Comparing Apples and Oranges

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Objectives:

At the end of the activity, the student should be able to:
- define measurement in the social sciences as the act of classifying or categorizing phenomena in a manner that makes them comparable across cases.
- define ordinal, nominal, and interval measurement scales.
- give examples of ordinal, nominal, and interval measurement scales from both ordinary life and the social sciences.
- understand and explain, via a simple example, the role of variance in producing explanations of causality.

Supplies and Preparation:

- at least 8-10 different pieces of fruit, preferably more. These should include several citrus, a couple different kinds and colors of apple (including a multicolor one if possible), a banana, and some other fruits like a tomato, pineapple juice, kiwi, cherries, grapes, etc. The key here is variety both within and between categories.

No additional preparation is necessary besides purchasing fruit.

Vocabulary:

measurement
measurement scales: nominal, ordinal, interval [ratio]
variable
case/observation
unit of analysis
data table (conventions of)
data: qualitative, quantitative

Duration:

Allow about 20-30 minutes for a moderately complex discussion.

Procedure:

1. Display fruit on a table or chalk ledge in the classroom; in larger classes you might also choose to give a brief summary of the items available. Ask students to select (mentally) three or four pieces of fruit and find three or four dimensions on which they could characterize all of their pieces. Allow approximately 4-5 minutes for students to do this on paper.

2. Introduce the old adage "comparing apples and oranges," which implies that the items are not comparable – that they are not instances of the same phenomenon. **??**Are these items comparable? Why? On what dimensions? Use to draw out potential variables: color, sweetness, family, region of growth, etc. ***Variables*** are characteristics whose value varies systematically across observations. Collect variables from the class on the dimensions they used to characterize their fruit (i.e., variables). List these on the board, grouped by scale of measurement.

3. Select several of these variables, preferably one per scale of measurement. Select several pieces of fruit – *all of the same color* – and ask the class to help you determine what values these pieces of fruit have on the variables you selected as you create a ***data table*** on the board. (Include color as a fourth variable; leave room on the right to add several more columns.) Indicate to the class that conventionally, a data table has cases as its rows and variables as its columns.

4. Discussion: At some level, apples and oranges *are* comparable. We just measured these pieces of fruit. ??What constitutes an observation here? What is our ***unit of analysis*****?** [Piece of fruit.] An ***observation*** is one occurrence, one instance of a value, on our dependent variable. So here, observations are yellow apple, pineapple, banana; unit of analysis is piece of fruit. ***Measurement*** is simply the process of assigning or determining a value for each observation on a given variable. This produces values of ***data*** – systematically collected pieces of information – that we enter in the data table.

5. Elicit from the class the idea that measurements of different variables differ in what kinds of information they provide about the values of the observations. Introduce the idea of ***nominal*** measurement: placing items into mutually exclusive categories that have no relationship to one another, that are simply different. Color is an example: yellow is not better than red or worse than orange; saying a piece of fruit is yellow is simply saying that it is 'not red.' Some other possible values for the variable 'color,' if we had a different sample, could be orange, brownish, green, or red. Color is an example of ***qualitative*** data– it describes a quality of the object. You might also continue this discussion to note that we could, if we wanted to, create a code by which red = 1, orange = 2, yellow = 3, etc., but that would not change the fact that the categories those numbers represent do not have any relationship to each other. We could code color as a *dichotomous variable* – yellow and "not yellow", where yellow = 1 and not-yellow = 0, but that also doesn't change the fact that those categories don't have any relationship to each other. **??**Name another dichotomous nominal variable? [Gender is a good one, or participation in an IMF structural adjustment program in a particular year, or voting similarly to the United States in the UN General Assembly on a particular resolution.]

6. ***Ordinal*** scales of measurement provide categories that have meaning solely in terms of their relationship to one another. Sweetness or size are ordinal scales of measurement. The values of 1, 2, and 3 don't really have any relationship to apples, bananas, and pineapple juice directly, but they only have a relationship in terms of each other. 1, 2, and 3 refer to more or less sweet (or large, or whatnot) <u>than another observation</u>: ordinal scales allow us to rank our observations into categories, where the categories DO have meaning in relation to one another (though usually *not* to the observation itself). With the class, brainstorm several ordinal scales in political science. [Ideological orientation – the standard 7 point scale – is a good example, as are the 'feeling thermometers' used in survey research.] Ask the class if 'sweetness' (or your chosen ordinal example) is a qualitative variable.

7. Introduce the idea of ***interval*** scales by asking the class, what if we added weight to this set of variables? How could I make an ordinal scale for weight? [lightest, middle, heaviest – add to the data table as Weight1] Are these the usual units in which we measure weight? [No, usually oz or

something like that – estimate as Weight2] These weight in ounces numbers have meaning independent of each other *and* the things they're describing. The unit of measurement – the ounce – is constant across the cases. An ounce is a separate concept that we can work with – I can say the weight of this book, or of me, in ounces, and the units are still comparable even outside of the original sample of yellow fruits, or even the population of all fruits. These kinds of scales – ounces, dollars, years, legislators, etc. – are called *interval* scales because the interval between one ounce and two ounces is the same as between two ounces and three ounces, or between forty-three ounces and forty-four ounces. The number value has a unit attached that remains constant outside of that sample you're measuring right now. That 'most sweet' pineapple juice would probably not be 'most sweet' anymore if we compared it to honey, a bowl of sugar, and some ice cream. Explain to the class that number of legislators in a lower house, number of soldiers killed in a war, weight in ounces, etc., are examples of ***quantitative*** data – they express information about the quantity or number of the observation.

8. Causality and variance: All of the fruit here have the same value on the variable 'color.' Can the color of the fruit, 'yellow' (or whatever color your fruit are), then explain why some fruit are sweeter [or some other dimension on your data table] than others? Can weight [or another variable] explain the value of 'color'? If three countries had revolutions, and they had differing levels of economic growth in the year before – high, medium and low – can we say that poor economic growth causes revolutions? *We cannot explain a variable with a constant, and we cannot explain a constant with a variable.*