Interacting with Network Representations of the Self and Needs

MICHAEL HOEFER, Department of Computer Science, University of Colorado Boulder, USA
STEPHEN VOIDA, Department of Information Science, University of Colorado Boulder, USA

In this position paper, we outline a reciprocal relationship between the study of human–computer interaction (HCI) and self-determination theory (SDT) mediated through personal informatics systems. Specifically, we draw from Max-Neef's development scale economics to recognize the self as a complex system, and suggest that network representations of the self are well suited to capture the complexity of self and living as suggested by SDT. The HCI subfield of personal informatics is well positioned to study the use of complex representations of the self to elicit new kinds of information about individual lifestyles, creating new datastreams for empirical studies that can advance SDT and support human flourishing.

Additional Key Words and Phrases: self-determination theory, personal informatics, reflective informatics, network visualization

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1 INTRODUCTION

Self-determination theory (SDT) is a multi-faceted theory that seeks to understand "behavior as a function of the conscious or nonconscious reasons or motives that organize it" [26]. SDT is comprised of six primary *mini-theories* that collectively provide insight into how human behavior is organized. In this paper, we focus on one mini-theory, basic psychological needs theory (BPNT) [27]. BPNT proposes that human well-being and growth is a natural inclination and largely a function of satisfaction (or frustration) of a discrete set of basic psychological needs: autonomy, competence, and relatedness [27, 30].

BPNT aligns more closely with the eudaimonic approach towards well-being [25], seeking meaning and flourishing in life, as opposed to the hedonic approach, which emphasizes positive feelings [10]. This eudaimonic approach has also been hailed by the development economics community as critical to creating sustainable economic systems [1, 13], given our biological tendency to adapt to positive mood states (a phenomenon known as the hedonic treadmill [6]). The hedonic approach, optimizing for positive affect, results in growing consumption that may be decoupled from need satisfaction [1, 9]. Fortunately, the eudaimonic approach to understanding well-being has been initially explored in the HCI community, such as by measuring the degree of eudaimonic vs. hedonic user experiences in technology use [19, 21] or suggesting eudaimonic design considerations for gamification [5].

In this work, we suggest how the HCI community can deeply engage with the basic psychological needs theory of SDT. We hope to illuminate the insights of *human scale development* and *barefoot economics* from Max-Neef, and contrast it with SDT. We suggest that HCI and SDT researchers can benefit from adopting the systems thinking approach of Max-Neef, and support personal informatics systems that reciprocally support SDT and human flourishing. This approach could be utilized for system improvement at various scales of social systems, ranging from the individual up

to an entire society or planet. It will likely be effective to start "small" by creating interactive systems that support flourishing of individuals and individual communities before seeking to affect higher-level systems. That is why, in this position paper, we largely discuss representations of individuals (intended to benefit the individual), but representations of entire groups is in need of further exploration.

The rest of this paper discusses theory, methodology, and application, in that order. First, we bring to focus the *human scale development* theories of Max-Neef [17, 18] and describe how a complex-systems view of need satisfaction can help HCI researchers operationalize SDT. Next, we suggest that a network data structure, well-suited for representing complex systems, can be used to create SDT-informed representations of the self. Effective self-representations can be used to support reciprocal feedback loops between an individual's mental model of themselves and their lifestyle. We close with a discussion on how SDT-informed personal informatics systems can support both the development of self-determination theory and support human flourishing more generally.

2 HUMAN NEED SATISFACTION AS A COMPLEX SYSTEM

To begin our discussion, we focus on the work of Manfred Max-Neef, a Chilean economist who began the *barefoot economics* movement [16], which seeks to put humans first in economic systems, and is aligned with more recent ecological economics thinking [7, 9, 24]. An important insight of Max-Neef's human scale development work suggests that human need is a complex system, stating that "human needs must be understood as a system: that is, all human needs are inter-related and interactive" [17].

An important capability in understanding a complex system is understanding the discrete entities that compose a system. Max-Neef highlighted the necessity of distinguishing between *needs* and *satisfiers* (how needs are met). Two follow-on postulates derive from this distinction (quoted from [17]):

(1) Fundamental human needs are finite, few, and classifiable.
(2) Fundamental human needs are the same in all cultures and in all historical periods. What changes, both over time and through cultures, is the way or the means by which the needs are satisfied.

SDT partially aligns with these postulates in that it suggest needs are "organismic necessities rather than acquired motives" [3], meaning they are culturally independent and universal across all humans. While this *needs-as-universal* paradigm implies the existence of independent ways of meeting needs, the SDT metaphor of seeing needs as nutrients ("needs specify innate psychological nutrients" [3]) only complicates this need–satisfier distinction implored by Max-Neef [17]. Max-Neef would say that the "nutrients" would be the entity that satisfies the need, and these would be called *satisfiers*. Innate psychological needs could be satisfied by any number of different nutrients that vary according to culture ("*What changes, both over time and through cultures, is the way or the means by which the needs are satisfied*" [17]).

