Co-creating Games through Intergenerational Design Workshops

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ABSTRACT  
In this paper, we present a co-design study into the development of intergenerational games. Three separate design workshops were conducted with 50 participants aged between 15-21 and 55-74 years old, representing younger and older cohorts respectively. A range of design activities were used to elicit ideas and allow participants of different ages to self-reflect, negotiate and collectively create games that they desired to play. The analysis reports on the game concepts envisaged from early brainstorming, group sketching and more refined storyboards. A number of genres and game-types are illustrated, as we compare the different game features designed. These ideas reflect a combination of interests from mixed-age groups. The paper concludes by discussing recommendations to developing intergenerational games.

Author Keywords  
Intergenerational relations, design workshop, elicitation, older adults, video games.

ACM Classification Keywords  

General Terms  
Design.

INTRODUCTION  
Intergenerational relations are a crucial means of exchanging values, social norms and life-skills, while preserving cultural and historical knowledge [12]. Intergenerational contact can reduce the prevalence of ageism, and significantly help improve the mental and physical health amongst the elderly [12]. Similarly, within the family, strong intergenerational relationships have been found to increase self-esteem for the young, and provide positive long-term psychological benefits for children as they move into adulthood [1]. Despite this, younger cohorts have been identified as more likely to perceive older people as disengaged from younger people outside their family (compared to older people themselves) [12], and have equated old age with notions of pessimism and conservatism [19]. Likewise, the negative stereotyping from older people towards younger adults is known to have a detrimental effect on their relationship with the young [8], as age has been found to be an “extremely powerful intergroup marker in communication between people of different generations” [14, p. 276].

Within HCI, understanding how different cohort experiences of norms, skills and lifestyles can influence and inhibit the comprehension of modern technology remains a formidable challenge [4]. This includes understanding how design practice can accommodate for the dynamic and diverse power structures between age groups [11]. An underlying interest driving this research is to understand how we encourage empathy and the lateral thinking of design ideas through processes, which constructively leverage on social and technological differences between the young and old.

In this paper, we describe the findings of three design workshops, which were organized as the foundation work to explore common interests, motivations and design ideas for undefined interactive gaming applications. Through a series of practical, hands-on activities we explored a broad range of themes, which were subsequently used to narrow down design concepts for intergenerational gameplay. Our intention of this study was not to create final video game concepts, but to explore approaches that could incrementally guide game designs that are suitable across age groups, and in the process provoke and reflect on the subject matter at hand. These illustrations aim to offer insights into individuals’ perceptions towards intergenerational games, as well as broadly identify the challenges of meaningfully engaging both younger and older people together.

Taking a co-design approach, the work of this paper seeks to contribute to a limited body of knowledge on intergenerational gameplay, by investigating common interests and understanding among the old, young and designers of intergenerational games. In order to do this, the authors seek to answer the following questions: 1) what are the marked differences between the age groups, if any, in the game ideas envisaged; 2) what attributes of games do the young and old perceive as important for games to be intergenerational; and 3) what recommendations for intergenerational games can be learned from the collaborative workshops?
RELATED WORK

Recently published statistics in the U.S. indicate the over 50s represent one of the fastest growing gaming communities [6]. However, arguably whilst the youth market is well catered for, there remains an absence of commercial games for the ‘graying population’ [10, 13]. Research studies that have explored ageing components have typically focused on evaluating commercial available video games (e.g. the Nintendo Wii) to determine their impact on functional health and physical wellbeing; two of the most prominent areas being exergaming and cognitive training applications. Nevertheless, in both cases there is often inconclusive or conflicting evidence to verify their efficacy [15, 17].

Likewise, understanding how to bridge generational differences within an inclusive design process remains a formidable challenge. In terms of requirements gathering with older adults, HCI researchers and practitioners have often focused on the constraints of eliciting technological ideas, indicating a lack of differentiation towards older people as a heterogeneous population [16]. This includes older people’s lack of confidence and implicit knowledge to learn the conventions of software interfaces, or vocabulary to conceptualize design possibilities using low-fidelity prototypes [16]. In comparison, requirements gathering with children and adolescents are more often about what adults perceive they require [5]. Druin et al. [5] account this problem to a lack of applied research involving children, and understanding of the different roles adolescents can play in technology development.

