Operationalizing

Conceptualizing is where you define your research problem and explain the constructs and theories that are relevant.

Conceptual definitions explain your constructs by telling what they are and showing how they relate to other constructs.

This explanation and all of the constructs it refers to are abstract.

To work with your constructs, you must establish a connection between them and the concrete reality in which you live.

This process is called **operationalization**.

Operational definitions describe the variables you will use as indicators and the procedures you will use to observe or measure them.

The connection between conceptual and operational definitions plays a crucial role in research.

It determines the connection between your abstract constructs and the concrete reality in which you live.

This means that a valid connection is a necessary component of all valid research.

Although a valid connection by itself isn't enough to guarantee that the research will be valid, an invalid connection guarantees that the research will be a useless and misleading waste of time.

The part of the conceptual definitions where you specify the essential qualities is especially relevant here ...

It gives some very good clues about how you can measure the concept in a straightforward way:

- Look for the presence or absence of the essential qualities.
- Choose variables that are indicators of the essential qualities.

Operational Definitions

To measure a construct, you need an operational definition that specifies:

- first, the variable you will use as an indicator of the construct, and
- second, the procedures you will use to measure the variable.

The operational definition thus associates a variable with a construct.

Creating this association—choosing a variable to be an indicator—requires you to use both your:

logical skills of **deduction**

(if you want to measure intelligence, the variables you choose as indicators of intelligence must somehow actually "tap into" intelligence)

and your ability to use **creativity and insight** to conceive of an appropriate indicator

(there is no straightforward way to produce indicators for constructs; there are no standard formulas or recipes)

Once you have selected indicators for your constructs, you can begin to take measurements.

Measurement

There are four kinds of measurements you can take:

- you can sort things into categories
- you can arrange them in increasing or decreasing order
- you can count them
- you can measure amounts and distances

It's important to know which kind you are doing because

- they use different procedures,
- they produce different results, and
- they make different things possible or impossible to do.

Sorting things into categories

Examples:

- What is your occupation?
- What is your first language?
- What is your marital status?

When you are sorting things into categories, the variable tells which category whatever you are sorting has been placed into.

With this kiond of measurement, the only thing you can say about an individual is which category it belongs to.

You will want to name your categories.

Here are a few examples of category names:

- John/Martha
- Canucks/Rangers/Bruins
- Door #1/Door#2/Door#3

Each category must have a **unique** name.

The names don't have any particular meaning; they are nothing more than **labels**.

If you use numbers in the names, the numbers won't have any of the properties that ordinary numbers have:

you can't add or subtract them and the ordering of the numbers will have no meaning.

Arranging things in increasing or decreasing order

When you sort things into increasing or decreasing order, you compare pairs of things like you do when you are sorting them into categories.

However, instead of asking if they are the same or different, you ask if the first one is smaller than, the same as, or larger than the second one.

With this kind of sorting, you end up with a set of ordered categories where the members of any one category are either larger or smaller than the members of other categories.

Although you can say that one thing is larger or smaller than another, you can't tell how much larger or smaller it is.

With this kind of sorting, the placement of a thing into a particular ordinal position, say "third largest," tells where that thing is in relation to all the other ordinal positions.

The third largest position is smaller than the largest and second largest, but it is larger than the fourth and fifth largest positions.

You see things that behave (in some ways) like numbers:

"1st," "2nd," and "3rd" specify the ordinal position of the categories in a way that "Joe," "Sam," and "Linda" don't.

But you can't do any arithmetic on them.

You can't add 1st to 3rd.

Counting things

The third kind of measurement is when you count things.

When you count things you use ordinary numbers:

You can add and subtract them ...

(I have four radios and you have eight: you have four more than I do)

... and you can multiply and divide them

(you have twice as many as I do)

Also, the number zero means "none," which turns out to be important.

Measuring amounts and distances is similar to counting, except you are not restricted to whole numbers.

- You may find that 19.348 percent of an issue of The Globe and Mail is occupied by advertising.
- There may be 9.74 minutes between one televised murder and the next.

You use measures of distance for locations of things in physical or conceptual space, and measures of duration for events located in time.

Measuring amounts, distances, and durations, like counting things, uses numbers which you can add, subtract, multiply, or divide.

Once again, the value "0" means "none."

Scaling

Scaling and mapping are ways of matching numbers or numerals to objects or events or qualities.

Scaling is the process of using numbers to represent phenomena in the world.

It's called scaling because it involves use of a scale to measure something.

Some examples are:

- bathroom scales,
- tape measures,
- "one-to- ten" ratings,
- batting averages,
- GPA

Numerals

Numerals are symbols used as labels to indicate which category something belongs to.

They are only symbols, like letters, and they have no mathematical meaning.

This is the kind of mapping you do when you sort things into categories.

Wayne Gretzky's "99" is an example.

Ordinals

Ordinals are numerals that can be used in arithmetical **comparisons**,

such as "greater than," "less than," or "equal to"

... but not in arithmetical **operations**, such as addition and multiplication.

