QALMRI INSTRUCTIONS

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"QALMRI" is an acronym that stands for:

Question:	(a) What was the broad question being asked by this research project? (b) What was the specific question being asked by this research project?
Alternatives:	(a) What was the author's hypothesis? (b) What were the alternative hypotheses?
Logic:	What was the logic of the hypotheses? If the author's hypothesis is true, then what should happen?
Method:	What were the methods?
Results:	What were the important results?
Inferences:	What inferences about the hypotheses and questions can be made based on the results?

Figure 1. An outline of the QALMRI method adapted from Kosslyn and Rosenberg (2003).

Q stands for Question

a) **What was the broad question(s) being asked by this research project?**
b) **What was the specific question(s) being asked by this research project?**

All research begins with a question, and trying to answer the question is the point of conducting research. The first step to understanding any empirical article is to identify the question or questions that were asked by the author (researcher), and understand why the question was important enough that we should care about the answer. In general, there are often two categories of questions being asked: broad and specific. Broad questions are typically too general to be answered by any single experiment and provide an overview of the general topic of interest (e.g., "What is the influence of playing video games on our daily behavior?"). Specific questions, on the other hand, can be addressed by a single experiment or set of experiments (e.g., "Does playing violent video games cause children to engage in more violent behavior?"). Answering one or more specific questions should be considered steps made toward addressing a broad question.

Generally, the first few paragraphs of the introduction of an empirical article should include the questions the article is addressing. The broad question can often be found in the very first paragraph of the introduction, where the author introduces the broad topic of interest that is being examined. It should be noted that sometimes the broad question is not made explicit, and may require some work on the part of the reader to draw a connection from the specific question to the broad topic. Additionally, specific questions might tap multiple broad issues making it difficult to identify a single broad question.

Hint: If you are having difficulty identifying the broad question, first identify the specific question, then try to connect that question to the broader topic. For example, the article might quickly introduce the specific question, "Does playing violent video games cause children to engage in more violent behavior?" and from this you might conclude that the broad question is about how video games impact our behavior. However, the topic could have been introduced by describing factors that can cause children to engage in violent behavior, and not by describing other ways video games have been shown to influence behavior. In this case, the larger issue might not be video games per se, but might center on aggression and childhood behavior. The specific question in this example is related to both of these broad questions, but it is important to separate the broad question as understood by the author, and other potential issues the question might relate to.

Depending on the writing style, the specific question might be found early in the introduction, shortly after the broad topic is introduced, or near the end of the introduction after the author

has provided a review of previous work on the topic. The review of the previous work should also provide some context, explaining why the questions being addressed are interesting, important, and worth spending time and resources addressing.

A stands for Alternatives

a) **What was the author's hypothesis?**
b) **What were the alternative hypotheses?**

A good empirical article will consider at least two possible answers to the specific question(s) being asked. Each possible answer proposed in the article is called a hypothesis. The author should explain why each possible answer is plausible, usually referencing previous articles and theories. However, the author's preferred or favorite answer is called "the hypothesis," while other proposed answers are called "alternative hypotheses." It is important to note that some studies have multiple questions. Each of these questions will require its own hypothesis and alternative hypotheses. The hypotheses can usually be found in the general introduction. After describing the questions, the author should provide the hypotheses and explain why those hypotheses are plausible.

Again, it is worth reminding students that the hypotheses are the possible answers to the question. However, sometimes the alternative hypotheses are not explicitly stated, or even considered by the author. If the alternatives are not stated clearly, the student should try to figure out what they could be on your own. For example, if the study is attempting to confirm the predictions of a single theory, what might other theories predict? Could a different interpretation of the theory proposed by the author make a different prediction?

L stands for Logic

What was the logic of the hypotheses?
If the author's hypothesis is true, then what should happen?

