A Network Visualization of Sustainable Consumption Corridors

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ABSTRACT

The sustainable development and ecological economics communities have called for research into representing "sustainable consumption corridors," which are intended to represent lifestyles at both the upper and lower bounds of sustainability. This research draws on psychological and philosophical theories of human need to motivate a network data structure for capturing the sustainability of an individual's lifestyle. We present an intra-individual network conceptualization, and corresponding network visualization strategy, to capture and communicate the ways in which individuals experience need and satisfaction. Attributes about needs, satisfiers, and the relationships between the two are encoded in various channels of the network visualization, enabling rich representations of the cost and benefit of various satisfying activities. This visualization builds toward a reflective personal informatics system that can help individuals develop improved need literacy, and enable communities to gather contextual information about the needs of their constituents.

1 INTRODUCTION AND BACKGROUND

Continued environmental depletion motivates exploring ways of living that can be sustained in the long term, without exceeding earth's carrying capacity. The sustainable development community has proposed the notion of "sustainable consumption corridors" which are the "minimal and maximal standards of consumption" [1] that if adhered to, would allow for human life to flourish within environmental limits. The largest open objection to using sustainable consumption corridors as a driving framework for sustainable development is the challenge in design [1] - how should we represent sustainable consumption corridors, and how can we understand the sustainability of the currently lived lifestyles?

Researchers studying ecological economics have suggested that a framework of human need would be an effective way to conceptualize "the art of living" as it relates to sustainability [2]. The primary goal of such an effort resulting in a society that "meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. Indeed, academics from various fields have theorized about the existence of a common set of universal basic needs. Interpretations from the field of psychology include Maslow's hierarchy of needs [5], while development economists and philosophers have developed a matrix of human needs [6] and a list of central human capabilities [8].

We suggest the lack of consensus about universal basic needs is due to researchers missing a way of representing and empirically capturing the experience of need and satisfaction across individuals. As such, we develop a network representation and visualization of need and satisfaction, intended to be elicited via a personal analytics system, and implemented using techniques from personal and visual analytics [3] and personal informatics [4]. The visualization is expected to be useful for both individual reflection and behavior change, as well as empathic communication to others, and aggregation into multilayer networks representing the needs and satisfaction of groups of people at various scales of social organization.

2 NETWORK VISUALIZATION OF SUSTAINABLE CONSUMPTION CORRIDORS

Given the lack of consensus on universal human needs, one of the goals in creating a network representation of an individual's need and satisfaction landscape was to be as theory-agnostic as possible. As such, the visualization does not explicitly rely on any particular theory or set of basic needs. Instead, the visualization focuses on the distinction between needs, which are general requirements for living a ''good life" [1], and satisfiers, which are the specific ways in which individuals meet those needs [6]. The network representation therefore consists of a bipartite network, with nodes representing discrete needs on one side, and nodes representing satisfiers on the other. The links between nodes indicate relationships between needs and satisfiers (see Fig 1).
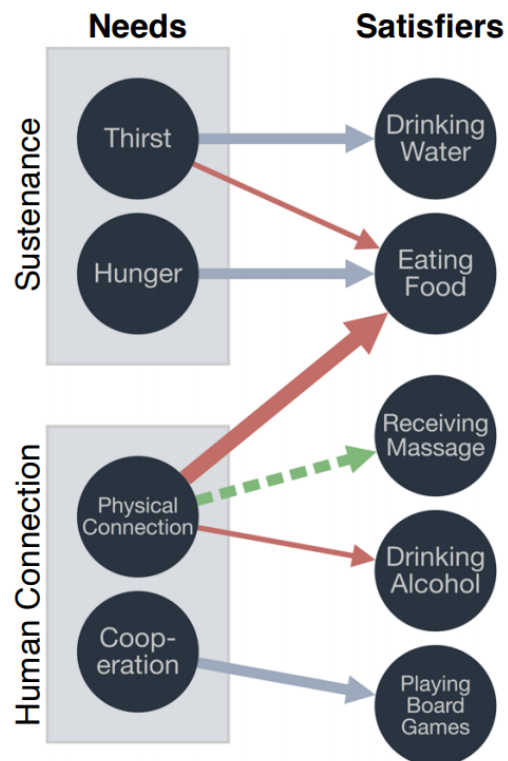