This seemingly lexical disagreement between Max-Neef and SDT is important, because it could mislead researchers into thinking that the quantity of satisfier (the "nutrient") is important, rather than the satisfaction of the basic need itself. This mindset, that need and satisfier are inseparable, might prevent researchers from asking (and answering) questions like "*how is the way in which this person meets their needs different from another?*" Given that behavior change is perhaps best accomplished by comparing a person to the world [11], our data model for need satisfaction must accommodate these eventual visualization tasks. Another closely relevant issue to HCI, as we'll later see, is the importance of the distinction between needs and satisfiers in constructing accurate visual representations of the self.

It is worth noting that multiple theories of basic human need have been proposed, many of which propose their own set of basic needs that differ from that of SDT. SDT suggests a set of three universal basic psychological needs (*autonomy*,

competence, and *relatedness*) that are satisfied due to a variety of diverse personal and environmental factors [26]. Nussbaum, in the capabilities approach, suggests ten fundamental capabilities [23], while Doyal and Gough suggest only two basic needs (*physical health* and *autonomy*) [8]. Maslow outlined a list of basic needs in both his original 1943 paper [15] and his later update [14]. Max-Neef proposed a 9×4 matrix of needs along axiological and existential categories [17]. More recently, Seligman developed the PERMA model of flourishing, with five needs [28], and Kaufman reimagined Maslow's hierarchy as a sailboat with three security and three growth needs [12]. Needless to say, as Dean describes, "[Despite its importance] need is also a concept that is interpreted in a mind-boggling variety of ways" [2].

While a full review of theories of human need is beyond the scope of the paper (see [2] for exactly that), it is clear that consensus has yet to be reached on the existence and composition of a discrete set of universal basic human needs. As such, HCI researchers should hesitate to adopt the three basic needs of SDT's BPNT as a "ground-truth" complete set of basic needs without close inspection for their particular application. In fact, one possible role of HCI is in creating systems that could lead to the empirical validation or unification of these diverse theories, which has already begun using a qualitative approach [4].

Regardless of the specific set of universal basic human needs, the insights of Max-Neef can help understand how we might model an individual's need and satisfaction, allowing for the development of systems that support interaction between an individual and a corresponding model of the individual's need system (i.e., a model of the self).

3 NETWORK REPRESENTATIONS OF THE SELF

Operationalizing BPNT requires a data model capable of capturing the complexities of individual need and satisfaction. The study of complex systems often utilizes a network data structure to represent pieces of, and relationships between, parts of the complex system [22]. Networks are composed of nodes (entities) and edges (links between entities). Max-Neef's research suggests that a node could represent either a need or a satisfier; perhaps the need or satisfer of an individual. While there could be a variety of meaningful edge types, one example would be edges that capture the relationship between a satisfier and the level of satisfaction of a need for that individual. For example, a directed edge could be drawn from satisfier x to need y, indicating that x resulted in a change in the satisfaction of need y. A prototype example of such a network structure is shown in Figure 1.

Constructing a network model of the self-as-needs allows for SDT and HCI to benefit from a variety of network science methods for understanding networked data. First, complex phenomena like *synergistic satisfiers* (which satisfy more than one need) and *pseudo-satisfiers* (which generate a "false sense of satisfaction") [17] could be described using relatively simple network motifs, which are generalized patterns visible in network data structures that indicate a certain type of system behavior [20]. For example, a satisfier that satisfies more than one need would, by definition, be a node with an out-degree greater than one, assuming that edges represent need satisfaction.

4 FUTURE DIRECTIONS FOR INTERACTIVE SYSTEMS

The network model and visualization presented in this paper is but a first attempt at representing the system supporting an individual's (or group's) needs and satisfaction. While the model provides a framework for structuring new data about need-satisfaction systems, the generation of the underlying data remains an open challenge.

To support different routes of data elicitation, personal informatics researchers can develop systems that facilitate both systematic reflection to generate subjective data directly about need-satisfaction systems (via self report), as well as provide interactive systems for engaging with objective personal data (e.g., financial transactions, calendar entries, etc.) for the purpose of constructing visual representations of self-as-needs. In addition, personal and visual analytics

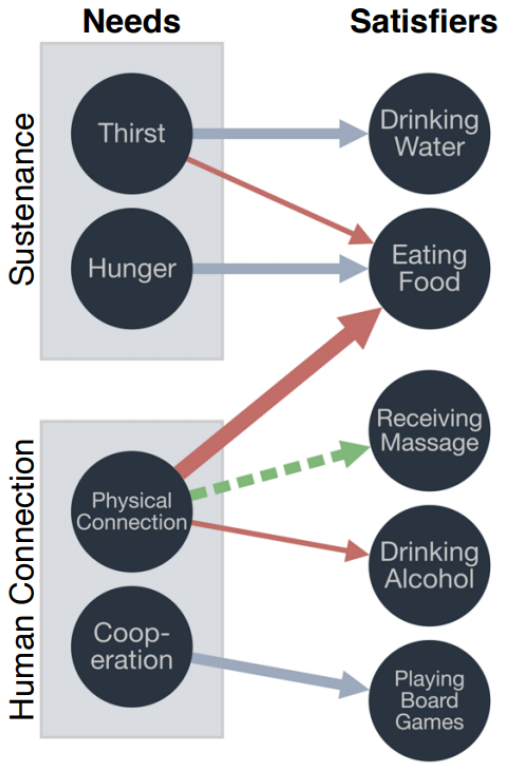

Fig. 1. Network visualization of human need and satisfaction

researchers can empirically assess the ways in which individuals make sense of and utilize these personal visualizations once they are constructed [29].

