

Developing a Methodology for Understanding How Children Cocreate and Learn from One Another

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When we envision the creative society, what do we imagine people doing? We might imagine individuals with diverse backgrounds working together on a range of exciting projects. Through their collaboration, they get to know each other and learn from each others' different skills and backgrounds. New ideas are conceived and explored. As problems arise, people solve them together. Projects require the interdisciplinary backgrounds and range of skills that the people as a team have.

These are the types of experiences our children should expect. The workplace they will enter is increasingly collaborative. As the most interesting work becomes increasingly complex, many work groups are more interdisciplinary. Working together creatively is not only important to professional and financial success, but also to personal development. For many people working with others makes the job more fulfilling. We learn from each other's knowledge and solidify our own understandings when explaining or justifying to others. And creative work is often of a more stimulating and more personally meaningful nature.

These trends towards the creative society have already begun. The Boston Globe recently reported, "Teams appeal to young workers because they have no interest in boring or ancillary workplace tasks, even at the entry level. Well-constructed teams provide an opportunity to be a decision maker and a key contributor early in one's career" (Truck 2005). Our children will have more full, productive lives later if they learn to think creatively and work together now. We should provide our children with the stimulating environments that will excite

them about learning and collaborating now, so that they will expect no less as adults.

Children today need to engage in creative learning in order for the creative society of tomorrow to exist. Children need to experiment with *fluent ideation*, the ability to generate many good ideas, especially unusual ones (Sternberg & Lubart 1999). Unusual ideas originate from experiences with playing with a variety of ideas and materials. As a result *diversity of experience* is important for members of the creative society. Groups of intellectually diverse individuals can come up with unusual combinations when they can truly collaborate. This ability is sometimes called *novel combination* (Sternberg & Lubart 1999), and is another important skill for individuals as well. None of these characteristics can exist unless people have a genuine *joy in experiences* and this joy can only come from within. Thus early motivating learning experiences must be relevant to children's existing interests, culture and personality.

In order to foster the environments that support creative collaboration, one must understand the features of the interactions that support creative collaboration and the ways individuals learn from each other. Two different perspectives can inform an understanding of creative collaboration: 1.) the nature of group creativity and 2.) the social dimension of individual creativity. In this first case, one would look at a group as a whole, considering their processes, goals and progress. For the second case in which the goal is to understand how individuals are influenced by other people, one might study individuals' *social influence*, the culture in which individuals' work, their adoption of others' ideas and their incorporating of the ideas into their own work.

The methodology suggested in this paper considers both perspectives, but focuses more upon how individuals are

influenced other people. It first considers how ideas move through a workgroup, which develops some understanding of the nature of group creativity. It then focuses on how individuals adopt ideas and then reincorporate them into their own creations. The methodology combines diverse sampling techniques and related analytical methodologies that previously have not been considered together. Through these combinations, researchers can create new ways of understanding how people influence each other's work and how they co-create.

The first section of this paper describes some key conceptions of creativity, with a particular focus on creativity as a social system. It then describes work on the flow of innovations and its relevance to the understanding of social creativity during design activities. Ultimately, it outlines a methodology for understanding social creativity through experience sampling, social network analysis, and computational technologies that provide the infrastructure for the first two ideas.

What is Creativity?

Creativity is often thought of as a process or product that is new and useful (Sternberg and Lubert 1999). But what might be new and useful to one person (say, a child) may not be to others. The perspective on creativity from different viewpoints is often explained in terms of 'p-creativity' and 'h-creativity' (Boden 1990). 'P-creativity' (personal or psychology) is new and useful to an individual whereas 'H-creativity' (historical) has not been done before. The first type of creativity is the critical one for the learning process.