In terms of intergenerational gameplay, it is recognized that expanding paradigms of gaming are needed to bring generations together. Particularly in the context of the grandparent-grandchild dyad, where social interaction with grandchildren is perceived to be a strong driver for many older adults in the adoption of digital games [20]. Understanding the intergenerational roles family members have in playing popular console games, Voida and Greenberg [21] identified more passive gameplay behavior for older players in the presence of children. While the extent of this ‘imbalance’ is unclear, they suggest older adults are more likely to give gameplay priority to younger partners. This is similar to the findings by Chiong [3] who reports that within the family, parents have a stronger tendency to focus on interacting with their children, while the children focus more on interacting with the game.

According to the findings of Vanden Abeele and De Schutter, “digital games that focus on intergenerational play are rare” [20, p. 425]. Of the research studies available, there is often a focus on the evaluation of the perceived usability and enjoyment of the gameplay, while maintaining relatively simple interaction for the older player [9, 20]. Within the empirical findings of previous intergenerational research, few studies have explicitly gathered user requirements with younger and older people together. Noticeable exceptions include Khoo et al. [10] who conducted two focus groups with younger and older volunteers on gameplay usage, and Mahmud et al. [13] who observed gameplay sessions with children in schools and older adults in community centers. However, in both cases they reportedly treated the cohorts as separate user groups, with no account of interaction between them. Subsequently, the question of how to design intergenerational games based on the understanding of what both younger and older people want, or perceive to be important, remains largely unknown.

Addressing this current gap in the literature, the challenge of our research is to transfer critical early insights of gameplay possibilities into viable prototype concepts. We have identified no known examples of co-designing intergenerational games using a similar methodological approach that is described in this paper.

METHOD

Individually undertaken over the course of a day, three workshops were conducted with separate groups of participants (Figure 1). These were designed to give a sense of group ownership, by allowing participants time to personally gather, analyze and reflect on relevant information. The selection of methods used, drew influence from established co-design studies, and more broadly participatory design (see below). Our intention was to explore wider themes of interest, understanding how these might indirectly impact on the types of games designed. Explicit examples of gaming technology were therefore intentionally avoided so as not to constrain participants’ conceptual thinking to existing systems.

Figure 1: Overview of the workshops.

Broadly, we drew influence from the work of Xie et al. [22] in examining low-fidelity prototype methods that engage the young and old as co-designers. More specifically, designing with, rather than for participants, the workshops drew ideas from Campbell [2] and the concept of taking multiple photographs of everyday objects and places (e.g. street corners) in order to dismantle and perceive a common problem differently. Inspired as the foundation work for the
**Method**

Similarly, for the analysis of the game sketches (again, see Method), direct influence was drawn from the research of Ezer [7] in her comparison of conceptual drawings of domestic robots created by older and younger participants alike. Applied within a gaming context, her work provided the authors with a constructive framework to quantify largely qualitative data.

**Participants**

We recruited 50 participants from local senior activity centers, high schools and polytechnic colleges. The sample consisted of 22 males and 28 females of predominately Chinese ethnicity. The mean age of the older cohort was 63 years (SD = 5.42) with an age range of between 55 to 74 years (i.e. the ‘young-old’), while for the younger cohort the mean age was 18 years (SD = 2.15) with an age range of between 15 to 21 years. Each workshop consisted of approximately 16 participants of mixed age (i.e. pairs of 8 young and 8 old).

All of the younger participants reported playing video games on a PC, with 70% on a mobile phone, and 48% on a game console. By contrast, 52% of the older participants played games on a PC, 35% on a mobile phone and 9% on a game console. Moreover, 93% of the younger adults reported playing with friends or other online acquaintances, compared to 79% of the older gamers who indicated they only played alone. For those who played digital games, the younger participant’s scored multiplayer (74%), action (74%) and role-play (63%) highest, while for the older gamers, casual (93%) and brain training games (57%), with very low scores (less than 15%) in other game genres. Only one person from each age group reported playing video games with their grandparents or grandchildren. Just over a third (39%) of the older participants had no experience playing video games, compared to all the younger adults who reported some experience.

**Materials and setup**

Conducted at the Institute for Infocomm Research, a range of visual prompts was used. These consisted of a laptop and projector screen, paper templates and various drawing materials (e.g. colored pens, post-it notes, etc.). The room was divided into presentation and workspace areas, allowing participants to communally converge together as well as breakout into smaller designated groups to work on specific activities. Upon informed consent (including where necessary parental consent), all sessions were video recorded and digitally photographed. A number of video cameras and audio recorders were strategically positioned in the room to record the working interaction of each group.

