TELLING DESIGN STORIES: THE RESULT OR THE ENTREPRENEURING INVESTIGATION

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ABSTRACT
Understanding the parallel elements between the artistic desire that drives the design process and how telling stories drives new design elements is the focus for this preliminary investigation. Two iterations of one graduate design methods seminar experiment provide transformative connection examples. Brief readings, short cycle prototypes and story teller-audience interactions set the stage for design entrepreneuring.

Keywords: engineering and design team education, story, organizational aesthetics and leadership

1   INTRODUCTION

I am riding Caltrain and twirling a water-filled paintbrush into a compact box of water colors to plan my afternoon class. I take the train during the week from San Francisco—newly planted from Boston—to Palo Alto where I am a visiting professor. During the first weeks of the commute I used a computer for this purpose, then books, finally I turned to what makes time stand still for me—painting. Today I am trying to figure out how to structure exercises to access story as a methodology and explorative form for a graduate engineering and design methods class. To do this I reflect back on what I already know, what I am learning from graduate student co-creators, and how my participant observation as instructor for the class will impact the developmental stages of their projects.

Collaborative design thinking is a social activity [1]. Members work together in groups, and emerging teams in the workplace and increasingly in engineering design courses. While these courses give an experience of working in teams, the elements of how insights help individuals create new approaches, sustain engagement and inspiration three or four years into a project, and appreciation for how to take an idea from concept to delivery are often not emphasized.

One central question organizes the current work: "How can the combination of active story-telling and self-reflective observation encourage real action and progress in engineering and design research?"

The suggestion is that the energy balance and emotional engagement of 'story-telling' can facilitate engineering design thesis work. The challenges that matter for students as they move across the developmental stages of the graduate research project have been well established [2, 3].

But what kind of explorative form is story? It is a connection to a framework that encourages students to take risks in their research. It is an action to tell, experience, prototype, and surprise with a 'story' because of the collaborative power of a class group. The explicit nature of the interpersonal connections in design groups that facilitate breakthrough [4] relate to the story of their work. We tell our co-developed design story informed by methodologies in engineering, psychology and art.

"Artistic desire drives my design process." This comment came from a graduate student—named Sangbae—developer of the famous robot stickybot, as he participated in one design methods seminar. Sangbae's gift is not only contained in his ability to build and deliver a robot that will climb and stick with hundreds of sharply tapered synthetic fibers, it is also in his capacity for connection and deep reflection within the group. We will return to his story in a later section. Before learning from his and other story elements, it's important for you first to consider why we believe in story as a powerful artistic medium and a useful explorative form. Stories can create a transfer of energy and balance leadership connections. In order to lay the ground for looking at telling stories we briefly discuss the artistic balancing act of leadership and connection. Then we consider the meaning of connections, with examples from the class where the participants explore and deliver their project "story," discuss the co-developed methodology, closing with what this tells us about the idea of design *entrepreneuring*.

Entrepreneuring refers to inventive actions that are characterized by a symbiotic energy flux within the collaborative connections of a group. Entrepreneuring may be observed in the behaviors of leading entrepreneurs and contained in the collaborative conditions of a group.

Students live their project stories within the collaborative connections and evolving dynamics of the class just like entrepreneurial leaders live their stories in the evolving dynamics of their companies.

2 THE ART OF BALANCED LEADERSHIP AND CONNECTION IN STORIES

Engineering project teams are well studied [4, 5, 6], and discussions of story as an art has been well established [7]. Connection as a concept is a well documented way of knowing [8] and unknowingly considering relational leadership in teams [9]. But the suggestion that the success of engineering design work and a balanced leadership intersect because of the connections to a story as the explorative and artful form is new.

But what kind of connection is it? Is it a connection because of how we feel about meaning and the creative power of group genius in directly working relationships [10]? Or is it a sense of a felt meaning around symbols and ideas of discovery [11] when individual within group viewpoint frames and contributes to a developing narrative and designed artifact. Connection is measured by behavioral dimensions of leadership [12,13,14] and felt meaning [15, 16] and sensing [17, 18]. Connection is also measured as an artful approach [19, 20, 21, 22, 23].

