

Design for empowerment: A case study of using information visualization to support and promote college students' subjective well-being

Shen, Yvette^a; Yu, Shasha^a

^a The Ohio State University, Columbus, US

* shen.1049@osu.edu

Mental health issues among college students are on the rise across the United States. Improving college students' subjective well-being (SWB) is a crucial issue. Although some theoretical insights are available about how design can contribute to well-being topics, no research has focused on the role of information visualization in promoting SWB. This is the first research study that proposed using information visualization as an empowerment tool to influence college students' emotions and behaviors in positive ways. In this paper, we examined the capabilities of information visualization to elicit empowerment and identified the research focus. A case study was conducted to investigate a personalized social support visualization system with the explicit intention to enhance college students' empowerment experience in support for their SWB.

Keywords: *information visualization, personal visualization, design process, subjective well-being, empowerment, social support system, college students*

1 Introduction

Mental health issues among college students are on the rise across the United States. The 2017 annual report from the Center of Collegiate Mental Health (CCMH) shows that higher education counselors are treating more students than ever before who are dealing with various mental health problems (Penn State, 2018). Also, half of all students at universities reveal feeling hopeless at some point, according to a report published in USA Today, and two-thirds of students who struggle with mental health challenges do not seek help (Simon, 2017). The timeliness and seriousness of these concerns has become a priority on most college campuses across the country. Because of the high demands, university counseling centers have a harder time keeping up with their students' needs. Also, simply providing counseling services doesn't necessarily solve the problem. More efforts to prevent mental health problems from arising are inevitable. For example, more life skills-based education, *i.e.*, a form of education that focuses on cultivating personal life skills such as self-reflection, critical thinking, and problem-solving skills, should be provided to students. It will empower students to cope with stresses and increase their quality of life and positive affect to enhance their SWB (Bird & Markle, 2012; Diener, Inglehart, & Tay, 2013; Lyubomirsky & Lepper, 1999).

Subjective well-being (SWB) is defined as "a person's cognitive and affective evaluations of his or her life" (Diener, 2002, p. 63). Design for SWB has propelled in the last decade. It aims to "design with the explicit intention to support people in their pursuit of a pleasurable and satisfying life" (Pieter M. A. Desmet & Anna E. Pohlmeier, 2013, p.1). Several

methodological approaches have emerged in the area: Emotional design (Norman, 2003; Jordan, 2002), Capability approaches to design (Oosterlaken, 2009; Oosterlaken and van den Hoven, 2012), Positive design (Desmet & Pohlmeier, 2013), and Life-Based design (Leikas, 2009; Leikas et al., 2013). Currently the well-being driven design has been mostly applied in the domain of product design, interaction design, experience design, and service design (Bertolotti, Di Norcia, & Vignoli, 2018; Calvo & Peters, 2012; van de Poel & Vermaas, 2015). In the field of information design and information visualization, visual computing methods are used to amplify human cognition with abstract information. However, no research to date seems to have explored the power of information design and information visualization on communicating and tackling SWB issues, as well as its ability to specifically reach college students. Therefore, how information visualization influences user behaviors, emotions, and the entailed environmental and social effects presents an important opportunity for investigation.

The aim of this paper is to gain a better understanding of how information visualization (infoVis) can play a constructive role to elicit positive emotions and positive behaviors and support SWB for individuals and communities. We first propose the research focus of design for empowerment in the realm of infoVis. Then we discuss the design stages of a case study that follows the proposed design research focus. The case study presented in this paper intends to illustrate how the concept of SWB and empowerment can inform design research and design processes. With this paper we hope to take a step in exploring how infoVis can be used as an empowerment tool that enables positive emotions and supports college students' subjective well-being.

2 InfoVis design for empowerment

One facet of SWB is psychological empowerment, *i.e.*, a person believes that she has the resources, energy, and competence to accomplish important goals (Diener & Biswas-Diener, 2005). Empowerment is a process that is rooted in personally meaningful goals, which means that facilitating empowerment requires an understanding of the priorities and values of the individuals (Brodsky & Cattaneo, 2013). Since different people have different personal goals and require different knowledge, skills, and resources to support their needs, it's important to find a means of communication that can stimulate greater engagement and personal connections.

