The Construction of Macro-Conditions in fsQCA

One of the difficulties routinely faced by researchers using configurational methods is the staggering number of logical combinations (configurations) than can be generated by a relatively small number of causal conditions.

For example, a fuzzy set analysis with four causal conditions yields a property space with 16 corners, which translates to a truth table with 16 rows. This property space is manageable. However, increasing the number of causal conditions to 12 yields a property space with 4,096 corners and a truth table with 4,096 rows. A truth table this large is the practical limit of fsQCA.

It is important to understand that each configuration (i.e., each corner of the property space defined by the causal conditions) constitutes, in effect, a qualitatively distinct state. Configurational logic dictates treating each combination as (potentially) a different “whole.” Of course, when there are 4,096 (or even as few as 64), it is difficult to imagine or envision each one of these distinct states. Thus, while configurational logic is appealing, its demands exceed the capacity of the human brain.

For these and other reasons, it is often useful to construct “macro-conditions.” These macro-conditions are “colligations”—meaningful collections of facts or evidence. Macro-conditions combine several component conditions into a single encompassing set, thus reducing the dimensionality of the property space (and the number of rows in the truth table). For example, if four causal conditions can be combined into a single macro-condition, then the truth table is reduced to one eighth its previous size.

Weakest Link/Ideal-Type Approaches

One way to create a macro-condition is to combine two or more conditions using "logical and." When combining conditions in this way, the weakest link (i.e., the lowest membership score) "rules" the combination. For example, suppose a researcher wants to address degree of membership in the set of underdeveloped, debtor countries that rely on agricultural exports. Perhaps it is only the cases with high membership in this specific combination of conditions that are candidates for the outcome in question. The formula for combining these conditions using "weakest link" reasoning is:

candidacy = min(underdeveloped, debtor, exporter of agricultural products)

A case with a score of 0.6 in "underdeveloped," 0.9 in "debtor," and 0.8 in "exporter of agricultural products" is assigned a score of 0.6 in the combination. The researcher would then use the derived measure of candidacy as a single causal condition, in place of the three component conditions.

The weakest link approach also can be used to assess the degree to which cases conform to an ideal type. Suppose, for example, a researcher wants to determine the degree to which each organization conforms to the ideal typic bureaucratic form. The first step would be to define the essential features of bureaucracy and then measure the degree of membership of each organization in each of the essential features. Next, the researcher would compute the degree of membership of each case in the combination of these elements by taking the minimum of the component membership scores. To achieve strong membership in the condition "bureaucratic organization" a case would have to register strong membership in all the component features.

Compensatory Approaches

A second approach to macro-conditions is to allow “compensation.” For example, suppose you are evaluating job candidates and you believe that job experience can compensate for weak educational credentials. One simple way to allow compensation is to average the relevant component scores. For example, when evaluating job candidates an employer might compute the average of degree of membership in the set with excellent educational credentials and degree of membership in the set with extensive experience, based on the belief that one aspect can compensate for the other. In this approach, a case that has a high score in one set and a low score in the other is awarded a middle-range score in the macro-condition. By contrast, using the weakest link approach, this case would end up with a low score (the min).

Compensatory approaches also allow for measurement and calibration error, just as they do in conventional psychometric research. Armed with many different indicators of the same underlying construct, a researcher can obtain a more reliable measure of set measurement simply by averaging the different membership scores. However, it is important to note that averaging tends to produce a lot of middle-range scores and thus may produce a clustering of cases near the cross-over point (maximum fuzziness).

As with the “weakest link” approach, it is important to create the fuzzy set versions of the component sets first, before applying the operation that is used to combine the components into a single macro-condition (e.g., min, average or max).

Substitutable Conditions

The third approach emphasizes combining conditions that independently satisfy the macro-condition. For example, the macro-condition might be “credit worthiness” and the substitutable component conditions might be “ownership of significant assets” or “high income.” It’s not necessary to have both, nor is compensation an issue because the satisfaction of either condition establishes credit worthiness. The two component conditions, because they are substitutable, can be joined by “logical or” to create the macro-condition:

creditworthiness = max(assets, income)

Combining many conditions with “logical or” tends to results in macro-conditions with high average membership scores, especially if the component conditions are nonoverlapping. The opposite is true of combing many conditions with “logical and”—the resulting macro-conditions tend to have low average scores.

Mixtures

The three approaches just sketched (weakest link, compensation, and substitution) can be mixed with each other as well.

For example, suppose a researcher has six causal conditions, but believes that one set of three should be joined via compensation, the other three via substitution, and the two sets should be joined via weakest link. Here's the formula:

$$\text{macro-condition} = \min(\text{average}(x_1, x_2, x_3), \max(x_4,x_5,x_6))$$

Again, it is important to point out that the component sets have already been converted to fuzzy sets and are properly calibrated.

It is also possible to use modified versions of these approaches. Suppose, for example, that a researcher thought the weakest link was the appropriate approach for combining four component conditions into a single macro-condition, but wanted to use the second lowest score to define membership in the macro-condition. The basic argument would be that three out of four high scores among the components would be "good enough" for high membership in the macro-condition. One way to accomplish this would be:

$$\text{macro-condition} = \max(\min(x_1,x_2,x_3),\min(x_1,x_2,x_4),\min(x_1,x_3,x_4),\min(x_2,x_3,x_4))$$

Many other mixtures are possible!