

An Introduction to Fuzzy Cognitive Maps (FCMs)

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Introduction to Fuzzy Cognitive Maps (FCM)

Fuzzy cognitive maps are one of the primary tools we will be using to evaluate collective perceptions about salt and the Occoquan as part of ECOS

They will be used to explore the Anxiety goals you've just articulated and the relationships between them in a series of interviews in June

What are fuzzy cognitive maps? (how do we define models?)

A model is a simple representation of reality that improves our understanding of how something works

We often think of models as statistical or physics-based representations of real-world phenomena that can be expressed using quantitative relationships between variables

Mental models: a representation of the surrounding world, the relationships between its parts, and a person's intuitive perception about actions and their consequences

Mental models become particularly important when systems transcend physical boundaries, representing social, ecological and/or engineered systems and their interconnections in ways that we may be unable to express with physical laws

Fuzzy cognitive maps are simply a way to express our mental models of a problem or system

- 1) Elicit and express an individual expert's perceptions and knowledge of a complex problem or system
- Combine the models of multiple experts to obtain a more wholistic (community) representation of that problem/system that captures diverse perspectives
- 3) Track the evolution of that collective understanding over time (our collective understanding is dynamic, which has implications for how a system is perceived, monitored, or managed)

Our individual interviews with each of you in the upcoming months are the first stage of this process with respect to salt and the Occoquan

A closer look at "fuzzy" cognitive maps

Cognitive maps represent concepts and their relationships through directed arrows

- Relationships are assumed to be causal (an increase in X <u>causes</u> an increase in Y)
- Relationships can positive, negative, or neutral



"Fuzzy" cognitive maps specify both the direction and "strength" of relationships

 Instead of saying an increase in X causes an increase in Y, we'd say an increase in X causes a weak, moderate, or strong increase in Y (fuzzy maps use weighted instead of binary links)

Specifying model links: coffee example



What is the relationship between coffee consumption and hours worked and how strong is it?

An <u>increase</u> in the amount of coffee consumed causes a (in the number of hours worked

- a) Strong increase
- b) Moderate increase
- c) Weak increase
- d) No effect

- e) Weak decrease
- f) Moderate decrease
- g) Strong decrease

Once we've elicited complete fuzzy cognitive maps for a series of individual experts we can aggregate them mathematically and reflect the collective perspective of an entire community of experts

Simple FCM (1 expert): coffee and productivity



Simple FCM (2nd expert): coffee and productivity



Our understanding of the system is enriched when these perspectives are aggregated



Expert Biochemist



Expert Psychologist Continue to add experts until the full contingent of perspectives represented by the expert community has been included *(for our study, all ECOS members)*



Evaluate changes in community perspectives over time (tracking evolution of FCMs to reveal new perspectives, interests, or goals pertinent to the system of interest; *Salt & the Occoquan*)



Thank you for Listening!

(and I'll see you later during this summer's one on one FCM interviews)