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Performing Collaborative Creativity: Learning from Diverse Experts Interacting in Ireland's Science Gallery

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This paper is submitted for Sub-theme 36: Creativity in doubtful times: Exploring challenges and threats to creativity

Performing collaborative creativity: Learning from diverse experts interacting in Ireland's Science Gallery

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ABSTRACT

This paper presents preliminary findings deriving from a larger project investigating the performance of collaborative creativity and is primarily concerned with describing the communication patterns of such performance. Interactions between different domain experts in Ireland's Science Gallery, Trinity College Dublin, were observed and recorded over the course of four months in 2011. The interactions have been loosely transcribed using the basic principles of CA. Preliminary findings include three observations. Firstly, creative performances involve a type of content we call 'idea talk'. Secondly, performances of creative collaboration involve variance, not equality, in participation by individual experts. Variance in participation in group creativity is somewhat in tension with findings from the equality of participation celebrated in the brainstorming literature (Osborn, 1979) and reported from research in other collaborative groups (Sawyer, 2007, Sonnenburg, 2004 Steiner, 2009). Thirdly, the role of the facilitator in creative collaborations requires a flexibility to move between roles of facilitator and participant and the communications skills to summarise and express the ideas of others as well as their own ideas. The character of what we call 'idea talk', the variance in participation and the multifaceted role of the facilitator may help define creative collaborations and in doing so, distinguish them from other group interactional forms such as meetings, focus groups, brainstorming sessions and other collaborative contexts.

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Introduction

In doubtful and uncertain times, the role of creativity in addressing problems, affecting change and generating value is increasingly prominent. At a societal and cultural level, creativity is claimed to contribute to happiness, leads to new movements, and great works of art (Csikszentmihalyi, 1999). More recently, creativity has become a macro-economic imperative claimed as essential to national growth and competitive advantage (Banaji, Burn, & Buckingham, 2006, Bissola & Imperatori, 2011; Florida, 2012). The call for an enhanced focus on creativity in education, and for more creative approaches to socio-political structures, as well as in social justice and equality suggest that creativity is central to addressing the current and future challenges (Moran, 2010; Robinson, 2009; Schlesinger, 2007). The complexity of problems, the pace of change, and the critical need to build and sustain competitiveness associated with these uncertain times, demands a more collaborative form of creativity, that moves beyond a historical reliance on individual creativity and the lone genius, and instead involves diverse groups, networks and societies (Bissola & Imperatori, 2011; Perry-Smith, 2006).

Our work here, by focussing on the interactions among a group comprised of diverse experts from different disciplines aimed at promoting the remit of Ireland's Science Gallery¹, allows us to contribute to understanding the phenomenon of interdisciplinary collaborative creativity at a micro level.

This paper sets out the theoretical literature that addresses the performance of collaborative creativity and identifies a gap in the literature, to which this study proposes to contribute. The performance of creativity in a collective context has been identified as an underexplored and neglected area of creativity research (Glavenau: 2010, Oak: 2011, Sawyer: 2010, Sonnenberg, 2004, Steiner: 2009). The methodology used and the empirical context is then described. Preliminary findings are presented before we conclude with a discussion of possible implications of our work.

¹ Ireland's Science Gallery opened in 2008 on Dublin's Trinity College Campus and regularly hosts exhibitions and events, engaging the general public on various science-related topics and themes

Theoretical background

This research responds to calls for further research in the performance of collaborative creativity and builds on the recent work of others (Bissola & Imperatori, 2011; Glăveanu, 2011; Perry-Smith, 2006; Sawyer, 2007; Sonnenburg, 2004; Steiner, 2009).

Creativity has been extensively studied, and our understanding of the phenomenon greatly advanced in the last fifty years, significantly by the field of psychology. The psychological tradition is most concerned with the creative mind, and hence has had until more recent years an overt and exclusive focus on the individual. The emergence of more 'social-psychological' or systems perspectives have paved the way for the study of group creativity (Amabile: 1996a, 1996b, Csikszentmihalyi: 1999, Sternberg and Lubart: 1999). Such systems perspectives and approaches to the study of creativity are vital to today's literature (Glaveau:2010).

Key issues of interest in the creativity domain are captured in the four p's of creativity research (Lubart: 2001); creative person, cognitive process, creative product, and creative place. Methods of enquiry have largely, though not exclusively been scientific, quantitative and experimental, including the testing methods of psychometric analysis, meta-analysis, longitudinal studies, contingency studies, and psycho-economic. Breaking with such tradition, researchers including Csikszentmihalyi, Gardner and Gruber have progressed theories of creativity using methods of analysis including, interviews and case studies. Sawyer, a psychologist who has studied creativity in broad areas such as learning, musicology, the performing arts and human-computer interaction, has progressed a new paradigm of enquiry to the field of creativity research by using the techniques of interaction analysis. His deviation from traditional psychological methods of enquiry was based on his study of group creativity and his early realisation that the psychology of the individual mind could not explain group creativity (Sawyer: 2007).

In more recent times, the performance of creativity in a collective context more generally, has been identified as an underexplored and neglected area of creativity research (Bissola & Imperatori, 2011; Sawyer, 2010; Sonnenburg, 2004). Such calls for further research into the performance of group creativity has resulted in a new wave of studies and an enhanced focus in the area. Early use of the term 'performance' in the context of collaborative groups was by those studying jazz and improvisational groups, (Becker, 2000; Sawyer, 1992). The collaborative contexts explored include learning environments (Sullivan, 2011), design sessions (Oak, 2011) cross-functional organisational environments and organisational design (Perry-Smith, 2006), innovation and product development situations (Sonnenburg, 2004), and voluntary, open, or weak tie collaborations (Steiner, 2009, Perry-Smith, 2006). Performance, in this context, is a multifaceted term which may be used to describe the creative performance of individuals, the composition of the group, the prevailing rules of the collaboration, the set of objectives of the underlying project, group productivity, communication peculiarities of experts and the prevailing group climate (Steiner, 2009: 19).

Communication is accepted as a major driving force for collaborative creativity (Sonnenburg, 2004). This has inter alia led to talk and its sequential organisation being analysed to learn how it enables ideas to emerge and be developed (Oak, 2011). Collaborative talk has been the focus of some recent contributions to the field of collaborative creativity (Glăveanu, 2011). In this study, the communication upon which any collaborative performance depends is the subject of examination. This communication is primarily, though not exclusively established, constructed and sustained by talk. The communication peculiarities described by Steiner (2009), the communication system explored by Sonnenberg (2004), the complex network of talk described by Oak (2011), or the 'common representational space' illuminated by Glăveanu (2011) enhance our understanding of the performance of collaboration, or group creativity and the unique attributes of its communication. This study contributes further to our understanding of collaborative creativity by identifying and describing features of the collaborative communication upon which it exists.