Ordinals take values like "1st," "2nd," and "3rd."

Numbers

Numbers, like ordinals, are numerals that can be used in arithmetical comparisons, such as "greater than,"

but they can also be used in arithmetical operations, such as addition, subtraction, multiplication, and division.

They have mathematical meaning—how many, how much, etc.

Variables may be **discrete** or **continuous**.

A variable that can take any value between the lowest and highest points is continuous;

- there are an infinite (or very large) number of possible values within the range.

A variable that can take only a small number of specific values is discrete.

- Sand, water, income, and freedom are continuous.
- Family size, number of cars owned, and gender are usually considered to be discrete

Things that are counted or categorized generally result in discrete results:

you speak of the number of people, the number of movies, etc.

Things that are measured in terms of quantity, distance, or magnitude generally result in continuous results:

you speak of the length of time that has passed, the amount of money you have, the height of a building, the brightness of a lamp

Levels of Scaling

Most textbooks distinguish four levels of scaling:

- nominal
- ordinal
- interval
- ratio

As you move from nominal to ratio, the numbers in the data contain more information and more kinds of information about whatever it is the numbers represent.

Nominal

With nominal scaling, all you are doing is sorting the cases into categories.

Each category is associated with a numeral, which is the name of the category.

The numerals don't mean anything in the sense that they don't imply how much or how many or how far or anything like that; they are just labels for the categories.

No arithmetic operations can be performed on the numerals associated with categories, because they aren't numbers—they are the names of the categories.

Here's an example of Nominal scaling

Do you drive to work?

____ 1. Yes ____ 2. No

When you see a "1" for someone, it means that that person <u>does</u> drive to work.

When you see a "2" for someone, it means that that person <u>doesn't</u> drive to work.

Ordinal

With ordinal scaling you order the cases into a set of increasing (or decreasing) categories.

One comes first, another comes second, etc.

You don't know how far apart one category is from the next, but you can tell how many categories come before or after the one you are looking at.

Here the numerals associated with categories behave a bit like numbers — they tell the ordinal positions of the categories — but they still aren't numbers; they are ordinals.

No arithmetic operations can be performed on ordinals — no addition, subtraction, etc.

Here's an example of Ordinal scaling

How often do you drive to work?

__ 1. Never.
__ 2. Rarely.
__ 3. Sometimes.
__ 4. Usually.
__ 5. Always.

You can see that a person who answers 4 ("Usually") drives more than someone who answers 3 ("Sometimes") ...

but you can't tell <u>how much more</u>.

Interval

Interval scaling puts each case on a scale that can be likened to a ruler.

Cases aren't sorted into categories; they can be anywhere on the scale (e.g. "3.14159").

Here you can look at the distance between points and you measure the distance in some kind of units.

To do this, you subtract the number associated with one case from the number associated with a second case.

Examples: Fahrenheit and Centegrade temperature scales

Ratio

Ratio scaling is the most powerful.

It has everything interval scaling has,

and it also has a fixed **absolute zero point**.

With Ratio scaling, "0.0" means "none"

You tell both the distance between values

The difference between $10.45 and $11.55 is $1.10

and the relative sizes or magnitudes of values

Example: A person who is 8 feet tall is twice as tall as a person who is 4 feet tall.

An example of Ratio scaling

Of the 20 working days in a typical month, how many times do you drive to work?

Your answer could be any number from “0" to “20".

With Ratio scaling,

You can talk about <u>relative amounts</u> of driving:

- You know that a person who says “10" drives twice as often as a person why says “5".

You can talk about <u>differences in amounts</u> of driving:

- A person who says “12" drives 2 days more than a person who says “10".

Comparing two Nominal values

The only thing you can say about the categories associated with two cases is:

they are the same

- they both like chocolate

they are different

- one likes it and one doesn't

Because you can't do arithmetic on nominal data, you can't say how big the difference might be.

Comparing two Ordinal values

With Ordinal data, you can tell if one case comes before or after another case

- someone who likes chocolate "a lot" likes it more than someone who likes it "quite a bit"

but not how far before or after

- what is the difference between "a lot" and "quite a bit"?

because you can't do arithmetic on ordinals.

Comparing two Interval values

You can tell both order and distance between values, . . .

. . . but you can't talk about how big one value is as a fraction of another.

Subtracting one value from another is okay;

multiplying and dividing are not permitted.

For example: Say it is 16 degrees today; it was only 8 yesterday.

You can't say that it is twice as warm today,

but you can say it is 8 degrees warmer today.

Comparing two Ratio values

With Ratio data, you can tell order,

this one is bigger than that

distance,

the difference between the two is 4.923

and relative size (as a ratio)

this one is twice as large as that one

Adding, subtracting, multiplying and dividing of values is okay.

	Same or different?	Bigger or smaller?	How much bigger?	How far from zero?	
Nominal	yes	no	no	no	male / female
Ordinal	yes	yes	no	no	slightly / often
Interval	yes	yes	yes	no	January 23rd
Ratio	yes	yes	yes	yes	19 bottles of beer