Connection Measured as Behavioral Dimensions

- Balanced leadership among members (Uhl-Bien, 2006; Heifetz, 2005; Baum et al, 1998)
- Felt meaning, directly work the relationships (Perl, 2004; Karanian, 2007)
- Sensing around ideas, symbols of discovery (Taylor&Carbone, 2008; Karanian, Skogstad, Taylor, 2008)

Connection Measured with Story as an Artful Approach

- Expression of connection as aesthetic form (Taylor and Karanian, 2009; Csikszentmihalyi, 1990)
- Belonging and responsiveness to 'story' that connects (Ramirez; 2005; Bourriard, 2002; Smith&Berg, 1987)
- Prototype Representation as the explorative form moving forward (Edelman,2008; Eris,2006)

2.1 Working Transformative Connections

Story as an artful approach and expression of aesthetic form creates connection between humans. Building on previous work [19, 20] it's important to consider aesthetics the way Ramirez puts it. He says that aesthetics is that branch of western philosophy that deals with the future of understanding, perception, cognition, and experiences which we qualify (often after the fact) with adjectives such as 'beautiful', 'ugly', 'elegant', or 'repulsive'. Aesthetic knowledge depends largely on sensing and feeling, on empathy and intuition, and on relating conception to perception [21].

3 THE BACKGROUND FOR THE PRELIMINARY INVESTIGATION

The stories included in the observations are a blended combination of two separate iterations of a graduate seminar in engineering design methods at Stanford University. A course description and syllabus is distributed, along with an overview of assignments and the core vision for the class. A unique feature is that students are informed in the "warm-up" phase for the class that the evolving dynamics of the class impact course curriculum. Each class has an organizing question received in advance, a surprise question, a practice exercise, and a design challenge. The seminar uses 'story' as an approach, with one lead instructor, a consulting instructor, at least one graduate student participant observer, and invited industry guest guides. The process relies on spontaneous yet thoughtful restructuring of class assignments. Successful completion of the class requires participating by attending class, completing prototypes, experiencing projective exercises and design challenges, two minute presentations, and a final paper and presentation. The current discussion considers class examples and preliminary reflections from two iterations: "Telling Your Research or Project Story;" and "Action Stories: an entrepreneuring energy measurement," offered during the spring quarters of 2008 and 2009. Three planning phases organize the current work.

3.1 Planning Phase I

A three month exploratory phase examined the significance of story for the purpose of considering the seminar as a collaborative group experiment, and developing the next iteration of the class. A discussion of whether or not to move in the direction of hypothesis driven research resulted in three hypotheses from the three co-authors. Work and rework attempted to synthesize the three hypotheses to one hypothesis. Two similar concepts emerged: balanced connections, and a transfer of energy. Planning for the next phase of the preliminary investigation included a review of ways to qualitatively prototype, observe, deliver a designed 'story' and recognize the impact of the co-developers.

3.2 Planning Phase II

The observation of two separate iterations of the seminar was qualitatively considered by the Instructor and reviewed in chunks by two co-authors. Elements of student stories were considered from concept to delivery across the developmental stages of ideate, discover, evolve and prototype, and delivery of results. Eight entrepreneurial leader telling response stories were also considered. Drawing, and paintings painted, with projective cue prompts, and other artifacts left behind were also part of the data gathered.

First-person methodologies indicated a way to distinguish one's personal truth from science. Our discussion was not only to recognize a science which includes first-person, subjective experience as an explicit and active component (25) but also to offer a non-traditional and unexpected way to deliver academic work and a relevant promise to the formative nature of engineering education.

3.3 Phase III

Building on Phase II work, a co-developed model of varying methods was formed and reformed by participants for each action story as episode in the latest class iteration: Action Stories: an entrepreneuring energy measurement. The impact on individual story development and progress from utilizing a new method for observing in each episode was explored.