The Science Gallery: analysing the context of the case

Ireland's Science Gallery, located at Trinity College Dublin, is a science centre with the unusual feature of having as its main offering temporary science-themed exhibits that emerged from the work of a diverse range of artistic and scientific experts. With a mission of igniting creativity and discovery where science and art collide (Horn, 2010), the interactions of these experts serves as a data-rich source of multi-disciplinary interactivity between individuals with a high level of domain specific skills. Often, the outcome is not pre-determined, and much like other improvisational settings such as jazz or improv theatre, the group is given an initiating topic to develop in a manner of their choosing. The following excerpt from The Science Gallery documentation, illustrates how appropriate it is as a subject of exploratory research:

We believe that innovation happens when an idea from one area collides with a different idea from another place. Bang. Sparks fly. 'Eureka' moments happen. Creativity explodes out from conversations and cultural encounters where there are differences. Our core proposition, our reason to exist, is to be *the* place 'where ideas meet', an electrifying environment for creative conversations between adults that begin on topics around science and emerging technologies and then really take off (Science Gallery, 2010).

Science Gallery Collaborations

The Science Gallery regularly plan and facilitate interdisciplinary encounters, or collaborations that are in part structured but also relatively unconstrained in that the outcome is not pre-determined. There are primarily two types of collaborative encounter, which have been captured as part of this data source. There are collaborations, which consist of a voluntary group of multi-disciplinary experts, invited to act as a special task force with an assigned focus. Such collaborations are called 'table talk' sessions and are typically about two hours in duration. They are one-off encounters with a specific focus and intent.

The Science Gallery also has a more structured collaborative group called the Leonardo group, who operate as a counsel, providing stewardship and advice to the Science Gallery operational team. The group is structured by membership process; there is a formal invitation issued to prospective Leonardos who must formally accept, in order to join the ranks and attain the status of Leonardo and the accompanying membership pin. The group meets four times a year as part of the Science Gallery management system, and additionally in other forums where a situation or opportunity requires Leonardo input or approval. The data examined in this paper derives from a Leonardo session.

All Science Gallery collaborations are carefully considered and planned, providing a structure and formality to the proceedings, as well as establishing a degree of informality conducive to a more democratic style of participation, than traditional meetings for example. As experts arrive to a formally scheduled collaborative session, they sign in at a registration desk and are invited to share in refreshments. The collaborations are structured in that there is a formal introduction and opening to the session, there is a semi-structured agenda, set times for breaks and a formal closing of the session. Each event is opened, usually with a fifteen-minute presentation providing information and context for the collaborative session. Throughout this fifteen-minute period, people openly ask questions, make suggestions, raise issues, and add further thoughts. Introductions are invited and each expert states their name, their field of expertise and sometimes their interest in the Science Gallery.

Sessions typically break into smaller groups after the initial fifteen minutes and much like the setup for a classic brainstorm the objectives are stated and proposed methodology explained. Each group at a table explores and discusses the table's assigned theme for ten minutes and then rotates to a differently themed table. The Science Gallery assign a staff member to each table, each with a flipchart and marker, playing the role of scribe and discussion facilitator. Unlike a focus group facilitator, the Science Gallery facilitator acts as a participant as well as a facilitator. As the large group rotates between tables, themes and facilitators remain constant, and each new group arriving at a themed table, receives a summary of the previous groups

discussion by the facilitator, so that they may build on what has come before. In this way, the sessions are both highly structured, but also fluid in that the outcome is not clear from the outset, and how the group orientate themselves to the task as well as how they participate and interact is determined by the experts.

Science Gallery group composition

The Leonardo group consists of up to fifty thought leaders drawn from science, the arts, technology, business and the media who feed program ideas into the Science Gallery. Both it and other creative collaborations instigated by the Science Gallery consist of individuals selected by the Science Gallery on the basis of expertise, either in academia or as practitioners. An interdisciplinary collection of individuals is appropriate to the diversity of thought demanded by comingling of the sciences and the arts, in the broadest sense. Interdisciplinarity is important for creative collaboration. Creativity, is is thought to be both enabled and enhanced, by fusing ideas from multiple disciplines. Weisberg (1999) insisted that one must go beyond the bounds of one's own knowledge in order to produce true advances. History provides many examples of how interdisciplinary interaction has forced breakthroughs such as the discovery of DNA, the cracking of the Enigma code, and the invention of the mountain bike. The voluntary nature of the Leonardo group ensures an open-ness in terms of collaborative disposition. Rhoten (2009) identifies such interdisciplinary disposition, or a willingness to participate discursively with others as a pre-requisite for collaboration. This voluntary nature of SG collaborations, combined with the diversity of expert disciplinary knowledge combine to make it a unique encounter. A further distinguishing feature of the group composition is skill and expertise level of the experts, such 'mastery' is conducive to creativity (Gardner, 1993).

In summary, the group composition of Science Gallery collaborations, is interdisciplinary, voluntary, and expert. These features set the collaborations apart from the composition of traditional organizational meetings, communities of practice, focus groups, and brainstorming.

Science Gallery physical space

Material culture, including things like tables, chairs, buildings and cities has been defined as the 'reification of human ideas in solid medium' (D'andrade, 1986, p. 22). Material culture has a role in framing how the collaborative performance evolves. Characteristically the material culture of an organization or institution constrains how people perform talk, largely due to their desire to achieve or affirm their organizational or institutional role through talk (Oak, 2011). As collaborations are typically, outside the traditional confines of a classic organizational or institutional setting, we must consider the potential role of material culture in supporting or stifling the collaborative performance. Hjorth (2005, p. 392) drawing on de Certeau and Foucault explores 'heterotopias' and describes a space and place, 'free from the order and necessities of the present', resulting in an environment conducive to imagination, creation and everyday creativity.

Everything about the physical environment of the Science Gallery is designed to celebrate the coming together of art and science. The push-button entrance, requires you to step inside an enclosed glass pod before the second doors opens to allow access. Like the laboratory style entrance, everything is part science, part art. It feels like you are witnessing and even part-taking in something highly experimental upon entering the building. There is always an exhibition on display in the gallery, the name of which is emblazoned in large graphic letters on the exterior of the modern glass building, attached to the historic stone-walls of Trinity. The round and square tables echo the elements of the Science Gallery logo in design and colour. The café menu has 'time for your daily dose' with an image of two pills written across the top. This comingling of art and science is evident everywhere. Every exhibition has a 'lab' component where members of the public can participate in an experiment or experience installations. This environment overtly promotes and celebrates the experimental, the progressive, and the challenging. In doing so, it creates an interesting venue for the performance of creative collaborations, which itself would benefit from such characteristics.

