



Ontario Science Centre DuPont Canada

Collaborating and Innovating

Agents of Change is a \$40 million initiative that will transform more than 25% of the Ontario Science Centre's public spaces over a three-year period. This will involve renewing key exhibit spaces, creating new approaches to visitor experiences, deepening and extending partnerships province-wide, and making significant architectural improvements to the science centre's building. Seven major new areas will feature content that explores the theme "Solving 21st Century Problems." Through the compelling experiences offered in these seven new spaces, young people will be exposed to the attitudes, skills, networks and tools that will enable them to become the drivers of a sustainable culture of innovation.

(<http://www.ontariosciencecentre.ca/about/aoc/default.asp>)

A number of 'experience spaces' will provide opportunities for participants to roll up their sleeves and innovate shoulder-to-shoulder with expert mentors from corporate, academic, educational and scientific communities. One of these experience spaces, The Garage, was the venue for a research project I conducted for the Ontario Science Centre (OSC) and DuPont Canada. DuPont Canada Inc., whose business origins in Canada date to 1877, is a diversified science company. The wide range of products sold includes nylon industrial yarn, synthetic fibers, polymer resins, packaging films, automotive finishes, crop protection products, and industrial chemicals. The company sells to approximately 3,000 customers in Canada, the United States and 40 other countries. (<http://ca.dupont.com/NASApp/dupontglobal/ca/index.jsp>)

The Garage is intended to be a team-based, collaborative, rapid prototyping challenge that aims to stretch or ignite the creativity of participants. By using unexpected, physical materials and expert advice and guidance, OSC visitors will develop problem-solving skills in a collaborative setting. Challenges will be set with time and resource constraints, often based on real world problems. Participants will have access to facilitators

who will staff the Garage and other expertise.

- Project Manager
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Web image courtesy of Ontario Science Centre
(http://www.ontariosciencecentre.ca/about/aoc/area_garage.asp)



Front-End/Formative Evaluation

As described on the OSC Web site:

The *Garage* will offer a high-energy, brain-powered, design-and-build workshop where participants are presented with a "Challenge of the Day" inspired by timely global issues. The task is to stretch your ingenuity, creativity and problem-solving skills to generate ideas and engineer possible answers within an allotted time.

Visitors will collaborate in teams to build their prototypes, with access to a variety of materials, equipment and expertise. Mentors, including Ontario Science Centre staff, will guide participants towards innovative solutions. You'll push yourself to the limit while having a blast – and provide an exciting spectator sport for other visitors!

(http://www.ontariosciencecentre.ca/about/aoc/area_garage.asp)

The OSC/DuPont Research Project was a front-end/formative evaluation study of Garage experiences for a sample of OSC visitors from May through to August 2002. It was a front-end study in that it was looking at how participants created innovative products through collaboration with a small group. It was formative evaluation in that we were working with a prototype for the Garage that had been tested the summer before. During an initial pilot (summer 2001) staff in the Garage recognized that different environmental conditions influenced whether or not the participants collaborated, and whether or not they engaged in activities.

The Garage was available to OSC visitors on Sundays, Mondays, and Thursdays, and each Garage had 9 to 16 participants. Co-researchers for the Garage included Ines Habara who coordinated research activities for the OSC/DuPont Project at the OSC, and Hosts who work with visitors on the floor of the OSC. I also had a training session with Garage staff, met regularly with them to reflect on successes and challenges of Garage activities, and supervised Hosts who were assisting with the data collection in the Garage.

Overview of the OSC/DuPont Research Project

The initial **Project Concept, Objectives and Scope** were based on OSC's previous research and the Garage pilot. The OSC/DuPont team believed that **Collaborating** is **one** key element leading to the generation of **new ideas, solutions, or 'aha's**. They wanted to better understand the broader relationships amongst collaborating, collaboration, innovating, innovation, and other required elements such as creativity, problem-solving, experimenting. And they wanted to explore the field of Collaborating, and possibly, certain activities, behaviours, and skills that contribute to the generation of new ideas, solutions, and 'aha's.

Initial Definitions for the project were (see **Initial Literature Review Documents** at end of report):

- * **Collaborating:** Collaborating is the *process* of diverse individuals working together to generate new ideas/solutions/'aha's, while engaged in a number of skills, activities and behaviours such as: observing, creating, problem-solving, prototyping, experimenting, juxtaposing, and risk-taking.