The goal of any research project is to carry out an experiment or set of experiments to discriminate between alternative hypotheses. The logic, therefore, is the general idea underlying how the alternatives might be distinguished, using empirical data as evidence for or against each hypothesis. Ideally, you should be able to state the logic in the form of an *if–then* statement. That is, if the author's hypothesis is correct, we would predict that manipulating a particular variable should change the participant's behavior in a specific way. If the alternative hypothesis is correct, then we would predict that manipulating a specific variable would change the participant's behavior in a different way. The logic of the study generally appears near the end of the general introduction. Often, the author will provide an overview of the research methods being applied in the study, and the predictions made in accordance with relevant hypotheses. From these predictions, you should be able to derive *if–then* logical statements.

M stands for Methods

The methods are the details of what the researchers did in the study. The amount of methodological information included in an article can be overwhelming. As a reader, you should first determine what your goals are, and what level of detail you wish to learn about research methodology. We will make a distinction between having a general understanding of research design and understanding all the methodological details. Depending on your goals as a reader, a general overview may be sufficient.

*A general overview of the research design***.** Before diving into the gritty details, you should first familiarize yourself with the general design of the study. It is important to note that there are a variety of different methods for testing a hypothesis and you should first try to identify the general method being applied. Some of the most common designs used in psychological research are experimental, quasi-experimental, and correlational. Experimental designs manipulate an independent variable to see changes in a dependent variable. For example, you could manipulate the time of day students take a test (evening vs. morning) and measure the change in test scores. Critically, in an experimental design participants are randomly assigned to one of the groups (evening or morning). On the other hand, quasi-experimental designs do not randomly assign participants to groups and instead rely on existing group

memberships (e.g., musician vs. non-musician, married vs. single). For example, you could measure the difference in test scores (dependent variable) for male and female students. In this case, gender is treated as an independent variable even though we do not randomly assign participants to each condition. Finally, in correlational designs we measure variables and look for relationships between them. For example, you could measure the amount of money people make and how happy they are to examine whether there is a relationship between salary and happiness. Once you have determined the general type of research design, you should identify all the key components of the design. If the study uses an experimental or quasi-experimental design you should be able to identify the dependent variable(s) (what is being measured) and the independent variable(s). Are the independent variables within- or between-subjects? Is the independent variable manipulated (i.e., experimental) or using existing group memberships (i.e., quasi-experimental)? If it is a factorial design, you should identify the levels for each factor. It might be worthwhile to draw a table, renaming and mapping the factorial design onto the appropriate cells of the table.

A general overview of the research design is usually described at the end of the general introduction, or if there are multiple studies, in the introduction to each study. If there are any details that are unclear from the general overview, you can search them out in the Methods section.

Methodological details. The methodological details found in the Methods section, provide in-depth descriptions of all the materials and procedures used throughout the study. For example, the methods section will describe who participated in the study and how they were selected. It will also describe what materials they used, how they were constructed, etc. There should be enough detail included that any researcher could replicate the study without tracking down the original authors to ask questions. The Methods section is usually broken down into the following subsections:

Participants. While reading this section, you should try to understand who participated in the study. How were they selected? Are multiple groups being compared? To what population are the researchers intending to generalize their results? Is the sample representative of that population? If a study was conducted to examine a particular population (e.g., men in their early 20's), then the participants should be as similar to that group as possible. If no particular group is specified, then the sample should be representative of the population in general. If the study uses more than one group (i.e., a between-subjects design), they should be equivalent on important demographic variables such as age, education, or gender. You should try to think of any demographic variables that are not described, or controlled for by the experimenter, that could influence the results.

Apparatus and materials. The apparatus is any equipment used during data collection, whether to deliver stimuli or measure responses. The materials can include scripts, surveys, and software used for data collection, as well as any stimuli presented to participants throughout the study. The authors should describe exactly how stimuli were presented, how those stimuli were constructed or chosen, and how responses were recorded. For example, if the researcher used a computer apparatus, they should describe the software used, how long stimuli were presented on the screen, the size of the stimuli, and the types of responses recorded. You should think about how the apparatus and stimuli would have looked to the participant. Is there any aspect that would have been distracting or confusing to the participant? Is the apparatus, stimuli, response collection, etc., appropriate for the specified task?