Methodology

Our research objective is to explore communication patterns evident in the interactions of experts from diverse fields as they engage in a collaborative creative performance in the empirical context of Ireland's Science gallery.

Our method of analysis draws inspiration from both Conversation Analysis (CA) and the closely related field of Interaction Analysis (IA) (Hutchby & Wooffitt, 1998; Jordan & Henderson, 2005). Drawing on CA allows us an insight into the structural nature of the collaborative process, while we draw more on IA to understand the substantive aspect of the interaction. The Sacksian approach to studying interaction and the tradition of Conversation Analysis in particular aims to describe the structures and practices of human interaction. Drawing from speech act theory, an adapted categorisation system was developed in order to analyse the structural development of the conversations. By categorising the speech acts and analyzing their frequency and positioning, Bales developed Interaction Process Analysis to provide insight into the distinct character of the group, the phases of its activity and the differentiation of its members (Bales, 1953). The Balesian sensitive coding and counting approach to the study of interaction preceded the Sacksian approach and specifically the influence of Conversation Analysis (Lehmann Willenbrock, Allen & Kauffield, 2013). The Sacksian tradition focused on the presence and organization of turn-taking in order to explain something about how speech exchange systems work. Analysing the allocation of turns, the order of turns, the size of turns, the pattern, transition and organization of turns can enlighten aspects of how interaction is established, developed and terminated (Sacks, Schegloff & Jefferson 1974, Sacks, 1992). Following this Sacksian tradition, Sinclair and Coulthard also developed a categorization system that enabled the identification of speech acts within classroom talk (1975).

Building on the works of Bales (1953) and later Sinclair and Coulthard (1975), a further evolved coding scheme has been developed, Act4teams, which describes four facets of verbal meeting behavior: procedural behaviors, problem-focused behaviors, action-oriented behaviors, and socioemotional behaviors (Lehmann Willenbrock,

Allen & Kauffield, 2013). This Act4teams categorisation system has informed the development of an adapted version for the purposes of this study. An adaptation of this problem solving categorisation system was required to allow for the particular aspects of collaborative creativity, which involve such activities as idea generation, re-imagining, creating and future projection component. The adapted categorisation system, which was developed iteratively during analysis, captures the structural work that creates, sustains and terminates sequences of interaction as well as the substantive emergent and creative work of the group.

Data Collected

Appendix 1 details the broader data collected in the Science Gallery under the headings; date of encounter, description of encounter, observational data collected (audio & video), collected materials and other data gathered. Two key collaborative sessions, Human Plus Table Talk plus the Leonardo meeting provided the sample for the recorded data collection. In total, 363 minutes of audio footage and 132 minutes of video footage was captured. Appendices 2 and 3 provide a more detailed breakdown and description of the recorded data for the Human Plus Table Talk collaboration and the Leonardo collaboration.

Leonardo Group Collaboration

The Leonardo gathering from which this data was gathered was scheduled between 2PM and 4PM mid-week and circa twenty-five experts attended the session. Copies of the minutes from the previous meeting were left on each table, along with collateral material from a recent exhibition in the Science Gallery. The first fifty minutes of the session were led by the Science Gallery Director. In town hall style, he provided an update on current progress and issues of note in relation to the Science Gallery. Throughout this fifty-minute period, people openly asked questions, made suggestions, raised issues, and added further thoughts, thus the session was interactive in nature. After a ten-minute coffee-break, a brainstorming-type session called ‘table talk’ was initiated. In this part of the session, there were four themed tables, each with five or six experts who were asked to help address a particular issue or area of opportunity for twenty minutes before rotating three times. Each table had a flipchart

with markers, an assigned theme and a Science Gallery staff member to facilitate and capture ideas on the flipchart. At the end of the session, everyone was thanked and the notes from the Leonardo 'Table Talk' session were subsequently circulated to all experts.

The initial fifty-minute interactive session led by the Science Gallery Director was captured with both audio and video footage. It is from this initial fifty minutes that we have extracted the two abstracts examined in this paper. Each of the four themed tables in the subsequent 'table talk' session had a voice recorder capturing sixty minutes of brainstorming activity at each table. Each sixty-minute piece of audio captures three groups, brainstorming that particular table's theme, for twenty minutes each. A further ten minutes of video footage captured the dynamic occurring at each of the tables at various intervals throughout the session. The follow-up notes from the table talk section were circulated in word format and have been captured as a key document.

Analysis

The data was loosely transcribed using basic CA principles. Sequences were identified by observable opening and closing statements. Within each sequence, the pattern of interaction between the facilitator and experts was diagrammatically illustrated. Sequences with two or more experts were considered 'interactive', and any sequences that were monologues were eliminated from further analysis. Treating the data in this way allowed for the micro analysis of the features of talk within each interactive sequence. The first two interactive sequences were selected from the Leonardo group data for initial analysis. They are presented and discussed as extract A and extract B in this paper. In order to describe what was happening in these sequences, an adapted categorisation system, was developed and applied across the sequences (See Fig 1).

Fig 1. Adapted categorisation

Question*	Questions about opinion , content, experience
Reply**	Realised by a statement, question or moodless item and non-verbal surrogates such as a nod. The function is to provide a linguistic response, which is appropriate to the elicitation
Providing Support*	Positioning, establishing experience, knowledge or know-how that informs their contribution
Task distribution*	delegating tasks during discussion
Defining the objective*	Vision, description of requirements
Clarifying*	Ensuring that contributions are to the point
Giving feedback*	Whether something is new or already known
Comment**	Realised by a statement or tag question. Its function is to exemplify, expand, justify or provide additional information
Procedural suggestion*	Suggestions for further procedure
Pragmatic idea	An idea with an associated action

Pragmatic development	A statement in response to a pragmatic suggestion, or projection that suggests a related, alternative or an additional pragmatic suggestion
Conceptual Idea	A statement suggesting a topic or a conceptual area
Conceptual Development	A statement that elaborates on or further explains the topic suggestion that has come before
C triggered pragmatic idea	A pragmatic suggestion in response to a conceptual statement
P triggered conceptual idea	A conceptual idea in response to a pragmatic suggestion

*Act4Teams, Willenbrock, Allen & Kaufeld (2013) ** Sinclair and Coulthard (1975)

The adapted categorisation system was created to aid the description of the type of talk, which occurs in this context. It seemed that the presence of pragmatic and conceptual ideas was a defining feature of the genre. We call this type of talk, typical of creative collaborations ‘idea talk’. Idea talk is thus defined by the presence of conceptual or pragmatic ideas in interaction.