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- * **Collaboration** is the *outcome*, where the results (the new ideas/solutions/'aha's) are greater than those possible by the individuals themselves (e.g., synergy).
- * **Innovating**: Innovating is the *process* of applying and implementing ideas/solutions/'aha's to solve problems and challenges.
- * **Innovation** is the *outcome*, where new or greater value has been created as a result of the application and implementation.

Christine L. DeGrow, Manager, Methodology & Consulting, Social Innovation Enterprise at DuPont Canada in 2002, proposed the following **Questions** to consider in the OSC/DuPont Research Project:

- * What are the conditions leading to Collaborating (working together)?
- * How do you reproduce these conditions?
- * What are these activities and behaviours?
- * What are the conditions leading to these activities and behaviours, and how to reproduce them?
- * What are the indicators of Collaborating that an idea or 'aha' has been generated?
- * What are the required shifts in attitude and self-perception?
- * What are the conditions leading to these shifts?
- * What are the conditions that lead to Innovating (applying/implementing)?
- * What are the indicators of Innovating?

To answer the above questions, the **Purpose** of the OSC/DuPont Research Project was to identify the processes/natures of Collaborating that generate new ideas/solutions/'aha's within a group of diverse individuals, using the OSC Innovation Project Garage experience as the venue for this pilot. The Research Team was trying to:

- * Identify the **specific and reproducible conditions** required to enable and encourage the processes/natures of Collaborating.
- * Be conscious of gathering information about **activities, behaviours, and skills that are also elements** leading to generation of new ideas/ solutions/'aha's.
- * Identify the **indicators that Collaborating** has occurred (i.e., 'better' ideas/solutions/'aha's).
- * Be conscious of gathering information about **attitudes that lead to Innovating**, or the application and implementation of the new ideas/solutions/'aha's.

The OSC/DuPont Research Team anticipated the following **Project Outcomes**:

1. Identification of different processes/ natures of 'Collaborating' and their outcomes.
2. Identification of which processes/natures of Collaborating result in the generation of new ideas/solutions/'aha's that are better than those possible by the individuals.
3. Understanding of the indicators of Collaborating.
4. Understanding of the conditions that enable the desired process/nature of Collaborating.
5. Understanding of how to reproduce these conditions 90% of the time.

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6. Information about other activities, behaviours, skills, that also contribute to generation of new ideas/solutions/'aha's.
7. Information about conditions (attitudes, self-perception, etc) that lead to 'Innovating.'
8. Learnings about how to transfer the learnings about Collaborating to other contexts.

OSC expected to apply learnings from the Research Project to reproduce collaborative processes in all relevant *Agents of Change* experiences, with the belief that this will ultimately contribute to the goal of fostering the necessary skills, behaviours and attitudes in youth to enable more innovation in society.

The following were **Potential Benefits** of the OSC/DuPont Research Project for stakeholders:

Garage Participants:

- * Participants will have experienced the benefits of 'Collaborating' to solve challenges.
- * Hopefully, they will be able to see themselves applying their learnings to other situations in their lives.

OSC:

- * Gain a clear understanding of the conditions that lead to Collaborating and Innovating that will aid the OSC in the development of the *Agents of Change* Project experiences.
- * Gain a clear understanding of the conditions that lead to Collaborating and Innovating that can be applied to OSC's internal processes, team, and products.

DuPont:

- * Gain a clear understanding of the conditions that lead to Collaborating and Innovating that might be applied in their process consulting work with external clients and partners.
- * Gain a clear understanding of the conditions that lead to Collaborating and Innovating that can be applied in DuPont (e.g., R&BD).

Research Methods

The OSC/DuPont Research Team agreed upon the following **Research Methods**:

1. **Participant Observation** during Icebreaker and Challenge activities by a Host researcher, Ines Habara, and Barbara Soren.
2. **Documentation** at each table of participants during the Challenge process.
3. **Sharing** about the process of Innovating and Collaborating.
4. **Feedback** about the Challenge with the Facilitator at the end of each Garage experience.
5. **A Written Exit Questionnaire** to gather demographic information, thoughts on future Garage experiences, and challenges participants might take on after the Garage.
6. **Written Reflections of Garage Staff** (the Facilitator and Materials Expert) on Innovating and Collaborating during the Garage experience.