4   METHOD

Intergy is defined as a "shared energy" between collaborative group members. A fluid transfer of enthusiasm, emotion and information visualized as an "energy flux." Intergy can be internal to the group and also shared to engage non-members (participant observers). Figure A depicts "energy flux" as the symbiotic movement of energy contained both inside and outside of a collaborative team. Entrepreneuring teams are characterized by a highly symbiotic energy flux—intergy flux between both the outside and the inside of a group.
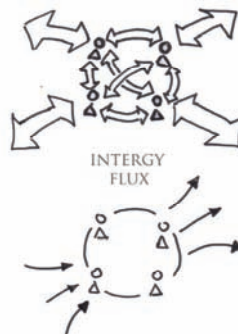

INTERGY
FLUX

Figure 1

Rather than as impartial and disconnected researchers, we approach each situation as "participant observers." So whether we are studying an individual or a group of individuals, we allow them to

engage us directly in their activities. This allows us to directly experience and observe Intergy as it is generated by the individual or individuals. Three methods seek to address the following Hypotheses:
1. Collaborative groups are characterized by Intergy.
2. Intergy is observable by outward variables in team interactions.
3. Entrepreneuring leaders epitomize Intergy.

The first method is participating observation of a seminar class. Video and audio recordings were made of the session in an attempt to explore Hypothesis 2. In these recordings, the voice of the recorder can often be heard as he is actively participating. Observations included the group's "outward variables" (such as gestures, interruptions, etc.). Due to the nature of the seminar, the primary vehicle for Intergy in this case was the sharing of personal stories. See framing of story as Intergy in Figure 2.
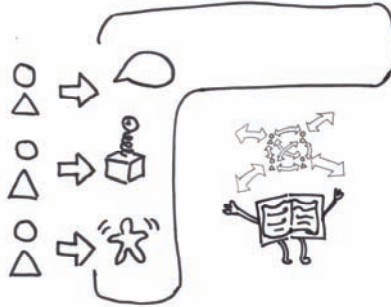

Figure 2

4.1 Participants
Advanced-graduate students and industry leader guest guides ranged in age from twenty-something to mature and seasoned something-year olds in the classes. Some took the class for credit while others participated and visited on a regular basis. Each class group had 8-12 participants. Each group had at least one female participant.

4.2 Setting
Each seminar iteration and class meeting was held on the 1st floor level of the same campus building. A long seminar table was partially surrounded by moveable white boards, chairs and small sofas.

4.3 Design as Organizing Questions for Each class
Organizing questions for the seminar were formulated based on factors of motivation, imagination, perception and cognition across the seminar project phases of explore, express, evolve and excite (see Table 1). Some questions (ie. Excite Artfully) emerged based on the evolving dynamics of the class.

Table 1: Organizing Questions for the Seminar

	Motivation	Imagination	Perception	Cognition
Explore ; Engage	What matters to you about your project? What do you 'need' as you move forward?	How would you tell your 8th grade self the title and first two sentences of your project?	How is sensation and the ways we organize perception grounded in physiological processes?	How do we make sense out of what is confusing about our designs and research project?
Express Internal	What are the collective unconscious factors that influence your view of your story? What happens when someone else tells your story?	How do you remain inspired and excited 2 or 3 or sometimes 6 years into a 'story' project?	What are your personal 'readiness' factors that will facilitate your moving forward?	If you return to the discovery phase of your story, where are you now in the arc of your work?
Express External	Does it matter if your story is 'like' others who hear, listen or ask about your story?	Imagine and paint a picture of where you are in your story…how do the stories of others inform?	Where is the energy in you? In this group? How is it useful in moving forward on your project?	How do you tell your story to varying audiences—academia or industry or both?
Evolve redesign	Where are you in the arc of your story? Beginning, middle, end?	What is it about being in the middle that is immobilizing or floating	What engages you about your work? How did other prototype solutions help you move forward?	As you reflect back on the quarter what one question do you have for yourself about the current state of yr story?
Excite Artfully	What are the images and	How does artistic desire	Why is it an art to leave	How did your drawing of

	themes of motivation in your picture test stories? What are the threads that follow you in your life?	impact the way you design your story? What are you not telling us? Vulnerability does what?	gaps? Why not give the beginning, the middle, the end—whole story? Can you feel the truth?	you inside a collaborative project inform what you know about your current story?