Extract A: Leonardo Sequence

As previously outlined, Leonardo sessions occur about four times a year and typically have twenty five to thirty experts. The voluntary multi-disciplinary members of this advisory council are initially updated in a townhall type manner. Subsequently, they are organised into smaller groups and invited to collaboratively discuss an assigned theme. Abstract A occurs 30 minutes into the initial, more structured part of the session (See Fig 2). The sequence is initiated when an expert (a Leonardo), Pat, asks a probing question in relation to academic research that is going on in the Science Gallery (turn 1).

Fig 2. Leonardo Abstract A

Turn No.	Leonardo Sequence 2	Nature of Contribution (Pragmatic / Conceptual)
1	Pat: What are you doing with these publications?	Question

1.1	Pat: Are you exploring them in some way?	Question
2	Tom (F): So the fact that there are serious publications coming out that would be key to celebrate and promote.	Conceptual idea
2.1	Tom (F): So far, we haven't done a huge amount	Response
2.2	Tom (F): What would you propose?	Question
3	Pat: I don't know but you should promote that there's science going on in SG	Conceptual idea
4	Tom (F): That story in itself is an interesting story I suppose. ...	Providing support*
4.1	Tom (F): Maybe it deserves its own sort of you know, press release, or publication or...	Pragmatic idea
5	Pat: I just thought I'd mention because we've had some problems (with research) in the past	Positioning
6	Tom (F): We'd be keen to gather these stories.	Pragmatic idea
6.1	Tom (F): If Adam,, Fiona and Alison and anyone else involved in the labs could (nods)...(do so)	Task distribution*
7	John: So maybe you could ask the academics...to write a paper for the layman as well.	Pragmatic idea
8	Tom (F): Yes, and maybe with the scientists involved as well	Pragmatic development
9	Sam: That's something that should be on the website	Pragmatic development
10	Tom (F): Yes	Providing support*
11	John: Put the original paper and the explanation paper together	Pragmatic idea
12	Sam: Pat is right...the notion that actual new research papers are coming out of what is happening here is really quite startling	Providing support*
13	Tom (F):..Perhaps a more focused strategy on labs in the gallery	Conceptual idea (2)
14	Sam: Lets have a lab in every exhibition	Pragmatic idea

15	Tom (F): Which is kind of the direction we are going in.	Giving feedback*
15.1	Tom (F): Any other comments or shall we kick on	Procedural suggestion

Abstract A Discussion

Abstract A was the first time since the opening of the Leonardo session by the facilitator, that any expert, had raised a question or contributed in any way. This is significant in that it paved the way for the development of the session. It set the tone and the accepted rules of engagement.

In response to the question from Pat (turn 1), the facilitator Tom shifted into dual role capacity, whereby he was both facilitator, encouraging and moving the conversation on, and participating expert, contributing conceptual and pragmatic ideas. In facilitator mode, Tom was inviting of participation ‘what would you propose’ (turn 2.2) and was encouraging of the topic ‘That story in itself is an interesting story I suppose (turn 4). This facilitator role was critical in the development of the sequence because he firstly captured the conceptual idea and was the first to contribute a pragmatic idea. Although Pat initiated the sequence with two probing questions relation to SG research, it was in fact Tom who captured the conceptual idea around the promotion of SG research (Turn 2). Pat’s response to the question ‘what would you propose’ did not result in a pragmatic idea, but rather a clarification of the conceptual idea from Pat ‘I don’t know but you should promote that there’s science going on in SG’ (turn 3). Tom goes on to contribute two pragmatic ideas (turn 4.1), John and Sam enter the conversation by each contributing one (turn 7) and two (turns 9 and 12) pragmatic suggestions respectively. As the sequence progressed, other experts joined in.

It is interesting to look at the pattern of interaction in Abstract A. You will see in figure three below, the pattern of interaction depicted diagrammatically, where F denotes facilitator and E, denotes experts. The numbered dots illustrate turns between expert experts and the facilitator, seen above and below the line, and turns among the

experts themselves, seen as dots in a row below the line. The colour coded dots identify the individual experts.

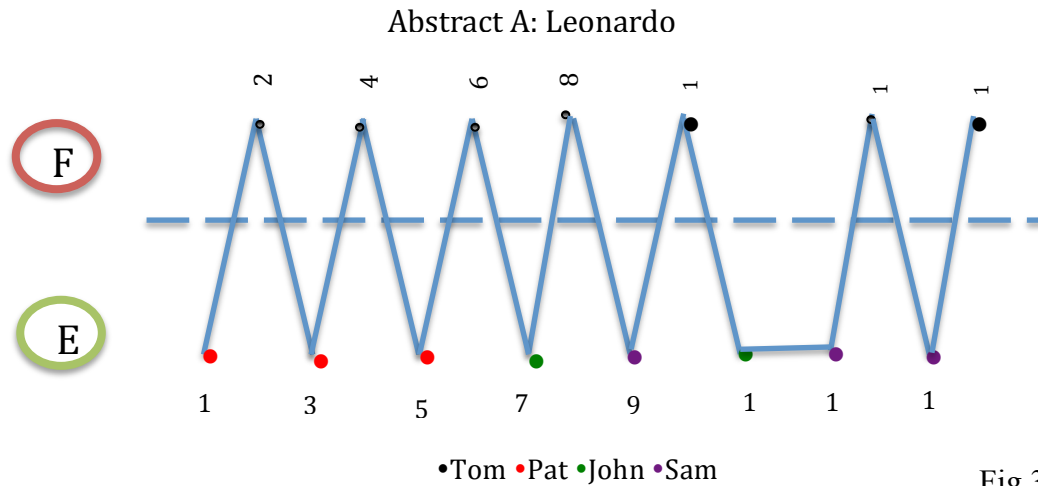


Fig 3.

The patterns illustrate instances where the interaction changed from being between facilitator and expert to being interaction between two or more experts. There was a lot of back-and-forth exchange initially between Pat and Tom in this abstract, but subsequently more experts joined the conversation, creating a change in dynamic, where more experts contribute. In abstract A, this occurs between turns 7 and 14. Looking deeper at what happened to instigate this change in the pattern of interaction and we can observe two potential triggers. Firstly we can observe that it was once the conceptual idea had evolved into the contribution of pragmatic ideas, led by Tom in turn 4.1, that the participation of further pragmatic ideas from John and Sam was initiated. Secondly, in turn 6.1 Tom asks some of the SG staff to gather the existing research stories that have been developed from the exhibition labs. This overt distribution of task illustrates to the group that there are indeed a number of stories in existence and that they will be gathered together by the assigned people. We can observe that the conversation moves from being hypothetical into being a real world activity that has just been activated by the task assignment of gathering the stories. Both observations involve the exchange between conceptual and pragmatic contributions.