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We also talked about A Garage Chatroom on the OSC Web site to continue the dialogue about the Garage experience with a larger community of participants and learn about Innovating and Collaborating outcomes over time, but it was not available during this project.

Therefore, we gathered and analyzed data about Collaborating and Innovating at each Garage using the following **multiple methods**, which were both qualitative and quantitative:

- * Researchers wrote a written report on their observations of Icebreaker and Challenge activities.
- * Documentation of each group's designs for Challenges was collected.
- * Participants' comments during the Sharing of the device they created during the Challenge, the process they had used, and Feedback sessions were recorded.
- * Notes were kept of Garage staff Debriefings following Garages (sometimes with Host participants, other people from OSC, or the DuPont Canada team), and Materials Experts wrote reflections about Garage experiences.
- * A coding sheet and excel table with all the participants' answers on the Exit Questionnaire were created and analyzed.

Constant variables included:

- * The time period – a one-hour experience and consistent use of time
- * A consistent space and layout – a room set up off the Arcade with an area to collect supplies from the Materials Expert and tables for groups
- * Abundant resources and materials
- * Norms or permissions for accessing materials and working on the Challenge
- * The same Challenge over the period of one month
- * The number of groups and people in each group
- * The number of OSC staff – a Facilitator, Materials Expert, and Host Researcher.

Sample Size Decisions:

The Research Team decided that the sample for the OSC/DuPont Research Project would include 30 case studies of unique Garage situations over a four-month period. By the end of August, 312 OSC visitors had participated in the OSC/DuPont Research Project. Of these 312, 229 participants took the time to complete an Exit Questionnaire.

The **Recommended Timing** of the 60-minute Garage Experience was:

<p>Icebreaker (Warm-up): 5 min. Challenge process: 30 min. Group Sharing: 10 min. Group Feedback: 5 min. Exit Questionnaire: 5 min. Clean-up: 5 min.</p>

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Finally, **Garage staff continually experimented** with changes to the Garage experience to test their impact on Innovating and Collaborating from May to August 2002, including:

- * The Environment and the way to display materials
- * The Ice-breaker (using performance, a verbal description, and a sculpture)
- * The Scenario for the Challenge (based on real-life to fictitious situations)
- * The Role of the Materials Expert (the initial role was a person who took care of material; a later, more creative role was a weird 'Client' who had a challenging problem to be solved and wanted a weird, wacky, wonderful solution, a group with team spirit, and a product that worked well and looked good)
- * The Challenge (A Water Challenge and a Dynamite Challenge)
- * The Feedback or Wrap up Questions with participants (which focused on the OSC/DuPont Research Project and the content, design, and staffing for the Garage in the permanent exhibition).

Summary of Key Findings

The following summarizes key ideas and findings.

Freeing Up: The Icebreaker

The Garage was advertised at Admissions and OSC visitors who were interested in participating were asked to sign up on the Lower Level at the Valley Information booth. Some were also recruited after the Electricity show or at exhibits in the Arcade. They were escorted to the Garage for a 2:00 p.m. start. Outside the Garage was a sign written clearly with blue/black coloured marker and red underline on white flip chart paper resting on an easel.

Participants entered the Garage, a room at the back of the Arcade. The noise from the area was loud, often making hearing and talking difficult. A hand-held mic in later Garages made the environment in the Garage seem calmer and less chaotic. The room had white walls and beams near the entrance, tables around the periphery for groups to work on, and a wall of materials on shelves and in bins opposite the door people entered. Participants didn't tend to notice, but there was also a second level that was blocked from access. Garage staff wore their OSC white lab coats.

The Facilitator welcomed participants, introduced the Garage staff and explained the intentions for the Garage. Then the Facilitator quickly began the introductory Icebreaker and divided people into groups, or had people work in groups of their own choosing. Typically, people worked with others who had come with them to the OSC. Sometimes, when groups were too large, the Facilitator asked if families or friends would mind working with another group. The 5-minute Icebreaker activity was intended to 'free up' Garage participants, shift their mindset from what they normally do, and begin a process of Collaborating that would set the stage for Idea Generation and Innovating. The activity required that individuals quickly introduce themselves to others they may or may not know by sharing something unique about themselves. Then as a group they came up with a product that may be cool, fun, or wacky that they shared with the other groups.

