practices, incorporating insights from a broader range of disciplines to enhance the quality of research instruments. Furthermore, the integration of technological advancements, such as adaptive questioning and interactive survey formats, warrants further investigation for their potential to mitigate some of these Identified challenges and improve respondent engagement. Exploring cross-cultural variations in response styles and developing culturally sensitive questionnaire designs also remains a crucial area for future research.

Additionally, longitudinal studies examining the impact of questionnaire design choices on data quality over time could provide valuable insights. Finally, the development of more sophisticated analytical techniques to account for and potentially correct for inherent biases in survey data represents a significant avenue for future methodological advancements**.**

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