Sawyer uses the term ‘emergence’ to describe how the group performance itself becomes the creative product (2003). Looking at performance, the presence of idea talk and most particularly the interplay between conceptual and pragmatic ideas is, based on our initial findings, the defining feature of the performance of collaborative creativity and is thus in itself the creative product that is achieved by group. Sawyer describes the performance as the collaborative emergence of the group (2009). Emergent phenomena are unpredictable, arising from free flowing and unstructured conversation. They are difficult to explain because they are the result of successive individual contributions. Abstract A resulted in a conceptual idea and an associated suite of pragmatic actions for the Science Gallery, which would seem to be a positive outcome in relation to the group remit. The interest of this study is in the interactive form of collaborative emergence rather than the outcome of the groups productivity for the Science Gallery.

Abstract B: Leonardo session

Turn	Leonardo Session	Categorisation
1	Tom (F): We now have a way that external people can submit ideas for the Science Gallery.....	Topic initiation
1.1	just wanted to test this idea with you....	Defining the objective*
1.2	we’ve launched it quite recently....we’ve just had two submissions of ideas	
2	Mary: Is it prominent on the homepage?	Question
3	Tom (F) It’s not hugely prominent yet, but people are pretty clever at finding stuff....	Response
3.1	Tom (F) The question is, we would like the Leonardo’s to have a role in kind of looking at these ideas and seeing which ideas might be good for the Science Gallery.....	Defining the objective*
3.2	Tom (F)What we were going to suggest was that we would take sort of a first cut, that we would take a small number of ones that we think have, you strong potential and bring those to the group. Does	Question

	that make sense as kind of an approach?	
4	Eric: Just a suggestion. I've done innovation stuff before. What you might do, or what we've done before is kind of create a YouTube for ideas you like, where people look at the ideas, like whether they be students or people who submitted the ideas	Pragmatic idea
5	Tom (F) Crowdsourcing team. Sort of thumbs up?	Conceptual Clarifying*
6	Eric: Crowdsourcing and thumbs up type approach and it takes....particularly if you've got a massive volume then what it does is it takes away the overhead from you to have to view all of these.	elaboration
7 7.1	Tom (F) You can create a kind of funnel that you could manage them Tom (F) From the teams point of view, we'd be keen to look at for example how practical this is	Summarizing
8	Eric yeah	Providing support*
9	Tom (F)Is it actually something we can do.....certainly looking at becoming, using an element of crowd comment	question
10	Mary A little practical thing that might help. It reminded me of when we do paper reviews for a conference, we get a lot of papers.....there are web systems in place which could be adapted or used as they are where you can vote on which one you'd like to comment on.	Pragmatic idea
11	Tom (F) So for external reviews?	question
12	Mary: yeah its just for external reviewers. It's a system of managing it	response
13	Tom (F) That's a good suggestion. I mean there might be one Leonardo that's very, who knows one particular area very well	Providing support* elaboration
14	Mary Because I think if these things aren't structured, they don't happen	elaboration
15	Tom (F) We have a structured submissions process but....we'd like to be able to say to people we have a process twice a year...and	elaboration

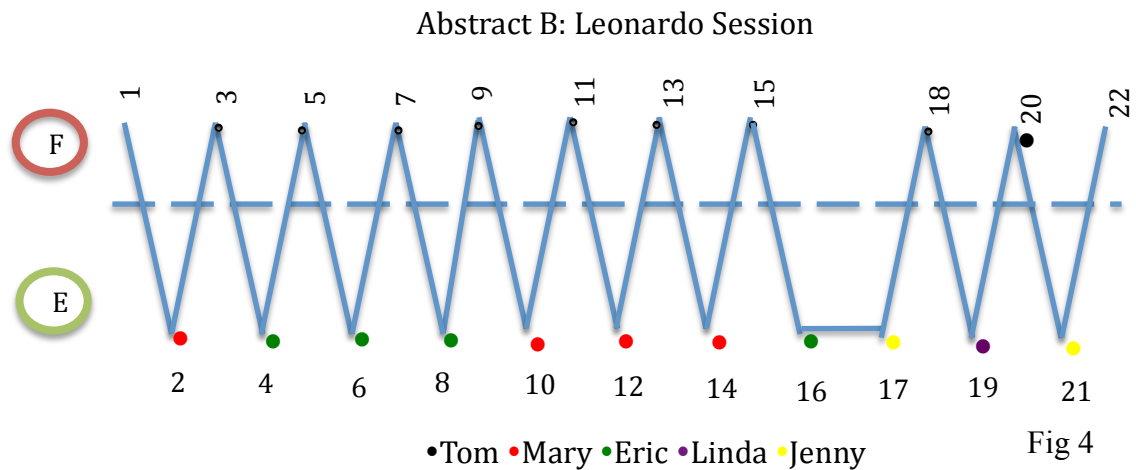
15.1	<p>following the Leonardo meeting or whatever we will revert to you</p> <p>Tom (F) We'd like to have sort of a clear response rather than people sort of getting annoyed as they submit an idea that they may be very attached to and that we maybe haven't had the chane to evaluate properly.</p>	
15.2	<p>Tom (F)I think the idea of maybe considering how we could get help reviewing them is a good idea...also in terms of crowdsourcing the ideas, we need to also be careful in case that people kind of feel that maybe they don't want the world looking at their idea. So we just need to watch that one as well</p>	
16	<p>Eric: one thing we found as well was that people vote very quickly without really thinking about it but if you force them to comment, you really see if the idea is interesting to people. You are required to sit down and write a sentence or two comment on the idea</p>	Pragmatic idea
17	<p>Jenny: I'd just suggest that on the web submission just to keep it as lightweight as you can. You can always go back to people for more detail so if you had a word restriction 200 words or something</p>	Pragmatic idea
18	<p>Tom (F) Cool. Ok thanks. Could you just capture these notes?</p>	question
19	<p>Linda: I am</p>	response
20	<p>Tom (F) Oh you are, ok sorry</p>	
21	<p>Jenny: Because sometimes people submit essays. And you don't want people submitting essays</p>	elaboration
22	<p>Tom (F) Yah ok</p> <p>Well have a look. If you get a chance at the forum as well and any suggestions would be great</p>	Procedural suggestion

Abstract B discussion

Abstract B occurs fifty six minutes into the Leonardo session. Initiated by Tom, the session facilitator, the sequence is six minutes in duration. Looking diagrammatically

at the pattern of interaction in Abstract B illustrates that there was multi expert interaction throughout the sequence (see fig 4). A change in the dynamic and pattern of interaction occurs between turns 14 and 19, involving four experts and Tom, the facilitator.