InfoVis is acknowledged for its ability to *make the invisible visible* and amplify our cognition (Card, Mackinlay, & Shneiderman, 1999). Successful InfoVis can make raw data digestible and turn information into knowledge and actionable insights (Baškarada & Koronios, 2013; Kard, Mackinlay, & Shneiderman, 1993; Yi, 2008). In recent years, the popular applications of personal visualizations (PV) attempt to enhance people's self-awareness and motivate people's positive behavior changes in the field of personal healthcare (Huang et al., 2015; Schneider, Schauer, Stachl, & Butz, 2017). Health apps such as FitBit and MyFitnessPal demonstrate successful cases of using design and visualization to help users achieve their health goals. Although design considerations of InfoVis have generally been focused on visual forms and their analytical functions, we argue that users' emotional and behavioral responses should also be considered as objectives in the process of creating infoVis that abides by principles of human-centered design philosophy (Figure1). Human-centered design focuses on understanding the needs of the people, and creating design solutions to

solve their problems and meet their needs effectively. Giving users the perception of control - the sense of empowerment- means maximizing the human-centered function of infoVis. Therefore, we suggest that when conducting design research aiming to cultivate people's SWB, positive emotions and behaviors from the users should be considered as much as needs and problems are. Specifically in this design study, how infoVis design enables the positive attitudes of gaining power to change the situation becomes a key objective.

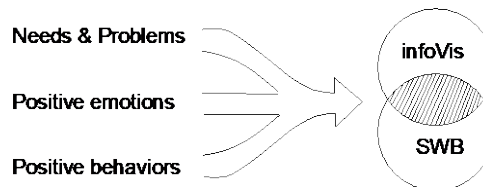


Figure 1. Research focus of information visualization design that supports subjective well-being

By combining quantitative and qualitative research, and infoVis techniques we conduct an explorative study into three main stages as shown in figure 2:



Figure 2. Design process to explore the role of InfoVis in empowerment

The following case study that investigates how infoVis may serve as an empowerment tool that supports SWB on college campus will describe the design stages in more details.

3 Social support system case study

In this section we describe a design case in which we aim to explore the relationship between infoVis design, and the empowerment affect in the context of promoting college students' SWB. The Ohio State University in the United States is chosen as the location of this case study. After conducting a scoping study, discussing with the target users, and comparing with different medium approaches, we find that infoVis on a tablet or desktop device (Starting in 2018, all freshmen in OSU receive an iPad from the university) seems accessible and with potential to include high quality graphics and functions.

3.1 Exploration

3.1.1 Define the problem

The exploration stage consists of both primary and secondary research. The literature on happiness and SWB has provided various dimensions of strategies that empower people to reach their full potential (Fredrickson, 2004; Lyubomirsky & Lepper, 1999; Ryan & Deci, 2001; Seligman, 2008). For example, meditation-based stress-management practices are helpful to reduce stress and enhance forgiveness among college students (Oman, Shapiro, Thoresen, Plante, & Flinders, 2008). Strategies from positive psychology, such as optimism, gratitude, goal setting, altruism, and hope are helpful for promoting positive emotion, reducing stress, and improving quality of life (Seligman, 2004). However, it seems that the knowledge of how to manage stress is not widely accessible for most students. For example, many students use avoidance and self-punishment to cope with academic and daily stresses

(Brougham, R. R et al., 2009), which will increase the negative effect instead of solving problems (Pritchard et al. 2007).

To understand the current undergraduate students' daily life stresses and how they currently manage stress, a general survey is conducted. The survey results show some common stress triggers among all students such as time management, academic performance, social relationships, etc. Only a few people (8 out of 100) visited the on-campus counselling service and the ones who had been put on the waiting list were told that their problems were not severe. The survey also reveals that students' knowledge of on-campus service resources is limited. Most of them rely on self-coping strategies rather than seeking external help and some of the strategies could result in negative impact, for example, eating ice cream or junk food, watching stimulating YouTube videos, or even self-harm.

3.1.2 Design opportunity- social support

Two undergraduate classes are also set to explore the subject of “happiness” with their semester-long creative projects. In one class, second year design major undergraduate students are asked to design Digital App concepts that promote positive psychology strategies to support SWB. The App concepts students proposed are based on user research and their own experiences. Among the 16 projects, Apps that focus on relationships and community support are the most desired subjects chosen by students (44%), follow by gratitude (31%), mindfulness (25%), and self-expression and emotional release (25%). The other class, Information Design for non-design majors, is focused on self-reflection and self-empowerment through data. Students are asked to acquire their own life data, and visually represent those data. Student projects, as demonstrated in figure 3, concern their daily lives and their consumption of time and things; their tracking of gratitude through journals and summaries of the positive and negative aspects of life; and visual explanations of how and what enable their own SWB. These infoVis projects (Figure 3) display some trends among students' lives on campus: the importance of friends and family, striving for healthy lifestyles and better time management. The survey results also reveal that talking and spending time with friends is one of the top strategies that students consider managing their stress effectively.