**Procedure**

Participants worked in groups of between 2 to 4 people, both within their own and mixed age groups, depending on the activity at hand. Three experienced facilitators monitored and facilitated the activities. The time and structure of each workshop is presented in Table 1.

**Introduction:** We first welcomed and asked everyone to introduce themselves and complete a background questionnaire. This consisted of standard demographic details on participants, including information on their gameplay usage (see Participants).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Activity</th>
<th>Time/mins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Consent/background questionnaire</td>
<td>15</td>
</tr>
<tr>
<td>Setting the agenda</td>
<td>Fond memory</td>
<td>40</td>
</tr>
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<td></td>
<td>100 pictures</td>
<td>60</td>
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<tr>
<td>Group sketches</td>
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<td>Storyboards</td>
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**Setting the agenda:** Participants then collaborated in pairs (i.e. one younger with one older person) to recollect and subsequently sketch a fond memory they had had with a grandparent or grandchild. Intended to allow participants to better know each other, an A4 paper template was provided which was designed to elicit descriptive details on a set of questions, such as whom, when and where the memory was - how they felt at the time - and why it was a memorable experience. All the sketches were then wall-mounted, as individuals summarized their experiences to the other workshop members.

Following on, separated into groups of four people (grouped according to their age), participants completed the 100 pictures activity. The research team compiled a broad set of 100 images on the themes of ‘fun’, ‘fitness’ and ‘friendship’. These themes were selected based on their applicability to gameplay. Collected from various media sources the images were digitally formatted and printed prior to the start of each workshop. Participants were asked to select three images they considered to be the most and least representative for each of the three themes. Individual words were written onto post-it notes that summarize their interpretation of each image. Each group was then allocated 5-10 minutes to present their selection and described the ideas these images evoked to the other workshop members.

Reviewing the material gathered from the two preceding activities, participants were then asked to formulate a series of ‘what if’ questions related to what they perceived important for intergenerational games. Written onto a different set of colored post-it notes, these questions were individually read out before being displayed on a designated poster.

**Group sketches:** From the poster, each participant was asked to select one question of interest. Arranged in a group of four people (comprising of 2 older and 2 younger),
individuals were instructed to rapidly sketch a game idea from their selected question positioned on an A4 board (see Figure 2). Once complete, each board was passed to the immediate person on their right. Everyone then worked on a new board and statement they received. This activity was designed to allow each member to incrementally capture alternative game ideas, or to build on existing ones. The process continued until each member of the group contributed ideas to four separate questions (accounting for up to 16 design ideas). Participants were then given time to internally critique and reflect on each other’s work.

![Image of A4 board with sketches]

**Figure 2: Example of the ‘ideas 360’. The pink post-it notes are the ‘what if’ questions surrounded by sketches and written ideas from the group members.**

*Storyboards:* Within the same groups, participants were then instructed to iteratively focus on a more explicit game concept. They were first given 30 minutes to brainstorm and select attributes from the previous sketches, during which time we introduced the following game components: 1) goal; 2) rewards; 3) player roles; and 4) gameplay location/s. Bringing independent ideas together, participants were asked to storyboard the final design concept onto an A1 sheet of paper. Once complete, the participants were required to present their storyboard to the other groups. In facilitating the discussion, we encouraged workshop members to prompt questions and discuss associated design features.

**Concluding session:** We rounded up each workshop with a general summary of the findings. Specifically, we asked what aspects participants found most valuable in the workshop. Finally, we debriefed participants on the research.

**Data analysis**

The final data consisted of approximately 120 hours of video and (replicated) audio recordings (accountable to the high number of separate workshop groups). Materials produced by the participants were collated and grouped according to age and workshop sessions. Adapted from Ezer [7], group sketches were rated by two independent coders on a 5-point Likert scale (“not at all” (1) to “a great extent” (5)) based on their likeness to three different game-types. These were coded into one of three dimensions (traditional, conventional or exploratory games). Gameplay controls were also coded into different types of input (e.g. game controller, gesture recognition, etc.). Analysis included descriptive statistics and one-way analysis of variance to compare mean scores. For all the group activities, to identify the main themes of the paper, transcripts were subject to open and more focused coding as described by Strauss and Corbin [18].