4.4 Analysis of Content and Measures

Design as 'story' and the transformative connections are considered descriptively. In the preliminary analysis, four dimensions of telling design stories are featured from a developing verbal, non-verbal and picture narrative: balanced leadership conditions, working the relationships, transfer of energy as emotion and truth, and an artful approach across the developmental stages of project level—from the ideating to delivery.

The intent of the preliminary exploration was to lay the groundwork for next phase analysis to explore a novel way to develop a metric for story as a transfer of energy that not only brings coherence to a developing individual design but also frames how story viewpoints characterize new design elements for leading team success.

The second method, intended primarily to address Hypothesis 3, was to meet one-on-one with leading entrepreneurs. In these meetings, observation took place while the observer was also participating in conversation. One method applied at each of these meetings included having the entrepreneur paint a picture. This method incorporates the "element of surprise" with a generative aspect to create a real artifact. In so doing, we hope to gauge an Intergy level from this interaction as well.

In addition to the experience of shared story, we used the group environment as a collaborative test bed with which to develop new and previously untested methods for observation and characterization of active groups. The novel approach here is to incorporate the development of these methods as part of the curriculum. By collaborating on the methods and observing themselves, the students will not only develop their own stories and group connections through a process of reflection, but will also achieve real progress toward a new research model for group observation. Method is defined by the ways that the story-teller knows when and if a successful story links to research or project developments.

4.5 Action Stories as Episodes

The third method was first formed and reformed by a co-development in the class iteration: "Action Stories: an entrepreneuring energy measurement." The course was set up so that each week would exist as an "episode," or a single installment in the overall context of the quarter. From week to week, developments on the group and individual level were made explicit in discussion. These developments included individuals' progress on their stories, deeper understanding and appreciation within the group, as well as progressively more involved and media-rich methods of observation and reflection. Method here is defined by the ways the individual, through the reflective story action of the group, knows the degree to which the group is engaged. Like the rest of the curriculum, these constantly evolving methods were formed and re-formed dynamically by the group. Three particular methods stood out and are explained in some detail below for class episode one, episode five, and episode eight.

Episode One: Marble Moments

In this exercise, each participant was given four marbles at the beginning of a group session. An empty ceramic bowl was placed in the center of the table. The participants were given the following prompt: "When a moment in our discussion makes an impression on you, place a marble into the bowl." At each instant a marble was placed into the bowl, the researcher records a "time stamp" of the event. This recording was done using a homemade computer program. The log of time data is recorded to a text file for later analysis.

This list of timed events was used to analyze the session afterward. It is critical that no actual recording of content took place and that no distinction between users was made; this lowers the participants' apprehension to engaging with the method. The reason for limiting the amount of marbles to some finite number is so that the participants are required to assign some personal value to these objects; that way, when a marble is placed, the participant is actually indicating that some personal value threshold has been met. Additionally, the fact that the bowl was communal and public,

and that each event could be heard and seen by all, set an open and collaborative tone for the exercise. The test was performed to determine:

- Whether any discernable "use pattern" of this method arises on the group-level, and to what extent the group engages with this method.
- Whether the method can accurately capture and reflect (and possibly contribute to) group engagement.
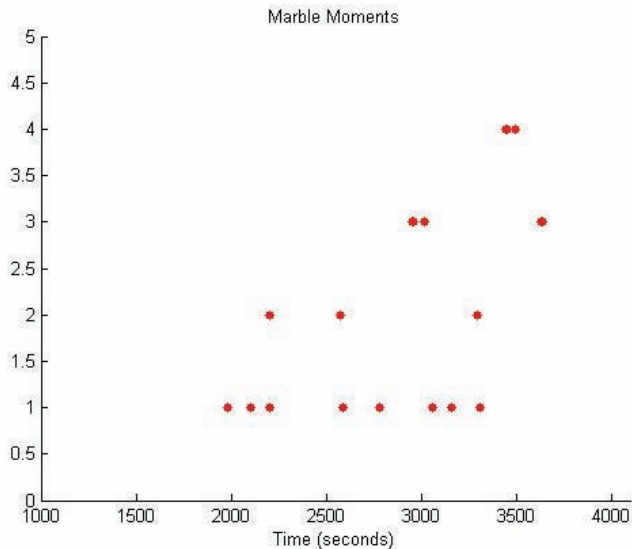

Fig. 3: Marble moments represented as a scatter plot.