Figure 1: Network Visualization of Human Need and Satisfaction

2.1 Gathering Data

There are multiple ways in which information about needs and satisfiers can be elicited from individuals. The network presented in

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this poster was constructed with sample data, but could be generated using a survey that systematically prompts individuals to reflect and provide quantitative information about their needs and satisfaction. A prototype data collection form is shown in Fig 2. Individuals provide information about the level of satisfaction of each need, as well the particular satisfiers they use to meet those needs. For each link in the network, they are prompted to quantify the contribution of that satisfier toward the particular need. The proposed system can also collect additional metadata about the satisfiers, such as the frequency with which it is engaged in, or perhaps the economic or environmental cost.

Figure 2: Proposed Interface for Collecting Need and Satisfaction Data

2.2 Encoding Edge Metadata

Fig 1 is a sample network visualization that encodes various forms of metadata about needs and satisfiers. The width of the link indicates the extent to which that satisfier is used to meet the particular need. Fig 1 therefore shows an individual who uses food more than alcohol in order to meet needs for physical connection. The colors of the links encode the user's *meta-satisfaction*, the extent to which they are satisfied with the particular need-satisfier relationship. Gray-blue implies the user feels good about using that particular satisfier to meet that particular need, while red indicates the user would like to change that particular need-satisfier relationship. The green link implies the individual would like to have this need-satisfier relationship in the future, but currently does not. The dashed line indicates the individual feels this particular need-satisfier relationship is unobtainable at the current moment. The meta-satisfaction color encoding helps create a rich visual representation of an individual's lifestyle, with clear indication of areas where they may want to focus on behavior change.

2.3 Encoding Node Metadata

The environmental impact of a lifestyle can be uncovered by looking at the satisfiers, and encoding environmental cost in the visualization. For example, the nodes could be sized (or colored) according to the pounds of CO_2 a certain activity produces. This would provide individuals with a clear representation of the impact that certain aspects of their lifestyle has on the environment. Alternatively, financial cost could be encoded in node size, painting a clear picture of the economic burden of meeting each need.

Nodes representing needs can be sized based on the extent to which a particular need is satisfied. For example, needs with low levels of satisfaction can sized larger, to indicate a bigger unmet need in the life of the individual. This may also motivate behavior change, to add or remove satisfiers that contribute towards meeting the particular unmet needs.

3 Aggregation and Multilayer Network Visualization

The proposed approach to capturing need and satisfaction in a lifestyle results in each individual having their own "need network."

However, given the universality of basic needs, the left side (needs) of the bipartite network will largely be shared across individuals. The commonality of nodes across individuals enables the aggregation of individual networks into a multilayer network, where each individual's network is but one layer of a higher level network representing the needs and satisfaction of the entire social group. This grouping can be conducted at various scales of social organization: a dyad, household, neighborhood, city, state, country, or even world. While there will be great diversity of satisfiers on the right hand side of the visualization, aggregation across individuals will allow communities to better understand the lifestyles of their constituents, and suggest systematic changes to better meet individual needs. While this poster only presents the visualization of a single network, future work should explore creating multilayer network visualizations [7] of these need-satisfier networks.

4 Implications and Importance

The presented network conceptualization and visualization is but the first step towards an informatics system for supporting reflection and understanding the state of human need and satisfaction in a population, operationalizing the concept of sustainable consumption corridors. While the network visualization may serve as a useful tool for behavior change and empathically communicating a lifestyle to others, the scalability of the multilayer intra-individual network approach holds the promise of providing a new data source from which effective policy and public health interventions can be crafted. Future work includes development of a web application for supporting the data collection process, as well as conducting a large scale survey to create multilayer networks for analyzing a population at scale. A long term vision includes this kind of network measurement approach being used widely at various scales of social organization, to shift the focus of economic activity towards human satisfaction rather than pure economic production. While this is the first known visualization of sustainable consumption corridors, we hope this work will motivate the information visualization community to develop and refine effective ways of representing information about the sustainability of lifestyles.

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