The goal would be to create reciprocal feedback between visualizations of the self and mental models of the self, such that the mental models could be revised and improved and brought in line with desired future selves. (See also Figure 2).

While these kinds of systems would support individuals locally, aggregating individual data may support large-scale empirical studies that would inform SDT. For example, a large sample of individuals could be randomly assigned a particular theory of need from which to construct their networks. Various outcome measures (participant satisfaction, ability to predict objective personal informatics data, etc.) could help determine the most useful theories of need and perhaps help to find commonalities between these theories. For example, if certain individuals' pattern of time usage or financial transactions are associated with two needs from two different models, perhaps those theories are both referring to the same underlying need. And, perhaps, we'll find that the three basic needs really are those suggested by SDT: *autonomy*, *competence*, and *relatedness*.

5 GOALS FOR THE WORKSHOP

We are excited to participate in this workshop and receive feedback about our ongoing research on network representations of needs, either regarding theory, methodology, or application. We look forward to learning about needs-based

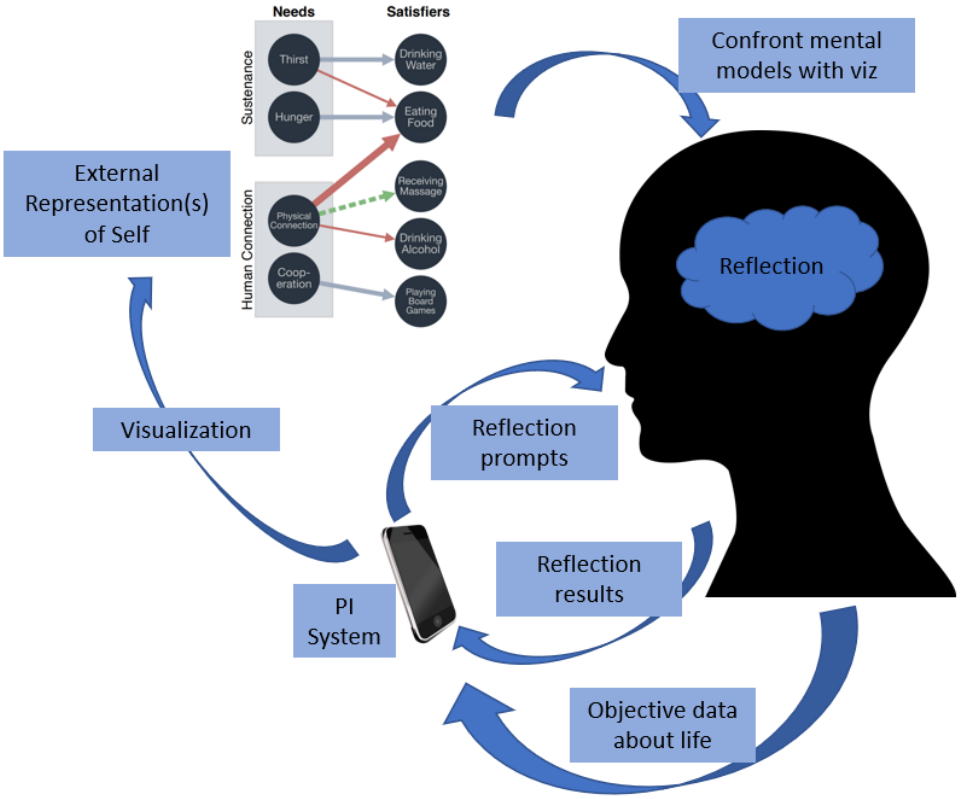

Fig. 2. A depiction of a framework for personal informatics systems to support the construction and interaction with network representation of the self. Structured introspection is combined with objective data about the individual's life and presented to the individual in a visualization. This visualization is then used to reciprocally influence the mental model that the individual holds of themselves.

approaches to game design, and collectively exploring methods for gamifying self-reflection on needs for both personal and societal improvement (with a particular interest in need satisfaction within planetary boundaries). We are also interested in forming collaborations to develop systems for supporting data collection about needs and conducting empirical studies of these (and other) approaches.

6 ABOUT THE AUTHORS

Michael Hoefer (michael.hoefer@colorado.edu) is a third-year PhD student studying computer and cognitive science at the University of Colorado Boulder. He is generally interested in studying social systems at various scales, and developing informatics systems that serve as problem solving interventions at each level. His application areas include dreaming, sustainability, and systematic well-being.

Stephen Voida (svoida@colorado.edu) is an assistant professor and founding faculty of the Department of Information Science at the University of Colorado Boulder. He directs the Too Much Information (TMI) research group,

where he and his students study personal information management, personal and group informatics systems, health informatics technologies, and ubiquitous computing.

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