When multiple marbles were deposited within one minute, this was recorded as a "simultaneous event." Multiple simultaneous events of two, three and four students (of eight total participants) were registered. Over the duration of the experiment, two distinct trends were observed: first, a shift toward synchronicity in group action and emotion as evidenced by the method; second, a clear engagement with the method which perhaps contributed to overall group engagement.

In subsequent iterations, we adjusted variables such as making the event discreet and providing each student with unlimited marbles. In combination with the first iteration, we were able to determine that the occurrence of synchronicity is, as expected, more prevalent with a public (as opposed to discreet) event. This supports the claim that by making engagement observable in the group, it in turn encourages synchronous action, and acts as a feedback mechanism which has a real positive impact on group engagement. Providing an unlimited number of marbles removed the visible upward trend in the data, spreading it out instead over a large number of smaller-scale events (never more than two students at a time). This is because with a limited number, a "calibration" must occur in which each student internally identifies the value of the marble in the context of the group discussion. This calibration is also a group action; without this, members of the group never "coalesce" on a shared value judgment.

Episode Five: Sound Clips

In this exercise, a live microphone was set up in the center of the group discussion table. Levels were pre-adjusted and recording of sound in the room was begun. Students had come to the session with a pre-prepared personal answer to the question:

   "What do you worry that you will not be able to accomplish during your time here at Stanford?"

Near the beginning of the session, the group left the building to wait outside, leaving the group discussion space isolated and empty. Then, one by one, the students re-entered the room to confess

their "worry" into the microphone privately. They took turns until each student's "worry" was on the recording.

After the session, the audio recording was manually edited into individual audio clips containing one student's "worry" each. These clips were then randomly sent (via email) to other members of the group, each student receiving some other student's clip. No two students were paired in receiving each other's clips; they were distributed in such a way so as to avoid this. The clip was accompanied with the prompt:

"Your task for next [week]: Listen to the clip, and prototype a solution to help your classmate!"

Students returned the following week with an impressive showing of solutions. Most of these solutions were, in fact, physical prototypes handmade (or handwritten) by the recipients of the clips. It was clear that a great deal of thought and effort had gone into these "prototype solutions," and that the method itself had encouraged this result. In order to share the solutions with the class, each student was given the option of having their clip played aloud to the entire group for context. Many initially displayed some discomfort with this idea but all eventually allowed their clip to be played. Following the clip, the recipient would then present the solution to the individual and to the group for feedback.

One student was absent from the "solutions" session and this had an interesting result in the group. Because of the way the clips were distributed, one student was left with a solution for the absent student. The group opted to postpone sharing that solution until the absent student returned the following week. For the same reason, one student was left with no solution to his "worry." As a result, the entire group opted to listen to his clip and prototype a solution in real time. Thankfully for this unforeseen scheduling conflict, an even greater level of engagement with the method (and among the individuals in the group) was made apparent. Every student actively engaged in offering solutions.

Usually in this group, the standard procedure is to hold a normal group discussion, going around the table and sharing our responses with one another. It was clear that using the "sound clips" method greatly increased the engagement of students with each other's concerns, and led to a much higher level of resolution in the solutions that were offered. The arbitrary pairing of each individual to another seemed to have created a sense of personal responsibility and deepened connection that led to this result.

Episode Eight: Still Images

In this episode, photographs were taken of the group at random intervals throughout the session. Later, five of the photographs were chosen, randomized and sent in an email to the group with the following prompt:

"Rearrange these photos by the level of apparent engagement each one shows."