Figure 4



This sequence is complex to analyse because there was a lack of clarity, or perhaps even mis-statement of the objective from the outset. The consequence is a somewhat meandering conversation with multiple attempts by Tom to clarify what is being asked of the group.

Initiating the sequence, Tom informs the group that there is a new idea capture feature on the SG website (turn 1.1) and that they (the SG) want to ‘test’ the idea with the Leonardo group (turn 1.2). He also informs the group that there have been two submissions so far on the new idea capture system (turn 1.3). The broadly stated objective of ‘testing’ the idea capture system is open to interpretation from the group. In response to the information that there had only been two submissions to the idea capture system, Mary queries whether the idea capture system is prominently displayed on the website (turn 2). In turn 3.1 Tom presents a different objective than the original ‘testing’ objective. This new objective is more specific and direct. ‘The question is, we would like the Leonardo’s to have a role in kind of looking at these ideas and seeing which ideas might be good for the Science Gallery’. This is new

information for the group and focuses the task, on the idea evaluation component of the new online idea capture system. Subsequent contributions are suggestions relating to the idea evaluation element of the idea capture system. Based on his past experience of idea capture systems, Eric suggests including a feature where people can vote on ideas (turn 4). Tom responds by identifying Eric's suggestion as applying the concept of crowdsourcing to the idea evaluation system (turn 5). A number of pragmatic suggestions, relating to the crowdsourcing concept were subsequently contributed. Mary, referring to her own experience with conference paper evaluation, suggests that the web systems that are used to review conference papers might be useful for the Science Gallery (turn 10). Eric suggests that people must comment as well as vote in order to participate. Jenny suggests there should be a word limit on ideas submitted to the idea capture system, as based on her experience 'people sometimes submit essays'. The ideas are all pragmatic and relating to enhancing the features of the idea evaluation element of the online idea capture system that has been put in place.

In turn 15 and 15.2 Tom elaborates on the reason for the desired direct participation from Leonardos in idea evaluation. He says the SG would like to respond to crowdsourced ideas, informing people that ideas are reviewed twice a year following Leonardo group evaluation. He even makes a proposal on how it might work should the Leonardo's be amenable to playing a role in evaluating ideas (turn 15). He suggests that the internal SG team review and filter the broad list of crowdsourced ideas twice a year and bring a short list to the Leonardos for their review. He never gets a straight answer to this request.

The statement of the initial task in turn 1.1 (testing the idea) set the context for the discussion. Despite two attempts (turn 3.1 and turn 15) to redefine the objective (asking Leonardos for help in evaluating ideas submitted online), the group took it upon themselves to contribute ideas based on their experiences with similar idea capture systems. Clarity in task definition from the outset would appear to be a critical predetermining factor in the successful development of idea talk.

Although not the defined objective for the group, the idea talk resulted in pragmatic ideas for enhancing the idea capture system. More specifically, the pragmatic ideas were linked to the concept of crowdsourcing the idea evaluation component. These ideas included a way of enhancing crowdsourced contribution (vote and comment), a structure that might enable selective review (derived from conference review web systems), and a word limit to keep the ideas concise and manageable for easy review.

Tentative findings and contributions

Finding 1: Idea Talk in creative collaborations

In exploring data from the Science Gallery interactions it seemed that the content of some collaborative creative performances were of a particular type. We have called this type of talk, idea talk and it is defined by the presence of pragmatic or conceptual ideas in interaction. By a pragmatic contribution we mean a suggestion, that can be understood without specialist knowledge, which is tangible in that it refers to a particular activity, phenomenon, or thing that can be advanced, adapted, acted upon, or progressed in some way. In contrast, a conceptual contribution is grounded in theory and requires a knowledge and understanding implied of that theory. Unlike pragmatic contributions, they are not associated with any particular action, but are rather a theoretical proposal or hypothesis from which pragmatic contributions may or may not be subsequently derived. It is possible to have sequences with conceptual ideas or pragmatic ideas, however it seems that the rich interactions are characterised by an interplay, between ‘pragmatic’ and ‘conceptual’ contributions, as initially interpreted by the researcher.

In Abstract A, the conceptual contribution involved was the promotion of the Science Gallery and subsequently, a range of pragmatic ways to initiate and realise the concept were suggested, such as the gathering of stories, the writing of press releases, placing the stories on the web, and writing a layman’s version of the research. In Abstract B, the conceptual contribution concerned, crowdsourcing and idea evaluation. There also were a number of pragmatic contributions on how the Science Gallery might utilise crowdsourcing, that arose in the interaction of the group. These pragmatic suggestions included potentially adapting conference paper review web systems, asking people to comment as well as vote in the idea evaluation process, and keeping wordcount on ideas submitted to a minimum.

These two abstracts were selected for analysis as they were the first two sequences of interaction in the Leonardo data. It is interesting to note that the abstracts are both

derived from the town-hall style portion of the meeting, the objective of which was more about sharing information than it was about idea generation. Having iteratively developed and applied a categorisation system to the abstracts, we have described what is happening in these abstracts and identified the presence of conceptual and pragmatic ideas as defining features of the communication system established in creative collaboration and further identified the interplay between conceptual and pragmatic as the richest form of idea talk.

Finding 2: Participation level variance

The creative performances observed in the sequences analysed of diverse experts about future Science Gallery activities involved a variance, not equality, in participation levels by individual experts. Dynamic is recognised as an important feature of collaboration (Nonaka, 1994). This research suggests, in line with previous research, that the performance of a multi-disciplinary group is positively influenced by dynamic. Looking at the pattern of interaction, the dynamic can involve a lot of direct exchange between the facilitator and one expert at a time, or the dynamic can involve inter-expert exchange or combinations of the above. The point is that dynamic changes throughout. Participation levels do not remain constant.

In abstract A, Pat initiates the sequence with a question relating to Science gallery research. In turn 5, he explains the reason for his question 'I just thought I'd mention because we've had some problems (with research) in the past'. In doing so, he positions himself as having experience with research or having particular expertise in relation to the area. The sequence would not exist without his probing question, thus his participation was not equal to others. His contribution carried weight. This is evidenced when Sam says 'Pat is right...the notion that actual new research papers are coming out of what is happening here is really quite startling' (turn 12). He did not contribute any pragmatic ideas himself, however his question was influential in capturing the concept of 'promoting' the Science Gallery research. The conversation evolved to include other experts and a number of pragmatic ideas emerged. It is not to

say who's contribution was more important, but rather to highlight that they are not equal.