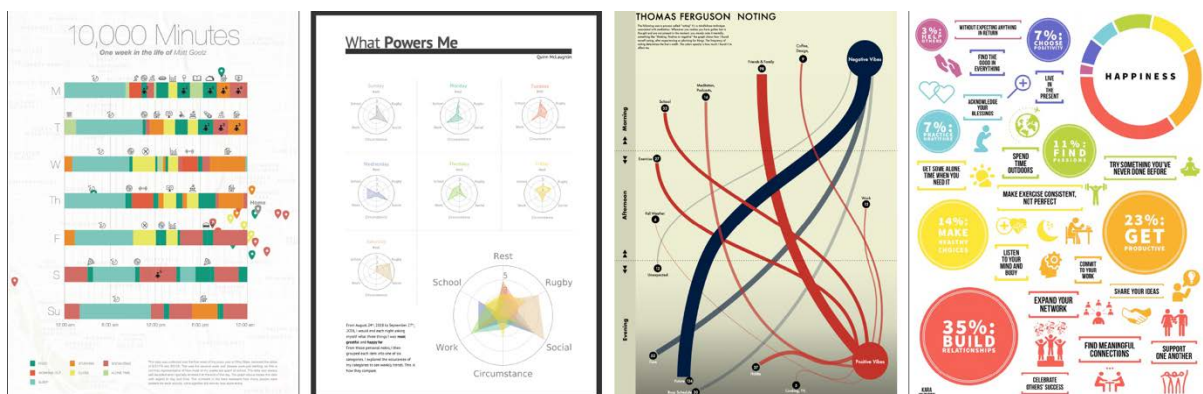


Figure 3. Left to Right: 10,000 Minutes by Matt Goetz, What Powers Me by Quinn McLaughlin, Noting by Thomas Ferguson, Happiness is... by Kara Johnson

3.2 Concept Development

3.2.1 Objectives

Based on the most significant insights and most recurring themes from the stage one exploration, we conduct a co-analysis discussion with some undergraduate students. We share the information gathered from the research and the key findings we identify with the participants and ask them to review the information while reflecting on their own experiences. The discussion allows us to deepen the concepts that emerged from the research, analyze them from different viewpoints, and prioritize issues that relate to campus SWB and infoVis.

We identify that the feeling of having strong social support is a key notion and a crucial meaningful goal to college students' SWB. Several studies state that social support can contribute to happiness and life satisfaction (Lundberg, Hansson, Wentz, & Bjorkman, 2008), and social support is negatively related to stress and other mental health problems (Brown, Wallston, & Nicassio, 1989). The perceived social support, defined as the perception that one feels cared for, esteemed, or otherwise closely involved with other people, is exceptionally important for maintaining good physical and mental health (Ozbay et al., 2007). If one has meaningful social ties, she can envision a world of relationships mapped inside her mind – a map that will lead to those who can be called on or nurture and support in times of need. Research on the empowerment process has found that with positive social support, people can move from a state of powerlessness to having more power (Baxter & Diehl, 1998; Lord & Hutchinson, 1998; Young & Ensing, 1999; Nelson *et al.*, 2001). This process is enhanced through knowledge and awareness, skill development, relationship building, and supportive community contexts (Lord & Hutchinson, 1998; Lucksted, 1997; Nelson *et al.*, 2001), all of which are available as different networks on most university campuses. However, as the undergraduate participants in this study confirmed, university campuses are large and complicated environments where it's hard for people to navigate these support resources.

Therefore, we recognize the design opportunity of providing better tools to help people on campus navigate the system of programs, organizations, or activities that are intended to support subjective well-being effectively. In light of the prevailing students' awareness of their social support system, several agenda questions present themselves:

How can our students:

- Be more aware of the existence of the support they have
- Find more meaningful and relevant support
- Develop more positive attitudes and behaviours

How can campus wellness services:

- Increase awareness of the existence and services they provide
- Measure service coverage and popularity that will assist in their decision making and participatory planning process.

In order to be of use to individuals and make them feel like their interests and preferences are actually being considered, personalized visualization of the social support system will better serve the goal of empowerment: gaining the power to make changes.

3.2.2 Content

Based on the objectives above, we design the social support network by including three layers of support. They are:

1. support from yourself: some self-empowerment strategies
2. support from available on-campus service centers
3. support from people close to you.