Additionally, the students were asked to state what it was in the image that led them to make their decisions. This was an attempt to identify what the outwardly observable variables of engagement are. Upon compiling the results and responses from all of the students, two interesting findings resulted. First, that although agreement on the ordering of the photographs was not very cohesive, there was a tendency to link more "engaged" moments with active verbs. This gives us some direction to observe "kinetic energy" in the group in future methods. Second, upon viewing the photographs in a group setting, the students were compelled to spontaneously and imaginatively recreate the actions and relationships they saw. This became a reflective exercise in observation that contributed positively to the group's understanding of its own behavior.

By applying these three methods, we hoped that the validation of Hypotheses 2 & 3 would, in turn, lead to the acceptance of Hypothesis 1 as a useful metric. This would allow us both to represent the Intergy of a group consistently and repeatably, as well as identifying a group of individuals whose Intergy level has directly contributed to their inventive action.

It is the last of the three methods, varying methods for action episodes, that provides the focus for something new. Results begin with three ideas and then end in the varying methods in action focus with Discussion illustrations.

5   RESULTS

Building on previous work, results were then considered as a reflection on the authors as co-developers of the work. Discussion and reflection turned to focus on the 'one thing' that was central to three ideas, something about energy transfer or a transfer charge. We talked about a sensed dynamic,

pieces of contained inside/and contained outside transfer of energy. We were chasing an equation, an infinitesimal measurement. Quantum? All of these conversations led to one word. Intergy.

We define intergy as a shared energy level between collaborative group members. A fluid transfer of enthusiasm, emotion and information visualized as an "energy flux." Intergy can also be internal to and contained inside the group and also shared to energize non members (participant observers).

5.1 Results as Three Ideas
1. Collaborative groups are characterized by Intergy. One vehicle for this is story-telling, as observed in the iterations of the graduate methods seminar.
2. Intergy is observable by outward variables in team interactions. These variables can then be considered through data gathering techniques.
3. Entrepreneuring leaders epitomize Intergy. These individuals can harness the power of story-telling, with the test case of painting responses for generative means, with the test case of artifacts.

5.2 Results from Varying Methods in Action

Progress through Reflection on Story Action

Many of these methods, by recording media or other data sampled from the group discussion, allowed for reflection on an individual and group level. This reflection on story action, reminiscent of the reflective action breakthrough of Donald Schon [26], noticeably contributed to the group dynamic as well as to personal story development. Naturally, not all methods were equally positive; some recording techniques detracted from the overall dynamic by making students uncomfortable or self-conscious. But those methods with which the students comfortably and enthusiastically engaged had a marked positive contribution. This contribution, created by the students' engagement with the method, represents our first success in observing intergy. Additionally, the notion that an observation method could lead to real progress for the observed individuals is an important and encouraging result.

Data as Artifact

In considering the success of an innovative and collaborative environment, we should hope to see that new objects or ideas are generated as a result of group discussion. Indeed, data collected by these methods have come to serve as lasting artifacts of the group interaction. That there is an enduring quality to the interaction, that elements of it are preserved for reflection, and that it gives real evidence of generative action have all been positive contributions to the group dynamic. Being able to observe this generative state, as well as create meaningful artifacts, supports our attempt to capture intergy in the group interaction. The notion of data as a lasting and useful artifact not just to the researcher, but also to those being observed is powerful.

Participant Observation and Collaborative Development

The standard paradigm of collecting data in this way is to separate the behavior of the group from the researcher to the greatest extent possible. Impartiality, secrecy and an intentional lack of involvement in the dynamic is accepted as necessary for collecting data. Also, it is often assumed that the methods should be fully developed beforehand solely by the researcher and data should be collected in a rote way, possibly many times for comparison's sake. Our work has changed that paradigm by showing that full involvement of the researcher in the group dynamics, using the group as a collaborative element to reform and redesign the methodology as the observation is ongoing, can produce compelling and useful data. So, the role of the "participant observer" has been validated, as well as the positive effect of allowing the individual and the group to change the way in which they are being observed. This collaborative experimentation is crucial to the successful observation of intergy.