Groups, be they adult workgroup or group of child collaborators, have their own creative processes beyond the processes of the individuals. The social interactions of the group may generate new ideas and developments that the individuals alone may not. "Social creativity emphasizes that

the heart of intelligent human performance is not the individual human mind but groups of minds in interaction with each other and in interaction with tools and artifacts" (Fischer et al 2003). These groups in many cases could be described as *communities of interest*, groups of "people from different backgrounds, all having a unique stake in a common problem." (Fischer and Ostwald 1993). For our purposes, the creative act of a community is

- an idea, novel and useful to an individual, and
- adopted by a community of interest

where an idea is an individual's thought that is instantiated in a form viewable or otherwise understandable to others.

Here a community of interest adopts an idea when they use it in their own work. When the group adopts an idea, the "usefulness" of individuals' creative products is validated. Once the idea has been adopted, it becomes not only a part of a group project, it also becomes part of the group's thinking.

Social Network Analysis and the Diffusion of Innovations

Social network analysis considers the structure of people in groups using statistical methods. The general shape of the network can be described numerically or graphically, specifying who is connected to whom, how strong the connections are, and who contacts others via intermediaries. In addition to social connections, social network analysis allows researchers to understand how ideas move through a network. The process by which groups adopt ideas is called *diffusion of innovation*. Diffusion of innovation is defined as the spread of new ideas through a society. "Diffusion is the process by which an innovation is communicated through certain channels over time among members of a social system." (Rogers 1983 quoting Beal & Bohlen 1955). When people choose to adopt new ideas depends on their personal influences including centrality in a network and the age of the individual (Valente 1996).

Social network analysis not only provides several theories about how information moves through a network, but also provides methodologies that can be applied to how people work together creatively. By tracking who contacts whom and who creates what and where they send it to, researchers interested in learning can develop new understandings of how learners collaborate and learn from one another. The shape of the network itself can be studied, which may provide insight into the structure of learning networks including important issues such as how much learners rely on each other versus teachers or mentors and the role of older children in younger children's experiences. Analysis of the flow of innovation might help researchers to understand how ideas catch on in a communities of learners, how the structure of the network influences who adopts when, what are the factors that influence widespread adoption and perhaps the structure of how children learn from one another.

The basic data needed to perform these types of analyses are represented as nodes (individuals) and edges (connections between the individuals.) An edge might simply represent whether a person knows another, how well they know each other, or whether an idea has moved from one person to another. This type of data can be gathered through the use of handhelds or cellphones.

Data collection with handhelds and cell phones

As handhelds proliferate, researchers have begun to look to them as a viable resource for understanding daily behavior. More and more people carry handheld devices, particularly cell phones. These devices may offer rich documentation of people's everyday lives. Logs of what people do with their handhelds can indicate who they are in contact with and when and what they are doing. Devices with GPS cellphones that

keep track of which cell phone towers they are near can indicate where people are and who they are near.

Previous work on people creating and sending their creations on wearables demonstrates that 1.) it is a worthwhile data gathering technique and 2.) engaging creative activities can be built upon these platforms. Computational-enhanced nametags, an early example, allow wearers to learn about other individuals in face-to-face interactions and understand a social group as a whole through public displays of the interactions (Borovoy 1998). This innovative work capitalized on people's typical use of non-computational social devices (nametags) and therefore successfully took advantage of existing social conventions. In one version participants wore LCD-display badges that showed short segments of text. Participants could create new texts and send and receive them. They could also view description of what was sent to whom and what was popular on public kiosks.

A related project by the same team, I-balls, allowed children to create and share animations on small physical devices and then see where their creations would go through the school's community. Children built animations on key-chain sized computers with which they could create animations that could be sent or could "hitchhike" to other devices. They could then go to a public display at the school to see the paths animations took through the network and which animations were popular and with whom. This work supported 1.) people's creative work 2.) sharing of the work 3.) logging of social network and flow of innovation data and 4.) near real-time display of the data. Still their work's focus was not on collaboration during work and, thus did not develop methodologies to support an understanding of my current area of interest.

MEASURES FROM THE LITERATURE

The following chart outlines the types of data needed to describe a group’s creative output.