From the survey data, 20 most common stressors experienced by college students are identified. The stressors are grouped into four categories: learning, living, connecting, and planning. Self-empowerment strategies are chosen according to theories from positive psychology (Seligman, 2004) and the effectiveness and practicality among students (for example, “learning to forgive” is not a strategy that can be taken into immediate action based on students’ feedback, so we didn’t include it). The available services and resources from the community are a crucial component of a social support system for students in a large-size campus. In this case study, we have identified and collected the on-campus service centers in a U.S. public university of large enrolment (>50,000). Each center is coded with relating stressors based on the services it provides. The social support system functions as a tool for students to match their struggled stress points with on-campus service centers. In addition to the suggested self-empowerment strategies and on-campus service centers, an interactive personal support layer also allows students to input and visualize the support from people close to them. It makes the social support network more personalized and helps to promote people’s awareness of the support network in their lives.

To ensure the map functions efficiently as a tool for navigating resources, all support elements are categorized into four types identified by James House in his book *Work Stress and Social Support Study*: emotional (the provision of caring, empathy, love, and trust), instrumental (the provision of tangible goods and services or tangible aid), informational (information provided to another during a time of stress), and appraisal (the communication of information which is relevant to self-evaluation rather than problem solving) (House, 1981).

3.2.3 Interaction and Visualization

The interactive experience is designed as a linear process prompt by different questions. Visualizations are progressively generated as answers to these questions. The structure of the narrative enables the micro and macro aspects of the information being presented to the user. Analytical tasks of retrieving, filtering, and clustering assist users to take full advantage of available data and information in local context therefore providing real help and solving real problems for students’ SWB.

In addition to considering the information and its hierarchy, design efforts are also made to allow information presented in a clear, attractive, and digestible way. Low-poly forms, organic shapes and bright colors are chosen to achieve an energetic, uplifting and relaxing sensation. Flower metaphors that suggest life and growth were adapted to shape the system map. For a personalized user experience, a student user first identifies her own stress points from the 20 stressors to create a unique “stress portrait”. Then as the result of user interactions, a complete social support map would be presented in front of the user to demonstrate her individual power and the social power that may enable her subjective well-being. Pictograms and textures are also used to be superimposed on the color regions to

encode categorical data in order to accommodate users with visual impairment. Figure 4 shows some mock-up screens of this interactive visualization project.

