

Science FAQ:

Research Designs.

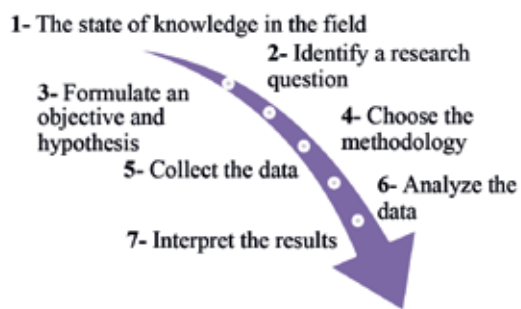
By **JADE DESROSIERS** and **ERIKA NEVEU**

What is the purpose of research, in concrete terms? How does a research project work? What are the specific issues in the field? At the heart of autism neuroscience research are many techniques and methodologies. This is the 4th article in the series: *Science FAQ* which will give you a better understanding of the different research designs, this is to say the different ways researchers can choose to advance science.

What exactly is a research design?

Is there only one right way to advance knowledge? Of course not! That is why researchers in all fields approach research in different ways, that is, through different methodologies. Whether the approach used includes a single person, a large group, last for many years, or only a few months, each approach (or design) has its own advantages and disadvantages. All the research team has to do is try to find the approach that will answer their research question as accurately as possible.

To achieve this, researchers must first assess the state of knowledge in the field through the existing scientific



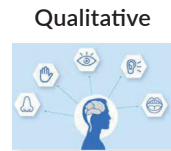
literature. Then, it will be possible to identify a research question that has not yet been answered. Based on the knowledge and the question, it will be possible to formulate the objective and the hypothesis of the research project. Once the research team has chosen the question it wants to answer and formulated its objective and the hypothesis, the team can now choose the most appropriate methodology to obtain the desired information. Each methodological choice allows for a different perspective on a research topic.

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Quantitative designs aim to describe, explain, or establish a prediction about a phenomenon based on the collection and analysis of numerical data. For example, determining the number of positive or negative emotions in autistic and neurotypical children in a game situation¹.



Qualitative design is a research design with one or a few participants which aims to collect a large amount of information to understand a phenomenon in-depth. For example, an interview could elicit a great deal of information about an autistic person who has the ability to recognize and name a note when heard (perfect pitch)².



Mixed design is a mixture of quantitative and qualitative design. The objective is therefore to collect numerical data (quantitative), detailed information (qualitative), and to analyze the data together to understand the phenomenon under study.

One of the methodological choices that researchers must make is the number of participants they wish to study, in other words, whether to conduct a group study or a case study. The number of participants included in a study is extremely variable and depends on many factors, including the design chosen.

Group Study



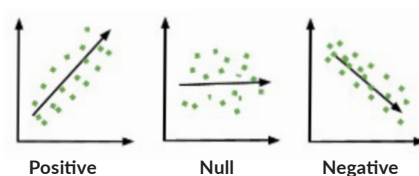
In a **group study**, many participants will be included in order to be able to apply the findings of the study to a large group of people; this is called generalization.

Case Study



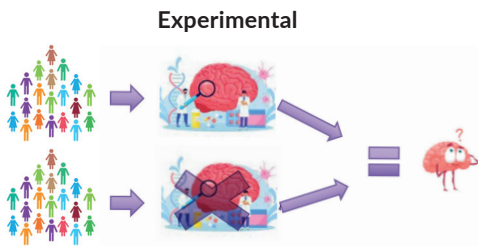
A **case study** examines a single participant or phenomenon to understand in detail the aspect of the person or situation of interest.

Correlational



A **correlational** design attempts to determine what the relationship is between two variables, and if there is one, how strong that relationship is. If there is a relationship between the variables, the correlation can be either positive or negative. A positive correlation indicates that the two variables vary in the same direction, i.e., when the value of one variable increases (or decreases), the value of the other variable also increases (or decreases). For example, in neurotypical participants, the greater the duration of deep sleep (one of the phases of sleep), the greater the ability of participants to recall a large

number of figures in a declarative memory task (ability to recall things consciously)³. In contrast, when the correlation is negative, the variables vary in opposite directions, i.e., one variable increases while the other decreases, and vice versa. For example, the more time autistic participants spend in deep sleep, the worse their performance is on a sensory-motor procedural memory task (the unconscious memory of motor skills)³. Finally, if the correlation is null, the variables vary randomly with each other. For example, in autistic participants and neurotypical participants, increasing or decreasing the duration of REM sleep (another phase of sleep) will cause an increase, decrease, or no change in procedural memory in a randomized fashion³. Thus, this type of research does not establish a cause-and-effect relationship, since it is impossible to determine which variable influences the other; it is only possible to determine whether they vary together or not.