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The outcome of the Icebreaker was that individuals and groups were freed up to take risk, be creative, and together come up with ideas. When given the opportunity to change groups after the Icebreaker, groups tended to want to stay together indicating that the Icebreaker was an opportunity to develop group cohesiveness and comfort working together, preparing people to Collaborate on the Challenge.

One of the Materials Experts described the Icebreaker as best suited for groups with people who do not know each other. He felt that everybody is forced to contribute something and will more likely contribute to the actual Challenge. He had found that for families, since they already know each other well, the Icebreaker is unlikely to change old patterns or dynamics within a family (e.g., a father taking charge or a child standing aside).

One of the most successful Icebreakers was introduced in early August. The Facilitator asked participants to find a material to which they could relate, introduce each other through that material, and make a group sculpture as a company mascot or logo that represented them as a company. This Freeing Up activity took less time than performing an ad that earlier participants had done, introduced individuals and groups to the materials and to each other, and helped them to start Collaborating and be creative as a group.

Idea Generation: The Garage Challenge

Photograph courtesy of
Ontario Science Centre

In the Garage Challenge participants worked in groups (of ideally four people) to find an Innovative solution to a Challenge. A Scenario was set by the Materials Expert, who then had to approve one of two designs by each group. Designs were drawn and explained by group members. The group then proceeded to gather materials and create a device that would solve the Challenge of the Materials Expert. Groups had 30 minutes to come up with two designs, have one design approved, find materials to create their device, test it, present their device, and share their process with the whole group.

The Garage was set up with materials in bins and on shelves on the side of the room across from the door to the Garage. In early Garages, there were tables set up as a barrier between the materials and the group's tables, and participants had to negotiate with the Materials Expert for materials they wanted to use in the design of their device. In later Garages this barrier was removed, as Materials Experts found that they needed to spend time roaming and helping groups with their devices and testing. Also, materials were hung on the walls for a more aesthetic look, and prototypes of group's devices from past Challenges were displayed for Idea Generation. Written rules for the Garage were written on flip chart paper and taped on the wall between the shelves for materials. Each table had paper to draw sketches and write ideas, markers, crayons, and pencils. There was also one material on the table, or given to the group by the Materials Expert that had to be incorporated into the device they designed.

Front-End/Formative Evaluation

Two Challenges were used during the OSC/DuPont Research Project – a Water Challenge and a Dynamite Challenge. Although Collaborating was high in both Challenges, Idea Generation and Innovating were quite different.

- * In the Water Challenge (a device to carry water from one end of a house to water the garden at the other end) groups used most of the space on the first level of the Garage, and sometimes groups discovered that they could use the second level, too. Groups could see each other's ideas as they were creating and testing their devices (usually a string and pulley along which a water carrying device moved using gravity). The Challenge required a container, string for distance, a hose (associated with past experiences watering gardens), and the scale dictated how much water was used. There tended to be less Innovating in the type of device groups developed, however people were very creative about how to use the material they were given as a functional or decorative aspect of their design, as well as other materials available. There was a lot of energy in the room and competition for space.
- * The Dynamite Challenge (a device to carry a candle that in 6 seconds would ignite a stick of dynamite) required that groups work intensely together, and use a contained space (it was "less space intensive" as described by a Materials Expert). The Dynamite Challenge needed a special candle, like a storm candle, had much less limiting factors, and scale didn't matter. As a result, there tended to be more solutions to the Challenge, and groups created more unique devices with materials that other groups were not using. Devices were more economical and materials simpler since groups didn't have to cover distance, so there was less waste than in the Water Challenge. The Dynamite Challenge also tended to have clearer time periods – 10 minutes for design, 10 minutes for building and testing, and 10 minutes for more testing and refining. Groups tended to be quieter, more intense, more reflective, and drawing and planning were clearer before groups went looking for materials.

The scenario for the Dynamite Challenge did not have as much everyday relevance and meaning as the Water Challenge did. On the Exit Questionnaire, participants in the Dynamite Challenge had little response to a question about challenges they might take on after the Garage, or suggestions for materials and other Challenges. In contrast, challenges related to house or school improvement were frequent responses related to the scenario for the Water Challenge. An implication is if Challenges are to have an impact on people's lives after they leave the OSC, participants have to come up with solutions that have relevance to things they experience in their own lives, and that make their own world a better place to live in. For the Dynamite Challenge, for example, the stick of Dynamite could be an Olympic torch that global audiences will witness, or a fireworks display that has to be lit for their local community.