**FINDINGS**

A summary of the selected main issues raised from the study is discussed below. The following section is structured around describing the broader elicitation exercises. We then move on to describe the game concepts created through the ‘Ideas 360’ sketches, leading to an overview of the more detailed storyboard designs. Finally, we discuss and reflect on the research outcomes.

**STAGE 1: SETTING THE AGENDA**

The memory sketches identified a number of underlying differences between the age groups. For the younger participants, associated memories tended to relate to describing the details of a daily activity, such as being taught a family recipe, going to the market or teaching a grandparent basic English. In some cases, this activity related to a very specific event. In comparison, as many of the older participants did not presently have grandchildren, they tended to think much further back in history to their own childhood, including memories with their own grandparents. Notably, the older adults tended to focus on the general interaction and experience (e.g. the feeling of spending time with a favorite grandparent) rather than a specific activity or event.

Following on, the 100 pictures activity was effective in illustrating the commonalities and differences between the age groups. In general, the older volunteers had a higher tendency to choose images for activities that they engaged in, or were willing to attempt, while the younger adults held concepts that may not be directly self-applicable. Examples of this were evident in the fitness theme, where many of the older participants selected images they associated with active ageing (e.g. swimming, brisk walking or stretching exercises). This was consistently different to the younger participants whose images were more centered on attitudes and concepts of macho or masculine ideals of fitness (e.g. body building, martial arts or break dancing), of which they rarely did themselves. Notably, for the older participants, positive perceptions associated with the theme of fun, illustrated a sense of generational bonding between family members, while the younger adults favored images that portrayed spending time with friends. By comparison, images that generally evoked group bonding (e.g. karaoke, eating out together) were commonly selected for the theme of friendship.

Leveraging on the previous two activities, a broad set of questions were accumulated from over 100 ‘what if’ statements. They included very specific intergenerational
questions towards how the gameplay could accommodate for physiological differences in age (e.g. what if my grandmother is stronger than me?), reversal of ageing roles (e.g. what if the young can know the feeling of being old; what if the game can make the old young and the young old?), or more generally fit into the diverse lifestyles of the different age groups. From a social perspective, the youngsters engaged with questions towards how the different cohorts could imaginatively communicate through music, or challenge grandparents through laughter, while both age groups questioned the notions of more conventional forms of gameplay logic – suggesting, games without rules, games where the player sets the rules or games with a high degree of unpredictability.

**STAGE 2: GROUP SKETCHES**

Generated from the ‘Ideas 360’ activity, an examination of the game sketches was reviewed. From a sample of 160 sketches, 74% consisted of sketches with text (including the labeling of drawn items), 19% text only and 7% sketches only (i.e. drawings without any textual description). Through their analysis, we wanted to identify any generational differences in the ideas drawn. Similar to Ezer [7], we did this by examining the most salient, recurring features described in the sketches, which in turn corresponded to examining two categories - game-type and gameplay control.

**Game-type**

Either visually represented in words, drawings, or a combination of both, the sketches were divided into one of three dimensions: 1) traditional analogue games: i.e. non-digital games; 2) conventional digital games: i.e. the popular depiction of PC, game console or mobile concepts (e.g. Wii/Kinect-type interaction); and 3) exploratory digital games: i.e. unorthodox or novel use of gameplay location, application or technology usage.

For the analysis we initially removed 51 sketches due to their lack of detail. To ensure equal sample sizes to compare against, we then randomly selected from the higher number of remaining youth sketches, examining a total of 84 sketches across both age groups. For traditional analogue games, there was found to be a significant effect of age for this game-type ($F(1, 82) = 16.66, p < .001$), with the older adults ($M = 3.71$, $SD = 1.38$) scoring higher than the younger adults ($M = 2.43$, $SD = 1.50$). In contrast, scores for conventional digital games were found to be significantly higher ($F(1, 82) = 10.37, p < .01$) for the younger adults ($M = 3.10$, $SD = 1.62$) compared to the older adults ($M = 2.02$, $SD = 1.42$). No significance was found on the effect of age on the exploratory game-type ($F(1, 82) = .15, p = .69$), illustrated in both groups by the relatively low mean scores (youths: $M = 1.76$, $SD = 1.10$; older adults: $M = 1.67$, $SD = 1.14$). Subsequently, it can be summarised that in drawing sketches, the younger adults were more inclined to illustrate characteristics of conventional digital games when conceiving intergenerational ideas. In comparison, the older adults favored depicting traditional analogue gameplay characteristics. No differences were identified between the age groups in the descriptive amount of exploratory digital gameplay characteristics.