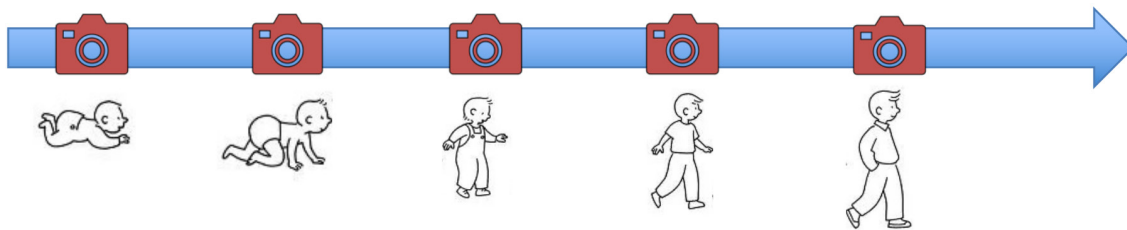
The objective of an **experimental** design is to determine the effect of one variable on another using two groups of people. To do this, researchers make experimental manipulations, meaning that one group will participate in the experiment, while the other will not (control group). For example, researchers might want to determine whether visual attention training improves the academic performance of students with low IQs⁴. If the experiment produces an effect in the experimental group and there is no change in the control group, then the researchers can establish a causal link and, therefore, say that their experiment causes the measured effect. In this

example, if visual attention training improves academic performance in the training group and the academic performance of the control group does not improve, then the researchers can conclude that the visual attention training causes the improvement in academic performance among students with extremely low IQs. On the contrary, if the two groups remain the same, or both improve in a similar way, then the researchers cannot establish a causal link, so they may conclude that they did not observe an effect caused by their experiment. In this example, if the participants who did the visual attention training have similar academic outcomes to those who did not, then the researchers may conclude that they did not find an effect of visual attention training on academic outcomes in students with low IQs. Therefore, with this type of design, it is possible to determine whether the observed effect is caused by the variable manipulated during the experiment, which is called a causal link.

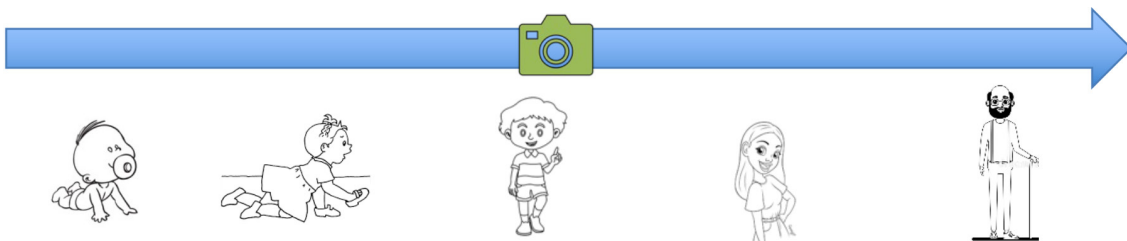
It is therefore essential to keep in mind that all types of choices are equally important, and that they are above all complementary!

Longitudinal, Transversal, or a Single Time Measurement

A research estimate can extend over time or capture a specific moment. We can compare the collection of information by taking a photo, or in other words, we collect, at a specific time, data that can then be analyzed. Thus, we can take several or a single photo.



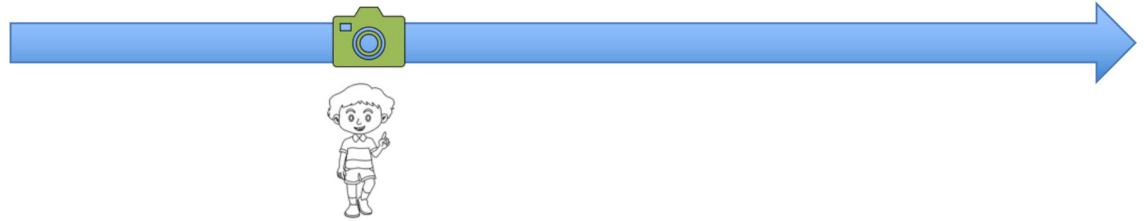
A **longitudinal study** design is carried out over a long period of time with the objective of seeing the evolution and development of the phenomenon studied. This means that the data collection will have to be done at several timepoints, similar to if we take several photos that we keep in an album to look at them several years later. In this album, we will be able to see, or not see, the evolution and development of the people concerned. For example, researchers might want to see the evolution of language skills in autistic people, and therefore measure the skills of the same participants at different times in their lives.




A **cross-sectional design** has a single measurement time, but collects information from participants of different age groups with the objective of seeing the evolution of the phenomenon being studied. This means that the data collection will have to be done at a single point in time, with people of different ages, as if we

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were taking a picture of different age groups at a specific point in time and putting them side by side to see, or not see, the evolution of our phenomenon. For example, researchers might want to study the memory abilities of autistic people at different times in life, and therefore assess the memory abilities of autistic people in different age groups.



A research design can also have **only one measurement time**. This type of design will make it possible to obtain precise and circumscribed information about a precise moment. In this case, we take a single photo to come and analyze it at that time. For example, researchers might want to measure semantic (language-related problem solving) and visuospatial (problem solving related to the ability to represent space)⁵ abilities in autistic individuals.

Methodological choices allow researchers to highlight different aspects of a phenomenon depending on what they are trying to determine. There are several other designs that are not detailed here which can be combined in larger studies as well. Thus, each design contributes in their own way to the advancement of knowledge. It is therefore essential to keep in mind that all types of choices are equally important, and that they are above all complementary! 

Articles cited as examples:

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