In abstract B, Eric positions himself in turn 4 as having experience with the subject matter of idea evaluation where he says 'Just a suggestion. I've done innovation stuff before. What you might do, or what we've done before is..' His idea about using YouTube precedes turn 5, where Tom expressly captures the concept of crowdsourcing as being what Eric is talking about. The exchange between Tom and Eric is influential in that it focusses the group on the techniques of crowdsourcing. Mary and Jenny also refer to their own experiences in their subsequent contributions. Mary's experience is not with innovation like Eric, but rather with conference paper review systems. Like in Abstract A, it is not to judge whose contribution was more important or indeed more influential, but rather to highlight that they are not equal.

Finding 3: Role of the facilitator

The importance and influence of the facilitator in establishing, sustaining and developing the communication of the collaborative group is critical for us to consider. Some of the observable skills of the facilitator include the ability to clarify the task, to seamlessly transition between the dual roles of facilitator and active participant, the ability to actively listen to, interpret, simplify where appropriate, and summarise succinctly the contributions of others. We have previously discussed the impact of a lack of clarity in task description in abstract B. This lack of clarity had an impact on the entire group discussion. We can see evidence of the seamless transition between the dual roles clearly in abstract A. Tom the facilitator moved into participating expert role when he derived and expressed the conceptual idea for the group (promoting SG research) from Pat's question relating to research. In more traditional facilitator style, he poses a question back to Pat 'what would you propose' (turn 2.2). Tom again moves back into expert mode when he contributes two pragmatic ideas (turn 4.1). There is evidence throughout abstracts A and B of occasions where the facilitator, regardless of which role he is in, skillfully simplifies and summarises his own ideas and the ideas of others.

The data illustrates that the role of the facilitator can have a positive influence on developing idea talk within the group context and indeed where it can have a less than positive influence when it fails in some of its critical roles, such as clarifying the task.

Conclusion

Our 'Idea talk' observation echoes previous work on the exchanges that occur between complementary or contrasting techniques such the cognitive exchange between divergent and convergent thinking, recognised as critical to the cognitive creative process (Guilford: 1950, Lubart: 2001); a writers' navigation between spheres of experience, such as a fictional sphere, the written work, and a revising mode (Doyle, 1998); the series of quick interactions between productive and critical modes of thinking in art (Israeli, 1981), the dynamic interplay between moments of active sketching and moments of contemplation in the drawing process (Goldschmidt, 1991); and the exchange between seriousness and play in classroom learning, identified as optimal to the learning environment (Sullivan 2011). The freshness of our contribution lies in detailing the nature of this interplay in the performance of creative collaboration among experts of diverse domains.

The variance in participation level finding questions the ubiquity of the equal participation doctrine as set out by the brainstorming literature (Osborn, 1979) and highlighted in recent studies of creative collaboration (Sawyer: 2007, Sonnenberg, 2004, Steiner: 2009). Sawyer (2007:140) describes equal participation as no one being in charge and no one creating more than anyone else. Equal participation is conceivably achievable and beneficial within a homogenous group of musicians, scientists, actors, or engineers, all working on a single task or multiple tasks, demanding reliance on their core area of expertise. In improvisational theatre and jazz for example, all experts share a common factor in that they are all performers, professional or otherwise. In such scenarios equal participation is essential to the

dynamic and the creative performance (Sawyer: 2003, 2006a). The issue is more complex when there is a heterogeneous group of multi-disciplinary experts who are discussing issues that are not pre-determined and can vary between any number of disciplines and areas of expertise. In such multi-disciplinary groups, with no such commonality, equal participation is neither possible nor desirable as expert contribution levels are dependent on subject matter. A designer's contribution to a scientific problem may be critical but is unlikely to be equal, either in depth or quantity of contribution, to that of the scientist. The designer's contribution may be valuable nonredundant information that contributes to the overall performance, however the scientist's contribution will derive from a depth of domain relevant knowledge, aiding not only the ability to share domain specific knowledge with the group, but to also assess ideas presented within the group as valuable or with potential to the specialised subject matter. It is not to suggest that one is more important than the other, rather that the interplay between the two does not represent an equality of participation. This fluidity of participation levels is optimal, where an 'expert' can step forward and subsequently regress as the topic evolves in the collaborative model. The context created within creative collaborations establishes an environment, whereby the contribution of non-experts is invited and valued. This characteristic of creative collaboration separates such instances from the prevailing rules of brainstorming and accepted principle of collaboration, whereby equal levels of participation are desired and all contributions are treated equally, irrespective of group make-up (Sonnenberg: 2004, Sawyer: 2007, Steiner: 2009).

Facilitating interdisciplinary collaborative creativity requires flexibility to move between roles of facilitator and expert. To structurally facilitate, encourage and move the conversation on in traditional facilitator style, but also critically to contribute in the form of capturing expressly the ideas of others, contributing ideas and summarising and simplifying where complexity emerges. In this way, the communication skills of the facilitator are critical in establishing, sustaining and developing the communication of the collaborative group.

These findings further our understanding of how the performance of group creativity is established, sustained, developed and terminated by communication. In

particular, it highlights a style of communication, which we call idea talk and which we define as the presence of pragmatic and conceptual ideas within the talk. The richest form of idea talk involves interplay between pragmatic and conceptual ideas which creates a peak moment of interaction. The variance in participation levels as well as the complex and highly skilled role of the facilitator separate collaborative creativity from other group forms, such as brainstorming, meetings, and town hall sessions. In doing so, they also further enhance our understanding of the contextual features particular to collaborative creativity.

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Appendices

Appendix 1: Data Gathered in the Science Gallery 2010-2011

Encounter	May 7 th , 2010: Meeting with SG Coordinator	5 th Aug, 2010: Meeting with SG Coordinator	18 th Jan, 2011: Interactive Meeting	Mar 15 th , 2011: Meeting with SG Coordinator	April 19 th , 2011 Interactive Meeting of Leonardo group
Description:	One hour meeting where Lynn presented the process and sequence of collaborative initiatives by which the Science Gallery generates and progresses	One hour meeting discussion access and permission as well as upcoming events, suitable next steps.	'Table Talk' session hosted by the Science Gallery with about thirty invited experts. A well-structured brainstorming-style event, where the multidisciplinary group of experts were invited to discuss and think about ideas for installations for inclusion in the next Science Gallery.	Discussion of upcoming Leonardo event and granting of access to record etc.	Meeting of 15- 20 members of the Leonardo group to discuss progress to date and to brainstorm 4 key areas.
Observational Data Gathered (Audio and Video	None	None	1 hr 52 mins of audio recordings 1 hr 43 mins video recordings Fully transcribed	None	166 mins of audio footage and 47 minutes of video footage was captured. 50 mins intro transcribed to date
Detail of documents, collateral gathered	Annual report 2009, Speech notes for international presentation	None	Branded notebook, follow up meeting notes document, powerpoint presentation,	Annual report 2010, branded science gallery story film	Minutes of previous meeting, follow up notes document
Details of other data	Photographs, SG menu, detailed fieldnotes	Photographs, exhibition collateral, fieldnotes	Photographs, collateral, detailed fieldnotes	Photographs, exhibition collateral, detailed fieldnotes	Photographs, badges, exhibition collateral, detailed fieldnotes

Appendix 2: Details of Data Captured from Table Talk - 18/1/11

In total, 112 mins of audio footage and 103 minutes of video footage was captured. The following details the composition of the recorded data.