**Game-type features**

Subjectively reviewing the sketches in more detail, the traditional analogue games commonly included word association, turn-based board and childhood playground games (e.g. hopscotch, tic-tac-toe, rock-paper-scissors). As illustrated in Figure 3, these drawings were rarely modified in appearance to their original gameplay concepts.

![Figure 3: Traditional game examples: (left), Sudoku, (right); two players and a checkerboard.](image)

In comparison, the conventional digital games incorporated motion sensor controls, large screen displays or portable tablet devices. Dictated by the youths, they also employed gesture and 3D graphics. As such, there was often some overlap between the divisions of conventional and exploratory gameplay, particularly in terms of the application areas.

For the exploratory digital games, more experimental ideas included alternative gameplay locations by proposing interaction on a public transport system (see Figure 4); new experiences such as transferring a shared memory into an interactive song, bringing an outside weather experience indoors, or reducing the hyperactivity of a child by making the game more ‘hyper’ or physically active; and, intergenerational storytelling using an augmented book that became interactive when wearing 3D glasses, or gameplay narratives that imaginatively allowed children to play out and express their feelings to older adults.

Technological influences that shaped these game ideas included wearing specialized footwear that slowed down, or restricted the physical performance of the younger player (Figure 4), or sensors that detected and enabled an external change in the chronological age of the player. The latter ideas refer back to earlier brainstorming sessions (see Stage 1), and the questions of how digital games could allow players of different ages to interact at their own pace without biasing the gameplay, or more radically become a ‘vessel’ for reversing physical characteristics. Often devised by the youths, there appeared a preference for some form of adaptation to accommodate, or nurture for different skill sets.

My idea is to have a program, and have a camera and sensor, so the young can play with some special effect. It will
let you know how you would be when you are old, say fifty-eight. For the old person, they will use a special effect to look younger. You know what you look like when you are young already (younger, P27).

Figure 4: (Top), exploratory games. (Top left), specialized footwear and body weights to slow down the younger player; (top right), gameplay on a bus; (bottom), conventional games depicting TV displays and/or motion sensors.

Gameplay control
The sketches showed that the younger adults were more likely to think in terms of commercial digital systems. 6% of the sketches indicated interaction via a conventional game controller, which were all described by the younger adults. 8% employed gesture recognition, and a further 11% included sensing technology (including wearable sensors on the body), of which 77% of the cases were described by the youths. In addition, 44% of the sketches included the use of a physical object (e.g. weapon, book, ball, rope, weights, pen, toy, headphones, etc.). These physical objects were equally sketched across both age groups with no significant difference in scores.

STAGE 3: STORYBOARD
Expanding on a selection of the sketches, across the three workshops eleven storyboard concepts were created. Table 2 summarizes their main features. Based on a review of the data, the game concepts were grouped depending on whether an age group was perceived to have a generational advantage in the gameplay, or not. Storyboards were assessed on the following criteria: 1) advantage based on prior knowledge of the game subject; 2) advantage based on prior experience of the game-type (technology experience was perceived to be an unfair assessment as this was thought to naturally favor the young adults); 3) advantage based on physical fitness (applicable to older children and teenagers); and 4) neutral, no obvious advantage between the age groups.

Across the concepts, four of the games favored the prior knowledge of the older player given they were primarily targeted toward educating young age groups (The Study Game, The Cooking Game, Chomp Chomp! and Chore Safari). In the case of Chore Safari this advantage was somewhat balanced out by the physical nature of the tasks (see Table 2). Three of the games favored the younger adults’ experience of online social gaming (Farm Whisperer) or emphasis on physical exertion (Kine-Box, Catch!). By contrast, four of the games were perceived neutral, illustrated by their imaginative gameplay, or cooperative behavior that focuses on the exchange of skill sets (Papa Cooking, Family Labyrinth, Teamwork Ants and the Bus Game).

Gameplay balance
Broady, three of the games can be described as being cooperative, six are predominately competitive, and two involve a blend of both game types (see Table 2).