6 DISCUSSION

Let's return to the story of Sangbae joining the seminar when the question was: "What happens when someone else tells your story?" How he told his story and the group response became very important for generating insights from the arc of the student's narrative to the meaning for future iterations of the class. "Our discussion today," he stated, "And your comments and questions after watching my television interview featuring Stickybot, makes me realize that I have returned to the very beginning— all the way back to years ago…where there was a hope and wish (in me) to make a robot that would climb and stick to the wall, like the gecko lizard. "This is that robot." The class offered personal connections in the form of appreciation when they learned that despite long distance travel from the west coast to New York, Sangbae had been personally excluded from the television depiction, while both the robot and the lizard that inspired the climbing sticking action were depicted. The words of care from the class appeared to energize Sangbae. When someone else told his story it helped him return to the past, and feel again the earliest stage wishes of his design process.

The meaning of hope in discovery, irreverently and incorrectly memorialized on that syndicated morning talk show was different for all of us. But one single thread connected the group with balanced similarity during the class discussion. We were riveted by the artful truth in Sangbae's fulfilled desire to move from hope to reality. We were present for an historical emotional moment in the design innovation process and we knew it. His story-telling became the vehicle for a collaborative connection of something—an energy flux—Intergy.

The transfer of ideas as intergy was the focus for other moments when participants identified themselves within their creative picture of a narrative—an arc, a spiral, a winding forest, an ocean with distant land barely in sight, a dot in the universe. The dot example illuminates. When asked to draw themselves in the arc of the narrative of his story, one student placed a dot on a huge white board—identifying himself as the dot and the universe of white—the space of his narrative.

In the class we talked and painted, reflected on carefully chosen readings and took non orchestrated turns telling our stories. Not just a story for the beauty of the story sake—but a story connected to personal discovery or a product or a development. We responded with insight, to where each graduate student or guest, was in their picture of the arc of the behavioral narrative—the beginning and the new, the middle and the sometimes immobilized and stuck, to worries about what's next.

We enjoyed the results when the introductory question was, "How do you tell your story in two sentences?" The group was stunned when the response from a shy, yet poised and award winning, woman student was so low her barely audible words trailed off, "The title of my research is…." They mostly male group stared in supportive disbelief. They all knew her from a distance. Many had previously seen the excellence in her mechanically engineered and inspired skin and medical device experiments. She was in the last stages of research experiments and ready to defend her thesis and didn't even know it! "Do you have any idea about what an impact you have made on us?" we asked. The group was so visibly energized that she remembered to be confident again in her work. "Wow," she smiled. "I guess that this is pretty interesting stuff that I am working on." Months later, following her successful defense she remarked to the seminar students, "More than you know, your attention and appreciation, really helped me move forward and complete my work."

The confidence theme emerged again when the question was, "What part of your story are you not telling?" when a class industry guide was a production company founder. His ways of telling his revolutionary film cutting discovery taught us that, "…it is an art to leave gaps." A product design student complained to the founder that no one on the teaching team was convinced by his elegantly detailed story, "Does my work just suck?" The founder just said, "Your work may suck. But it's more likely that you are telling them too much—never give the beginning, the middle and the end."

It is difficult to capture in words what happened when we asked about the part of the story the students were not telling. An advanced graduate student told the kind of story that cut so deeply into our emotions when he relayed a chilling war story—we could not consciously remember the story. Earlier in the quarter he had informed us, "I don't like to be spontaneous, that undermines my authority." Yet in the moment of the class story—he clearly had only prepared a framework in advance and surprised himself with an on-the-spot story development. He explained that his father was the only other person that he had told. "Are you aware of your story impact on this group," we asked. He surprised us with deep sincerity and an unexpected response, "I have no idea." The conversation among the group at that point considered the power of vulnerability in truth. We talked about how our confidence in him was enhanced by observing and reflecting on his ability and willingness to talk about the part of the

story he was not telling. The paradox of engagement [27] with the group—as the power of vulnerability over demonstrating authority and confidence was stunning.