Observational data collected for two key Collaborations

The two key collaborations attended were the Human Plus Brainstorm and the Leonardo group meeting.

Human Plus Brainstorm
<u>Audio (Total: 73 Mins):</u> <ul style="list-style-type: none">• 15 mins Audio: intro, context and set up by SG Director• 10 mins Audio: Sub-group* 1 discussing assigned topic• 10 mins Audio: Sub-group 2 discussing assigned topic• 10 mins Audio: Sub-group 3 discussing assigned topic• 10 mins Audio: Sub-group 4 discussing assigned topic• 18 mins Audio: SG table leads reporting back the key ideas emerging from each themed table.
<u>Video (Total: 72 Mins):</u> <ul style="list-style-type: none">• 15 mins Video: intro, context and set up by SG Director• 57 Mins wide-frame footage of multiple sub-groups interacting (mostly inaudible due to high volume)
Each sub-group consisted of 6 to 8 people lead by a SG facilitator
Leonardo Meeting
<u>Audio (Total: 290 Mins):</u> <ul style="list-style-type: none">• 50 mins Audio: intro and context by SG Director & interactive group discussion• 60 Mins Audio: Sub-group* 1 discussing three topics for 20 mins each• 60 Mins Audio: Sub-group 2 discussing three topics for 20 mins each• 60 Mins Audio: Sub-group 3 discussing three topics for 20 mins each• 60 Mins Audio: Sub-group 4 discussing three topics for 20 mins each
<u>Video (Total: 60 Mins):</u> <ul style="list-style-type: none">• 50 mins Video: Introduction, context and background presentation.• 10 Mins Video: capturing setting and wide-frame group behaviour (inaudible due to noise level)
* Each subgroup consisted of 4 to 5 experts led by a SG facilitator

Table 1.2 Detail of Key Observational Data collected

Appendix 3: Details of Data Captured from Leonardo session - 19/4/11

In total, 165 mins, 46 seconds of audio footage and 47 minutes and 20 seconds of video footage was captured. The following details the composition of the recorded data.

1. Introduction Section

Audio 1 folder / WS750005intro.MP3

Lead – Michael John Gorman / Director

Intro 24:45 to 1:12:05 – good quality (47 mins, 20 secs) – Audio

Intro 24:45 to 1:12:05 – good quality (47 mins, 20 secs) – Video

Content overview: Welcome and introduction from SG Director. Overview of what has been happening in the Science Gallery in recent months as well as forthcoming activity. Experts interject with questions, suggestions and discussion items throughout. Issues, opportunities and actions are discussed as they arise and actions captured by SG facilitators.

2. 'HACK THE CITY' TABLE (theme 1)

Audio 2 folder / WS750006.MP3

Facilitator – Michael John Gorman / Director

Group 1: 5:00 to 18:20 – reasonable quality audio (13 mins, 20 secs)

Group 2: 19:26 to 32 – reasonable quality audio (12 mins, 34 secs)

Group 3: 33:00 to 46:28 – OK audio, partially inaudible (13 mins, 28 secs)

Content Overview: Facilitated discussion around the assigned theme, whereby the facilitator initiates the discussion and captures notes on a flipchart. After the first group complete their discussion, they leave the table and a new group arrives. A summary is given to the subsequent group who arrive at the table by the facilitator and they build on the discussion. This is repeated for a third group who arrive at the table to contribute to the discussion, when the second group moves on.

3. 'SHOP' TABLE (theme 2)

Audio 3 folder/ VN680006shop.WMA

Facilitator – Robert Kiernan / Head of Retail

Group 1: 3:00 to 18:30 – inaudible audio (15 mins, 30 secs)

Group 2: 19:00 – 32:20 - OK audio (13 mins, 20 secs)

Group 3: 33:30 to 44:15 - good quality audio (10 mins, 45 secs)

Content Overview: Facilitated discussion around the assigned theme, whereby the facilitator initiates the discussion and captures notes on a flipchart. After the first group complete their discussion, they leave the table and a new group arrives. A summary is given to the subsequent group who arrive at the table by the facilitator and they build on the discussion. This is repeated for a third group who arrive at the table to contribute to the discussion, when the second group moves on.

4. 'RISK' TABLE (theme 3)

Audio 4 folder / VN680002Lynn.WMA

Facilitator – Lynn / Education and Outreach Manager

Group 1: 5:06 to – 17:30 OK quality, partially inaudible (12 mins, 24 secs)

Group 2: 18:36 to 31: 16 – good quality audio(12 mins, 40 secs)

Group 3: 32:24 to 46:00 - good quality audio (13 mins, 36 secs)

Content Overview: Facilitated discussion around the assigned theme, whereby the facilitator initiates the discussion and captures notes on a flipchart. After the first group complete their discussion, they leave the table and a new group arrives. A summary is given to the subsequent group who arrive at the table by the facilitator and they build on the discussion. This is repeated for a third group who arrive at the table to contribute to the discussion, when the second group moves on.

5. 'FOOD' TABLE (theme 4)

Audio 5 folder / VN680007.WMA

Facilitator - Rob / exhibitions manager

Group 1: 5: 50 to 17:20 – excellent quality audio (11 mins, 30 secs)

Group 2: 19:00 to - 31:00 ok quality, partially inaudible (12 mins)

Group 3: 31: 39 to 45:46 – good quality audio (14 mins, 7 secs)

Content Overview: Facilitated discussion around the assigned theme, whereby the facilitator initiates the discussion and captures notes on a flipchart. After the first group complete their discussion, they

leave the table and a new group arrives. A summary is given to the subsequent group who arrive at the table by the facilitator and they build on the discussion. This is repeated for a third group who arrive at the table to contribute to the discussion, when the second group moves on.