Cooperation
Games that focused on cooperative behavior and positive interdependence include Family Labyrinth (names devised by groups), a concept in which older adults and their younger players progress through an outdoor environment, leveraging on their size or strength to overcome physical obstacles. For example, described under the terms of ‘big and small’, it was reported how younger children could crawl and unlock spaces too small for the adult to fit through, while the older adult could provide ‘power ups’ by selecting edible objects too tall for the child to reach (Figure 5). Roles were perceived to be asymmetrical, drawing out virtual skills of strength and coordination.

In the game Teamwork Ants, players were designated roles in a virtual colony of ants (i.e. carrier, digger or fighter). Symbolizing the family, through group co-ordination, the gameplay goal was to strategically forge and bring food back to the ‘nest’ by removing pathway obstacles, constructing bridges, crossing waterfalls or fending off attacking enemies. Tasks were reportedly rewarded through points and time to completion. Body gestures to control the movement of the characters, and the use of a mini-map to show directions were all suggested by participants.

Figure 5: Big and small: illustrations of the Family Labyrinth concept.
In another example, cooperative ideas were envisaged through the synchronized, coupled actions of two players who played alongside each other to control the movement of a virtual human character feeding himself (similar to the analogy of controlling a ‘string puppet’). Entitled *Papa Cooking*, the game utilizes the coordinated efforts of both players, as household objects like a knife and fork are fitted with sensors to control physical actions, and reduce the visibility of using a technology per se.

**Competition**

Games that leveraged on competitiveness included *Catch*, a multiplayer game that requires players to collect ‘healthy’ food (from junk food) in order to feed an on-screen character. This includes the option to ‘snatch’ or throw items to the opposing team. Teams are then required to physically exercise their character to stay fit. As a form of punishment, the losing team has to work twice as hard to win back their fitness. *Chomp, Chomp!* on the other hand is an interactive tabletop game that brings the family together and encourages young children to eat a balanced diet. Players gain points from eating healthy portions of food, which allows them to accumulate and ‘shoot’ virtual objects (i.e. missiles) to damage another player’s mini-character, subsequently reducing their health status. Anticipated interactive features include being able to monitor what is eaten.

![Figure 6: Chomp, Chomp! The rabbit represents a mini on-screen character, reflecting the health of the player.](image)

For game concepts like *Farm Whisperer* (largely adapted from the social network Farmville game), they were perceived to employ a more balanced blend of competition (making money by growing crops and rearing animals) and cooperation (socially interacting with online friends).

**Player roles**

There was a clear trend that when participants think about games in an intergenerational context, the roles of the players are based closely to everyday life. Even when game scenarios are set in an imaginary situation, such as for *Teamwork Ants*, ants take on the roles of a builder or defender. For six of the storyboards there was no distinction in the player roles between age groups. Only in one storyboard do physical characteristics account for an obvious role difference (*Family Labyrinth*). Rather, these concepts exemplify a need for orchestrated actions and an exchange of expertise to achieve set goals. Interestingly, across the storyboards there are no explicit examples where the younger adult is designed to be the dominant player.

In contrast, four of the storyboard games depict the use of children (under the age of 12) as opposed to more representative players within the younger participant’s age group (ages 15 to 21). In all of these instances, the grandparent effectively takes on the parental role of reinforcing prosocial behavior, such as mentoring a grandchild with their homework, teaching about healthy eating habits, or the importance of doing chores. Less reciprocity is expressed in the gameplay, with more governance by the older adult in ‘testing the knowledge’ of the child (e.g. “*the grandma will ask what is this picture and the child will answer*” (older, P18)). Moreover, the grandparent is perceived to be decisive in determining what to do (“*Grandma says ‘hey’, I want apples. So this is the target for the Grandchild, go get apples*” (younger, P21)).

**Technology usage**

With the exception of one game (*The Study Game*), all the storyboards utilized the use of state of the art devices (i.e. smart phones, mobile tablets or game consoles), or more unorthodox, novel forms of interaction. For example, these included a multi-touch tabletop interface (*Chomp Chomp!*), an in-transit bus entertainment system (*Bus Game*), and novel use of everyday objects, such as kitchen utensils (*Papa Cooking*) and a plastic bag for collecting virtual food (*Catch!*). Linking all these different concepts is the reliance of gesture and multi-touch interaction, with common reference to ‘sensors’ when referring to gestural interfaces. Although gesture is an increasingly common form of interaction in modern games, integrating the affordances of physical with digital objects (*Papa Cooking, Catch!*), emphasizes the imagination of many of the older adults (given the early workshop preferences to describing non-digital games). For both parties, despite their uncertainties, few concerns were raised about how the technology would work (“*the computer will judge how to select the food*” (older, P8), “*we don’t know how smart, smart TV’s are. Could be one person can play one time, or four persons. If the sensor is big enough, everybody can play*” (older, P43)). Rather, given their generalized descriptions, it was often assumed the technology would be appropriately designed for both age groups.