Procedure. The procedure is the step-by-step listing in chronological order of what a participant did in the study, and if appropriate, a step-by-step listing of what a participant did for any given individual trial. You should try to picture yourself as a participant in the study. Does the task seem easy or difficult? What were the instructions given to participants? Were the instructions clear enough that participants would have understood them? Is it possible the researcher treated participants in different groups differently?

R stands for Results

What were the outcomes? The outcome of the study will be detailed in the Results section. First, you should try to gain an understanding of how participants generally performed in the task. The results of the study are often summarized using descriptive measures of central tendency (means, medians, or modes) and variability (e.g., standard deviation). These descriptive measures are usually displayed in a table or figure that provides you with an easy-to-understand summary of the results.

Second, how do you know the differences you see in the descriptive measures are reliable and should be taken seriously? We rely on inferential statistics to help us make judgments about our data. In the results section, the author will report the statistical tests (e.g., *t*-test, ANOVA) that they used to analyze their data and the resulting *p*-values. The *p*-value of a statistical test represents the probability you would have observed the reported difference in the sample, by chance alone assuming there are no true differences in the population (for more information, see Gigerenzer, 2004). The *p*-value is always a number between 0 and 1, and the commonly accepted standard is 0.05. If the *p*-value is less than 0.05, (say, 0.049) the result is said to be “significant,” and we can be reasonably certain that the difference found in

the sample, represents an actual difference in the population. Other common *p*-values include 0.01 and 0.001, each of which increases the probability that your results were not due to chance and represent an actual difference in the population.

Sometimes, the results section can be difficult to navigate. There can be numerous statistical tests with many different results. You should try to identify the important results. Which statistical tests directly relate to the questions asked? In other words, the hypotheses made predictions about the changes we would expect to observe in our dependent variable for each of the groups or conditions. For example, there might be predicted differences between specific groups or, in the case of correlational designs, predicted associations. Try to find the statistical tests that test those specific predictions.

I stands for Inferences

The results section details the results of the author's measurements, and statistical inferences about whether differences between those measurements should be considered reliable. But what does it all mean? The real payoffs of conducting an empirical study are the inferences one can draw from the results that bear on the questions asked and help identify which of the possible answers (i.e., hypotheses) are most likely to be true. Given the results, what did the authors conclude? The Discussion section will contain the inferences (note that the use of the word *inference* is separate from *inferential statistics*) the authors made about their results. Ideally, if the logic and methodology are sound, the results should be more consistent with only one of the hypotheses, allowing the authors to eliminate one or more alternatives. At this point, you should be able to work backwards through the first half of our QALMRI answering all the questions the authors originally set up. For example:

(Logic) How do the results line up with the logical if–then statements?
(Alternatives) Given the results, which hypothesis does the logic implicate?
(Questions) What does that hypothesis say about the specific and broad questions?

As a goal, you should try to summarize the author's conclusions in a short paragraph, as they relate to the logic, alternatives, and questions.

Once you gain an understanding of the inferences the authors have made regarding the results, you should try to think critically about their conclusions and about broader implications. Do the statistical tests support the author's conclusions? Were any of the alternatives not convincingly ruled out? Why? Were there any limitations or confounding variables that could alter their interpretation of the results? For example, if the study uses

existing group memberships (e.g., musician vs. non-musician), are there any other differences between the groups that could also explain the results? What specific and broad questions did this particular study fail to address? Do the results of this study create new specific questions that might help us understand the broader question?

References

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Kosslyn, S. M., & Rosenberg, R. S. (2003). Fundamentals of psychology: The brain, the person, the world. Boston: Pearson.