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Both Challenges were difficult. The Dynamite Challenge was more complex with its time concept, more open, needed more testing and fine tuning or adjusting, and was more sophisticated. In the Water Challenge participants felt more comfortable being given impediments – materials they couldn't use, whereas blocking the use of some materials was not as possible in the more complex Dynamite Challenge. One problem in the Water Challenge was that the focus of each group was on a flimsy tree and small garden at the end of the room and the moving of the tree or fence to which devices were attached became frustrating in testing. Another problem in the Water Challenge was that groups often made the same kind of device (a pulley system from one end of the first or second level to the tree at the other end) resulting in a profusion of lines across the room, and a feeling of chaos. The Facilitator seemed to have less of a role than the Materials Expert in the Water Challenge because the device took a long time to build, and there was lots of animated, fun group activity. There was very little early testing of the device, or testing with water.

Collaborating

How groups Collaborated was particularly evident during the middle period of the Challenge (10-20 minutes), after ideas were generated and the Materials Expert decided on a design with the group. Materials exploration happened most during this period, and group members helped each other create their device either as a whole group or split into smaller groups to work on different components. The Facilitator and Materials Expert were very important during this Collaborating stage of the Challenge to assist with group process, question designs, and suggest materials to make devices work more efficiently.

There were different types of Collaborative groups:

- * Family groups
- * Groups with friends
- * Groups where people had not previously met
- * Groups in which Hosts who wanted to experience the Garage participated.

Garage activities highlighted characteristics of groups that were more 'functional' and more 'dysfunctional.' In most groups there was a leader who became evident very early in either the Icebreaker or initial decision-making about design who, if effective, was good at valuing the input of others and delegating tasks that needed to get done.

'Functional' groups provided:

- * Opportunities for individual learning
- * Worked efficiently and effectively with the group rather than individuals solving problems
- * Respected and valued one another's ideas
- * Discussed, created, and invented together with group members being flexible and adaptable to others' ideas
- * Ultimately created a successful device to solve the Challenge.

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In contrast, ‘dysfunctional’ groups tended to have one or several individuals who had a pre-determined idea, were rigid and inflexible in terms of shifting from that idea, and generally were not able to complete the Challenge successfully. One of the Garage staff observed that communication and teamwork are most important in the Garage. As he explained, if individuals “are doing their own thing, each strong idea wants to have its own way.” Another staff person observed that there were problems when people came late, after the Icebreaker. They tended to be more “bossy” and less Collaborative with others.

Young children often had ideas – in some cases their ideas were valued and a simple but effective device evolved out of their original concepts. In other cases, ideas of younger people were not listened to or heard by older members of the group, but the younger person later became involved in simple tasks as the whole group became highly engaged in their device creation and testing. Families that worked most successfully tended to differentiate tasks that were age and skill appropriate for the various members of the family.

‘Aha’s & Innovating

‘Aha’s and **Innovating** tended to be most evident in the last half of the Challenge, when a group’s early tests failed and they considered how to improve their device with new materials and creative new solutions. In some cases the original idea the group had grew and became elaborated while they were testing and experimenting with materials. In other cases, new ideas evolved as groups realized that their original plans for a device were not feasible, they explored an innovative idea, and under increasing pressure as time was running out, they experimented with new materials and designs. As one of the Materials Experts explained:

When a test run shows that something in their design does not work, the limiting boundaries of the original design have to be crossed, new ideas are needed, which opens up space for Innovating. One could say that, “Testing is the catalyst for Innovating.”

Therefore, there tended to be ‘Aha’s when errors occurred. These were noticed during testing, helping groups to discover what they were unable to do. What wouldn’t work became an ‘aha,’ resulting in quick changes to designs and devices. Innovating tended to occur if people failed at a task or in solving a problem and had to re-think it in new and creative ways. Garage participants described their ‘aha’s in some of the following ways:

- * Groups found out their device didn’t work or they couldn’t do it (e.g., filling a balloon with water resulted in too much friction on a pulley system) and they had to work backwards from the final outcome they wanted (e.g., when the balloon was to be poked to tip water inside).
- * A gradual evolution rather than an ‘aha.’
- * Small ‘aha’s along the way, in testing, and noticing what didn’t work.
- * We had ‘aha’s “every 5 seconds – we came up with something we wanted to do; it didn’t work and we kept coming up with new ideas.”
- * There were solutions that participants observed from other group’s designs and devices.