In another class the group was so engaged when a graduate student was describing her research story through idealog moments in tablet pictures—they didn't see another graduate student reminded of a childhood moment, jump up, run to his office, and return with a small pottery artifact. The picture taking method (see episode 8) for that class captured the engaged yet shocked faces of the graduate students, sitting on either side of the student who proclaimed, "Ok…were you carrying that in your pocket since 6th grade? "I didn't even see you get up and leave the table!"

This stretched the boundaries for the group, not only for the ideas behind the work, but for the imagination contained in the back story of engagement for each student moving forward.

Artifacts in the form of an object built or a painting painted illustrate another form of outward variable. One approach was to encourage the creation of a shared object in the moment, thereby stimulating Intergy among group members and providing a lasting piece for reflection after the fact.

During a final class experiment for each test class, students took turns using the same water-filled paint brush, sharing palettes previously filled with a myriad of water colors and painted one picture that was prompted by: "…and now let's end the seminar with a silent paint. Paint yourself in a collaborative work space. Be sure to leave a space." In this exercise, participants engaged each other in a generative act, so their level of Intergy should be readily apparent. The hope with this exercise is that the artifact itself (i.e., the painting, see Figure 4) would serve as data from which this Intergy level could be discerned afterwards. The meaning of the space between the people was discussed.

Figure 4

A second iteration of this exercise was applied in meetings with entrepreneurial leaders. The setup was similar, though unexpected, with the directions: "Paint yourself in the middle of the collaborative work of your company." Be as creative as you like, and be sure to leave a space." The hope was that, though the individuals were painting solo and without the engagement of their group, the space they chose to leave would be indicative of how that individual perceives the contributions of his group members to his own personal story. One particularly interesting example is an interviewee who chose to leave the "space" directly between his eyes and hair, in effect blanking out large portions of his face. He

specifically explained the space as thinking space—indicating his own special brand of collaboration (see Figure 5). And when the researcher noticed that he hesitated after he completed the painting, and then reluctantly signed the painting, she asked, "What happened there?" He responded, "I never sign my work, it detracts from the design…besides it's not my work, it's our work." By forcing a generative state, this exercise suggests Intergy as it is manifested in a lasting, physical artifact.

Figure 5

So we see the participants of the class, along with the instructor, reflecting on action, and working the collaborative conditions for connection, in the space between the story and the people. Perhaps the most significant findings were the transformative story connections that occurred because the participants were telling their truth. Connections in this context are most like pure art and are about formativeness for the sake of formativeness [24] in an engineering and design world that doesn't always recognize the transformative power or take the time to form true new connections.

An interesting finding was that the method variation for each class episode was unexpected and raised the level of anticipation and mystery. We believe that the method acted as a type of design intervention, and purposely distracted the students away from planned thinking and towards imaginative engagement. The generative and reflective quality of the method development process was successful in creating engagement among the students; indeed, student engagement in class participation was evident.

Implications for why telling stories make explicit the connection between the student's arc of the narrative and the definition of entrepreneurial leadership are not clear. Limitations exist in the current small sample size and the in-process exploration of a systematized approach to the analysis of a story. Deciphering the variables that contribute to when individual story telling is characterized and energized by a group viewpoint that frames the developing narrative and designed artifact will be a next step focus.

6.1 Closing

If we bring these ideas together, the success of engineering design work and an entrepreneuring intergy intersect because of the connections to a story as the explorative and artful form. By painting a picture of a telling design story system we make explicit the implicit transformative connections that set the stage for progress and inventive action in graduate student work.

Planning a class for students who are engaged in the individual process of working on engineering and design research requires a scholarly approach that is open to consistent shifts in methodology. The flowering and excitement that builds in the telling design stories class is similar to the coherence of an entrepreneurial leader in the early stages of a collaborative breakthrough.

We face the challenge of analyzing that which is observable but intangible, obvious but often ineffable. The words of clinical and research psychologist Paul Rosenkrantz [28] apply, "This psychology kind of research study almost always has to be simultaneously obvious to be significant."

Surely collaborative groups of humans are among the most complex systems ever to be studied, and to extract knowable and repeatable results from the infinite subtleties of their interactions is no small task. Ultimately, we should hope to establish reflection in story-telling action as the foundational picture for inspiration, creativity and communication.

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