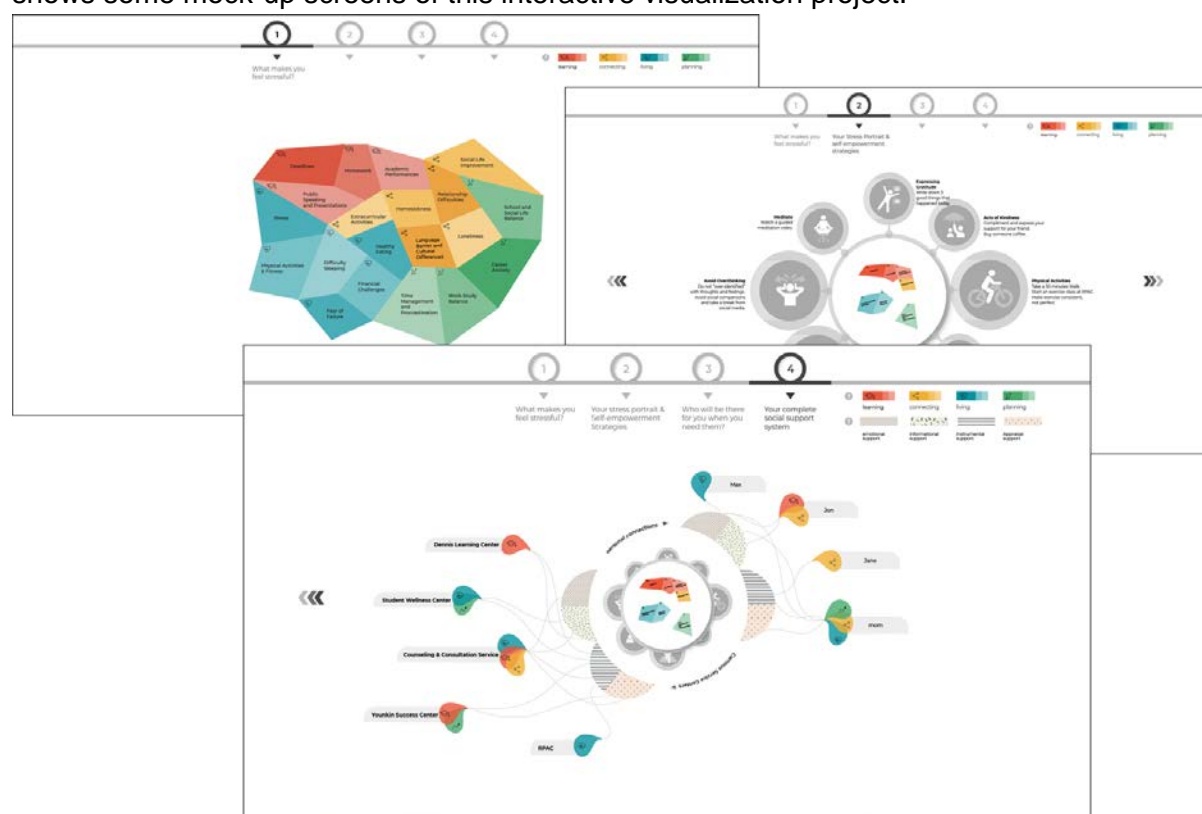


Figure 4 “Our Social Support System” information visualization concept mockup

3.3 Assessment

The assessment process is still ongoing by the submission time of this paper. The assessment stage is orchestrated to test both usability issues and users’ emotional and behavioral responses. The usability aspect will be tested through a series of set questions following ISO’s usability test guidelines (ISO, 2013). Questions relating to users’ emotional and behavioral responses will mainly focus on the empowerment affect that facilitates SWB (Nelson, Lord, & Ochocka, 2001):

Table 1 User assessment plan.

Effectiveness	Does the social support map successfully produce the intended result? Questions relate to: theme, target user, purpose, initial reaction, aesthetics, overall impression and impact
Efficiency	Does the social support map successfully achieve maximum understanding with minimum wasted effort? Questions relate to: speed of reading and understanding the information, identification of information hierarchy, color-codes, pictograms, typography
Satisfaction	Does the social support map successfully fulfil user expectations and needs? Questions relate to: learning of new information, confirming existing information, reusing potentials, chances of recommendation
Awareness	Does the social support map raise more awareness of issues related to SWB and the available social support?
Emotion	Does the social support map elicit more positive feelings from the users? Choosing words from an Emotional Words Chart, e.g. Plutchik’s wheel of emotions (Karimova, 2017)
Behaviour	Does the social support map motivate users to increase community participation, set better goals for themselves, take more initiatives in peer support and self-help?

4 Discussion

This research study investigates the opportunities to use information visualization to communicate and tackle SWB issues, as well as its ability to elicit feeling of empowerment from the users. It describes a design case in which a personalized social support visualization system is created with the explicit intention to enhance college students' empowerment experience in support for their subjective well-being. Although some theoretical insights are available about how design can contribute to well-being topics, this is the first research study to propose using information visualization as an empowerment tool to influence college students' emotions and behaviors in positive ways. The design process of the case study deliberately envisions an empowerment affect from the target users. The design solution intends to not only serve as a bridge between an individual and her social surroundings, but also makes one feel capable of reaching a particular goal, i.e. coping with daily stress, while gaining knowledge about systems, resources, and the power dynamics related to the goal.

The assessment results will tell us whether this design for empowerment approach of information visualization is a valid one. In addition to the current assessment plan, it will also be valuable to compare and measure the emotional impact of information content versus the visual forms. If users have an overall positive emotional response to the visualization products, which factor contributes more to the affect? Does a customized visual design increase positive feelings and the sense of empowerment? Also, in addition to this design approach in which using infoVis to close the gap between what is available and those who need access to the resources, we will explore other design solutions that can empower college students to address issues of SWB.

This research has the potential to be a significant contribution to information design research in general, and information visualization and design for well-being specifically. It offers research-based and human-centered design guidance for information visualization designers. Scientific studies are able to provide concrete evidence regarding the problem and needs of the user. Design research and design practice, on the other hand, are able to bring human-centered solutions to the problem. The considerations of human emotions and behaviors are as important as form and function in the design of information visualization.

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About the Authors:

Yvette Shen: Yvette is an Assistant Professor at the Department of Design, The Ohio State University. Her creative works and research essays on information and data visualization have been recognized and awarded by various design organizations and publications. Her work has also been exhibited worldwide.

Shasha Yu: Shasha is a graduate student in the Department of Design at the Ohio State University. Prior to OSU to pursue her M.F.A. degree, she had a master's degree in Psychology and worked as a UX researcher in a global Game Design company for three years. Her expertise is in gameplay in education, co-designing, and information visualization.