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Also, the Materials Expert sometimes gave each group counter-intuitive materials to Generate Ideas and provoke Innovative thinking (e.g., for the Water Challenge a sieve, strainer, or colander; panty hose; a baby bib with a short lip). When Garage staff found that devices for each Challenge were becoming predictable (e.g., a rope and pulley system for the Water Challenge, or a ramp with steering or guide rails for 'vehicles' in the Dynamite Challenge), they removed elements to try to promote more unique solutions (e.g., in the Water Challenge, the tree at the end of the garden was removed and the garden spread along the back wall, and no pulleys or overhead lines were allowed).

In a Debriefing discussion following a Garage in August with a group of Garage staff and DuPont Canada observers, the creation process was described as "a spiral with iterations, bubbles that result in gathering information" (and 'aha's with comments like "That's perfect," "That's cool"). When group dynamics and Collaborating are not good it gets in the way of Innovating (e.g., where weird ideas are not permitted by a group leader). Where groups value individuals' ideas, they like seeing original ideas and changes in ideas. In some cases, a core idea is embellished and enlarged; in other cases new ideas evolve.

A key question and response for Garage staff at the end of the OSC/DuPont Research Project was:

*When was the solution to a Challenge an outcome, and when was it Innovating?
Innovating was when there was a successful solution to a Challenge that was new and creative for everyone in a group, not unique to an individual.*

Ideally, participants will leave the Garage understanding that the Innovating their group Collaborated on during a Challenge is a microcosm of what happens in their every day world and workplace.

Debriefings, Roles & Responsibilities of Garage Staff

After most Garage experiences, the Garage staff and Hosts who had been participants in a group met to discuss the Garage design and activities, roles and responsibilities of Garage staff, and what we were learning about Idea Generation, Collaborating, Innovating, and 'aha's. These debriefings were very important for:

- * Stimulating discussions about the OSC/DuPont Research Project.
- * Providing reflections on successes, improvements, new elements to try, and elements to no longer use (e.g., inviting participants, design, environment, materials, set up, freeing up participants through the Icebreaker, Idea Generation, Collaborating, Innovating, 'aha's, and failure).
- * Continually evolving and improving Garage experiences.
- * Planning for the permanent *Agents of Change* exhibition and best possible conditions for the Garage within the exhibition area.

Front-End/Formative Evaluation**Garage Participants Feedback & Profile**

Sharing and reflecting activities by participants helped to provide very useful information for Garages. The Facilitator asked the same core questions during each Garage, but the number of questions asked depended on time participants had at the end of each Garage. At the end of the last few Challenges in August, the Facilitator began to ask a new set of questions in this final Participant Feedback or Wrap up section of the Garage to find out more about how the Garage could best be presented and facilitated when it became part of the permanent Innovation exhibition at the OSC.

Most participants completed a brief Exit Questionnaire (N=229). Some had to leave because they had tickets to see an Imax film, were meeting others in the OSC, or had other commitments. The questions were to collect demographic information, group size visiting the OSC, how people heard about the Garage, hobbies and interests. There were additional questions about other Challenges, other materials, and the potential impact of the Challenge on participants. We also were able to make comparisons between the group who participated in The Water Challenge from May to the end of July (N=146, 64%) and those who participated in The Dynamite Challenge in August (N=83, 36%).

To briefly summarise **the demographic profile** of Garage 2002 participants, and **how people heard** about the Garage:

- * Across both Challenges and all of the participants in the 2002 Garage, there were consistently more males (54% males and 45% females).
- * 19 OSC members (8% of participants) participated.
- * Half of the Garage participants were 12-17 years (39%) or 8-11 years (10%), and 65% were visiting with family. As a result, most of the adult visitors were 35-44 (20%) years and 45-54 years (9%). 'Children' in families ranged in age from 5 years to 20 years, but were most often 10 to 12 years, and teenagers were 13 to 15 years.
- * The Garage also appealed to young adults 18-24 years (14%), many of whom visited with friends (13%). Up to five people were in groups of friends, or friends and family.
- * One-third of the participants were invited into the Garage by Hosts on the floor or Garage staff (35%), or heard about it at the Information booth on the lower level where the Garage was located (17%) or at Admissions (16%).
- * In August, promotion of the Garage at Admissions improved and 23% decided to join the Dynamite Challenge after they found out about it when they entered the OSC (compared to 12% during the Water Challenge).
- * Participants had a wide range of interests, but most popular were sports and physical activities, computer and Internet, and building or creating things.
- * One-quarter of the participants, 61 people, left their names and contact information indicating that they would be interested in telling OSC staff about their Garage experience in a month or two.

Front-End/Formative Evaluation**Preferences for other Garage Experiences**

The Exit Questionnaire also included questions about the Challenges participants would like to experience, materials they would like to have available, and personal challenges they might take on after their activities in the Garage.

Across participants, the most frequent responses to **Challenges that people wanted to do** if they came back to the 'Garage included:

- * The same thing, the same because it was fun, or the same experiment to make it better (14%, 32 responses)
- * Another Challenge, invent new things that are useful, another problem to solve, or something different, and maybe some new materials (9%, 20 responses)
- * Build something mechanical or that supports weight (6.5%, 15 responses)
- * Building things (5%, 12 responses)
- * Robotics or an electronic project (4%, 10 responses)
- * I don't want to know, half of the fun was not knowing what you were going to do (3%, 7 responses).

After the Water Challenge, participants were most interested in building something mechanical (8%, 12 Water Challenge responses), another Challenge (7%, 10 responses), and the same thing (6%, 9 responses). Similarly, in the Dynamite Challenge, participants were most interested in another Challenge that included the same thing because it was fun and challenging (19%, 16 Dynamite Challenge responses), another Challenge (9.5%, 8 responses), and building things (7%, 6 responses).

The most common responses related to **available materials** that participants would like to use in the Garage were more tools (7%, 16 responses), or that the materials were okay or great (4%, 10 responses). After both the Water and Dynamite Challenges, participants particularly wanted to have more power and hand tools, and screwdrivers available. After the Dynamite Challenge, several commented that materials were okay (11%, 9 responses), and 5 participants (6%) wanted to work with Lego.

Longer-term Impact of the Garage Experience

After the Garage experience, the most common challenges that participants thought they might take on were related to school or work (5%, 12 responses), things for around the house (5%, 11 responses), and building things (4%, 9 responses). After the Water Challenge and its focus on watering the garden of a home, doing things around the house was the challenge most people would take on (7%, 10 Water Challenge responses), as well as finding solutions to everyday problems in new and interesting ways (3.5%, 5 responses). After the Dynamite Challenge, people were more interested in building things or inventing things on their own (5%, 4 Dynamite Challenge responses).

Front-End/Formative Evaluation**Optional for return visitors**

Return visitors were asked why they decided to return, and how this Garage experience was the same or different for them than the last time(s) they tried a Challenge. Nine people returned to try a second Garage experience for various reasons, including: being a member at OSC; the Garage was fun; wanted more time to explore and try out things; came with friends; heard there was a new Challenge; and wanted a Host position at OSC.

Other Comments

Two important suggestions related to Collaborating were made at the end of Exit Questionnaires. One Garage participant responded that it would be good to enforce the over 11/12-age minimum (their group with a 9 year-old proved somewhat difficult). Another participant found that a group of strangers with a large variation in age did not run as smoothly because of age differences.

Conclusions

One of the big outcomes of the OSC/Dupont Research Project was a shift in the original definitions for Collaborating and Innovating. The following definitions differ from those in the original hypothesis and proposal based on what we learned about Collaborating and Innovating as **general processes** that occur throughout numerous phases of activity in the Garage context:

- * **Collaborating**: the process of individuals **'working' together** towards a common goal (in this case, solving the Garage Challenge).
- * **Innovating**: the process of **developing effective solutions** to a problem within unusual constraints (in this case, solving the Garage Challenge within a limited time frame and with limited or unusual materials). This consists of two main sub-processes which operate in an iterative cycle until an effective solution is found:
 - + **Idea generation**
 - + **Applying & Testing Ideas**

As a result, Collaborating and Innovating (rather than Collaboration and Innovation) are used throughout this OSC/Dupont Research Project Report.