**Narrative and game world**

Of the eleven storyboards, many of the concepts have some description of a game world (i.e. an artificial environment) for which the game would be played. Four are directly related to reality (supermarket or kitchen), while three have more fantasy-type influences (ant colony, forest or farm). Of those without a game world, the concepts tend to give older adults a prior advantage. Games with fantasy influence appear to be more balanced across groups. A commonality amongst all of the storyboards is the lack of a gameplay narrative. That is, all the storyboards tend to be
<table>
<thead>
<tr>
<th>Game</th>
<th>The Study Game</th>
<th>The Cooking Game</th>
<th>Chore Safari</th>
<th>Chomp, Chomp!</th>
<th>Farm Whisperer</th>
<th>Catch!</th>
<th>Kine-Box</th>
<th>Teamwork Ants</th>
<th>Bus Game</th>
<th>Family Labyrinth</th>
<th>Papa Cooking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Game features</strong></td>
<td>Complete homework related tasks</td>
<td>Teach and pass on family recipes</td>
<td>Win chore-related tasks</td>
<td>Teach healthy eating to young children</td>
<td>Harvest and cultivate a virtual farm</td>
<td>Exercise and catch healthy food to feed virtual characters</td>
<td>Win adventure tasks</td>
<td>Collectively find and bring food back to the nest</td>
<td>Win simulated game with commuting passenger</td>
<td>Complete a series of puzzles situated in a virtual forest</td>
<td>Coordinate the physical actions of a virtual character</td>
</tr>
<tr>
<td><strong>Goal</strong></td>
<td>- Grandparent helps facilitate grandchild’s learning. - They test knowledge through posing questions about the child’s homework. - Self-imposed forfeits (e.g. no lunch).</td>
<td>- Older player sets the questions on home cooking. - The younger player is rewarded in points for correct answers. - Questions get incrementally more difficult.</td>
<td>- Grandparent arranges a ‘shopping hunt’. - Determines the time, date, venue, what to do and what to buy. - At the venue, players race to find products. - Collect the most products to win.</td>
<td>- Family members sit around an interactive dining table. - Players win points for eating healthy food, growing a personalized character. - As a reward, players can playfully shoot objects to other characters.</td>
<td>Build up a farm by growing plants and feeding animals. - Players win points for eating healthy food, growing a personalized character. - As a reward, players can playfully shoot objects to other characters.</td>
<td>- Catch food items as they drop down the screen. - Feed healthy items to own character and unhealthy items to opponent’s character. - Exercise unhealthy (‘fatter’) character back to shape.</td>
<td>- Conquer physical challenges (e.g. ‘the mountaineer’ - climb 100 steps). - Players win points and special rewards to upgrade their character. - Points can be allocated to support weaker players.</td>
<td>- Each player takes on a designated role (e.g. carrier). - Players move through a virtual environment, working together to overcome obstacles and defend against attacking enemies.</td>
<td>- Pairs solve virtual puzzles and avoid traps. - Physical characteristics (e.g. size, strength, agility) are used to activate and control on-screen objects. - Players take it in turn to complete tasks.</td>
<td>- Carry out familiar meal preparation, cooking and eating tasks. - Each player controls part of a virtual character. - Co-ordinated actions from both players are required to achieve set goals.</td>
<td></td>
</tr>
<tr>
<td><strong>Gameplay balance</strong></td>
<td>Competitive</td>
<td>Competitive</td>
<td>Competitive</td>
<td>Competitive</td>
<td>Competitive/Cooperative</td>
<td>Competitive</td>
<td>Competitive</td>
<td>Competitive</td>
<td>Competitive</td>
<td>Cooperative</td>
<td>Cooperative</td>
</tr>
<tr>
<td><strong>Input control</strong></td>
<td>Face to face, Speech</td>
<td>Portable device</td>
<td>Portable device</td>
<td>Multi-touch table</td>
<td>PC, Portable device</td>
<td>Gesture</td>
<td>Gesture</td>
<td>Gesture</td>
<td>Gesture</td>
<td>Gesture</td>
<td>Gesture</td>
</tr>
<tr>
<td><strong>Player roles</strong></td>
<td>Asymmetrical</td>
<td>Asymmetrical</td>
<td>Asymmetrical</td>
<td>Symmetrical</td>
<td>Symmetrical</td>
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<td>Asymmetrical</td>
<td>Symmetrical</td>
</tr>
<tr>
<td><strong>Location</strong></td>
<td>Indoors</td>
<td>Indoors &amp; Outdoors</td>
<td>Outdoors</td>
<td>Indoors</td>
<td>Indoors &amp; Outdoors</td>
<td>Indoors</td>
<td>Indoors</td>
<td>Indoors</td>
<td>Public transport</td>
<td>Indoors</td>
<td>Indoors</td>
</tr>
</tbody>
</table>