TABLE 1. Data gathering and analysis

AREA	DATA	METHOD	ANALYSIS AND REPORTING
Group Task	Goal and subtasks	Interviews, reviewing project documents, logging of transfers of information	Descriptive text and descriptive statistics.
Individual	Individuals’ backgrounds	Surveys and interviews	Descriptive text and descriptive stats.
Individual	Individuals’ creative output	Experience sampling, ethnography, logging of work tasks/changes to project	Descriptive stats and pattern recognition of logs using reality mining techniques
Group	Group background	Observation, interviews	Descriptive text and descriptive stats
Group	Social network: Group social structure individuals’ influence	SNA surveys of closeness & kinship, logging of intragroup communication	SNA: closeness, kinship, models of social network
Group	Transfer of design	Logging of group activity	Descriptive stats and

Group	components Adoption of design components	Logging of group activity	pattern recognition of logs using reality mining techniques Descriptive text, stats and pattern recognition of logs using reality mining techniques
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The goals of the group should be identified. This information might be gathered by through interviews with the participants or by viewing any project documentation, both initial plans and logs of activities. One would use the description to interpret when the goals were met through the contributions of the group. For individual participation, one wants to understand the person's background and their potential ability to contribute to the design task, creatively or otherwise. The individuals' creative output is described best through real-time artifacts of creation including logging of tasks and experience sampling.

It is important to understand the group dynamics. In order to do this, one should know the group's history and the structure of the social network. Understanding the social network includes the overall social interaction, task-related social interaction, social cohesion of teams, and individual influence. For the generation of ideas, one wants to map specific individual creative contributions to particular design tasks, observe when others view the contributions, and, more importantly, when others adopt them. One creates a model of the adoption of ideas and the factors that impact the process.

But how would such a methodology actually be implemented? Who would the participants be, what would their task be, and how would their mutual creation be understood? The next section describes a specific example of how such a methodology would be implemented.

An Example of a Study Design

Our research group develops programming environments for children. With one program called Scratch (Maloney et al 2004), children write programs in a visual environment to create videogames and interactive animations. Currently, we are in the early stages of porting the project to cell phones. This new platform allows children to work on projects together in ways that they couldn't previously. They exchange code samples, share games with each other, and incorporate others' project components into their own all on their phone. In addition, they can, of course, use their phones to talk to each other. Their individual programming process, finished programs, sharing of projects, incorporation of each other's ideas and cell-phone communication are logged.

A study using this technology addresses how children exchange ideas as they learn to program in Scratch. The goals in such a study are to 1.) describe the children's social network and how they fit into it and 2.) describe how ideas move through the network from one child to another.

In a Scratch activity with cell phones, children create interactive animations and games on their computer, download their creations to their phones and send the creations to their friends. The programming environment has jigsaw puzzle-like blocks that fit together to create procedures. Media files such as images and sounds can be activated as sprites. Sprites can have different programming sequences associated with them.

Once the children create a file they like, they download it to their phone either through a USB or Bluetooth connection. Their phone displays the finished product only, not the code. When they send it to their friends' phones, their friends see only the finished product on the phone itself. They can upload the file to their computer to open and edit it in Scratch.



Figure 1: Scratch Software

Thirty 12 to 13-year old children will participate in the after-school programming activity. Each child receives a cell phone with the Scratch program installed and a phone plan.

After gaining permission from their parents, a survey is sent home asking about previous relevant experiences and the children's social networks. An experience survey includes questions about after-school activities along with previous computer, programming, and video game experience. A social network survey includes measures of closeness, kinship, and neighboring (adapted for children from Marsden and Campbell 1984) and the size of personal networks (adapted from Killworth et al 1990). Then the participants begin an after-school programming workshop where they will receive their

phones. The workshop occurs twice a week for three months and is taught by the developers of the software. During this time, the children use the phone to make normal phone calls, as well as use the phone as part of a 3-month programming after-school project. In the workshop the children create programs that can exchange on their phones during the workshop or outside of the workshop setting.