Conclusions about 'Collaborating'

The OSC/Dupont Research Project has demonstrated that OSC visitors who do not know each other can form teams and work together on a project in a short space of time. They will resist in fact changing initial teams (e.g., after the Icebreaker group exercise participants did not want to re-form for Challenge teams).

Once excited by the Challenge presented, Garage participants could see meaning in it for themselves and become committed to the outcome. Competition aspects sometimes, but not always, played a role in the commitment.

Front-End/Formative Evaluation

Observing and talking to Garage participants indicated that when solving a Challenge had personal meaning, and people understood why it was worth working on a solution to that Challenge, there was much more good will and Collaborating in the groups.

How 'Innovative' were the solutions?

During 2002 Garages, some solutions to Challenges were more of an application of a participant's prior knowledge, while other solutions were more Innovative, something genuinely new that a whole group agreed was new and creative. Past experiences, level of education, cultural context, and style of living are some of the factors that influence the extent to which a solution is Innovative for an individual. We had no way to 'measure' degree of 'Innovativeness' of the final solutions, so can make no conclusions regarding this. However, the Research Team felt participants were 'Innovating' as they worked to find effective solutions to the overall Challenge, and the many small problems that arose as they built and tested their ideas.

Conclusions about Relationship between Collaborating and Innovating***What is the Importance of Collaborating and Innovating?***

The importance of Innovating while Collaborating with others created the feeling of group (rather than personal) empowerment in 2002 Garages. When an effective solution was the outcome, participants responded on Exit Questionnaires that they were more confident that they could solve future problems and take on new challenges in their personal lives, at school, or in the workplace. Ines Habaras believed that the outcomes could be that, "We get citizens, family members and employers full of energy, not only to solve problems but also to look for new problems to be solved!"

Qualities of Collaborative experience in which there was Innovating in 2002 Garages

(these qualities were also summarized as potentially important qualities for Garage experiences in a preliminary Report on related 'Current State' research, see **Initial Literature Review Documents**).

1. There was a supportive environment or emotional climate.
2. People were respectful of others in the group.
3. Participants felt driven towards a clear goal.
4. A risk-taking spirit was encouraged and celebrated.
5. Facilitators provided a 'compelling vision' or scenario for the Challenge so participants wanted to collaborate on the Challenge and provide 'creative tension' during the Challenge.
6. Knowledge and risks were shared in groups.
7. Opportunities were provided for collaborative efforts in both Icebreaker and Challenge activities.
8. Experimentation, rule breaking, and game-changing ideas were rewarded.
9. Failure was encouraged.
10. Ideas were quickly turned into action.

Front-End/Formative Evaluation**Learnings for OSC Garage Successes**

During all of the Garages, there was the strong OSC tradition of education and respect for the visitor, which helped Garage staff to think of materials and display that might increase the chance of failures, but ultimately increase the chance of success for participants. Garage staff continually experimented with different methods to increase group spirit, help groups who had come to OSC together to better understand how to work together more efficiently and effectively, and have a 'fun' experience during their visit.

Debriefings, ongoing discussion, and reflections throughout this OSC/DuPont Research Project, by the planning group from OSC/DuPont and Garage staff, also indicated how intriguing questions about Collaborating and Innovating are, and how potentially meaningful the outcomes of this Garage research might be to the Ontario Science Centre and DuPont Canada.

For example, Garage staff wanted to continue to explore the following '**Intriguing question:**'

How do Garage staff provide opportunities for participants to showcase the strength/s they bring with them to a Garage (comfort, esteem, skills, abilities, understandings) before enabling them to explore other strengths while they are engaged in the Garage activities?

In conclusion ...

2002 Garage experiences confirmed that the definitions, characteristics, qualities of staff, and success indicators that were found to be critical to Collaborating and Innovating in the literature, were also critical to the success of OSC Garages. Ongoing staff Debriefings after Garages and continual experimentation with the Garage design, materials, Icebreaker Activities, Challenges, and staff facilitation were important to the success of the 2002 Garages. New learnings came from the dedication and commitment of Garage staff to experiment and attempt to ensure that in most cases each Garage experience provided younger to older participants with fun, stimulating, challenging individual and group experiences that encouraged people to take on new challenges in their everyday lives.

Front-End/Formative Evaluation

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