ANALYSIS

The structure of the social network of children is described using survey data and social network analysis of cell phone usage. Based on the survey data, an initial model of closeness, along with social network size and shape is generated for each child and for the group. Then whom each child called is identified and how often they call, data that can be used to describe the social network. I describe who sends programs to whom, using techniques reported by Valente (1996). Through this analysis, I can identify adoption rates of ideas.

DATA COLLECTED	MEASURES
Social network survey	The characteristics of the children's social networks overall
Logging of children's location and cell phone usage	The social network in the programming group. Who is influential in the group
Logging of the children's programming	When children generate new ideas individually
Logging of program exchanges between children	Which new ideas are transferred through the network and where they go in the network. Adoption rates of the ideas
Children's use of other's code	How other children's new ideas are incorporated into children's work

The advantage of this potential study is that it is possible to capture the social network data (including location), individual work data, and group exchange and adoption of ideas all on one device.

Conclusions

These developments represent a new potential direction in understanding how people create together. By working with multiple innovative methodologies, it may be possible to learn about how people collaborate on design projects and how they adopt each other's ideas. Through these findings, we may discover that it is possible to further define and understand when social creativity occurs and what features of environments and communities support it.

References

- Boden MA (1990) *The Creative Mind: Myths and Mechanism*, Cardinal, London.
- Borovoy, R et al (1998) *Meme Tags and Community Mirrors: Moving from Conferences to Collaboration*. Proceedings of CSCW.
- Csikszentmihalyi, M (1988) *Society, Culture and Person: a systems View of Creativity* in Sternberg, R.J. (eds), *The Nature of Creativity*, Cambridge University Press, Cambridge, pp 325-339.
- Csikszentmihalyi M (1999) "Implications of a Systems Perspective for the Study of Creativity." Pages 313-335 in Robert J. Sternberg, ed., *Handbook of Creativity*.
- Eagle N and Pentland A (2005) "Reality Mining: Sensing Complex Social Systems", *Personal and Ubiquitous Computing*, To appear: June 2005.
- Granovetter, M (1982) *The strength of weak ties: A network theory revisited*. In Peter Marsden and Nan Lin (eds.) *Social Structure and Network Analysis*. Beverly Hills: Sage.

- Feldman Barrett, L & Barrett, DJ (2001) An introduction to computerized experience sampling in psychology. *Social Science Computer Review*, 19(2), 175-185.
- Fischer, G (2003) Designing Social Networks in Support of Social Creativity. Position Paper for the Workshop "Moving From Analysis to Design: Social Networks in the CSCW Context", ECSCW'03.
- Killworth, P et al. (1990) Estimating the size of personal networks. *Social Networks* 12:289-312.
- Larson, R & Csikszentmihalyi M (1983) The experience sampling method. *New Directions for Methodology of Social and Behavioral Science*, 15, 41-56.
- Lave, J & Wenger E (1991) *Situated Learning: Legitimate Peripheral Participation*. Cambridge: Cambridge University Press.
- Maloney J Burd, L Kafai, Y Rusk, N Silverman, B and Resnick, M. (2004) Scratch: A Sneak Preview. Second International Conference on Creating, Connecting, and Collaborating through Computing, Kyoto, Japan, pp. 104-109.
- Marsden P & Campbell K (1984) Measuring Tie Strength. *Social Forces* 63: 482-501.
- Sternberg & Lubart (1999) The Concept of Creativity: Prospects and Paradigms in *Handbook of Creativity*, Cambridge University Press, Cambridge pp: 3-15.
- Rogers. E (1995) *The Diffusion of Innovations*, 4th Edition. The Free Press, New York, New York.
- Torrance, EP (1988) "The Nature Of Creativity As Manifest In Its Testing," in Sternberg, RJ (ed) *The Nature of Creativity*. Cambridge, England: Cambridge Univ. Press.
- Truck, P. "A Penchant for Teamwork." *The Boston Globe* 16 October 2005.
- Valente TW (1996) Social network thresholds in the diffusion of innovations. In *Social Networks*, 18: 69-89.