**Key** –  - Favor physical fitness of YOUNGER player  - Favor prior gameplay experience of YOUNGER player  - Favor prior knowledge of OLDER player  - Neutral
episodic and do not require sustained or long-term usage. Thus, there appears to be a tacit understanding that intergenerational gameplay is perceived to be closer in alignment with casual than sustained gaming.

**Motivations and rewards**
In general, gameplay motivations were inadequately thought out in the workshop groups. Beyond achieving the goal of completion, approximately half of the groups loosely specified the reward of the game to be about improving intergenerational relations, by ‘creating a happy family’, or ‘enabling generations to work together’. Of the six storyboards that specified a reward, there was no indication how they might accumulate in value the longer the player progressed in the game. Namely, rewards tended to be given at the end of a task (although not in all cases), rather than during the gameplay.

**DISCUSSION**
Our workshop approach focuses on bringing younger and older participants together to share experiences, skills and lifestyles, which mutually build understanding and empathy when designing game concepts. Besides collecting a wealth of insights from participants, an advantage of this process is that both age groups were able to negotiate between themselves to find appropriate compromises on design features. The immediate feedback from participants allowed the research team to better engage with each group, thus allowing for more informed design decisions. As could be expected the younger adults were more dominant in suggesting how they perceived aspects of a game to operate, or what factors might restrict their interaction. By contrast, the older adults were good at moderating discussions, and were generally more opinionated in questioning the practical attributes of the game mechanics (e.g. cost, setup, etc.).

Previous intergenerational studies have been critical of short introductions to ‘draw out curiosities’ between participants [11]. Consequently, reducing our design process is unlikely to have produced the same range or depth of ideas, in focusing on exploratory, rather than predefined games. The authors spent considerable time contemplating the number and length of activities, cautious of participant dropouts with a longer study. However, there are likely benefits of extending the length of the workshops to run activities over a series of refined sessions. This includes following up design concepts with more detailed mock-ups, which in turn could be evaluated by different groups of younger and older participants.

**Designing for intergenerational gameplay**
The results indicate that one size does not fit all when designing intergenerational games. Yet, despite the variations in game choice, the majority of the storyboard concepts shared a number of common characteristics. They were predominantly short, easy to master and family orientated. Interestingly, none of the games described the rules, narratives, player skills or rewards in great detail. The suitability of the storyboard concepts to our target audience relate to specific design features and game goals, rather than a particular genre. They include a strong educational component of practical learning, or passing down family traditions (e.g. family recipes), passing time through games that can be easily absorbed, or more strategic, problem-solving games that involve cooperation and role-play. Interestingly, a number of the game designs focus on a younger age group to the participating youths. This is reflected in concepts that center on completing homework tasks or healthy eating, and of which favor the prior knowledge of the older adult. Likewise, there are game concepts (e.g. Teamwork Ants and Catch) that are likely to engage across multiple age groups, given no distinctions were made towards the age of the player.

Based on our findings, we recommend when designing intergenerational games, the following elements should be considered:

**Leverage on differences in ability.** An awareness of the heterogeneity of the user groups, in designing for older old as compared to younger old, or early childhood compared to late childhood, or adolescence is critical. To address possible disparities in skill sets, designers should build on the intrinsic qualities and experiences of targeted age groups. For example, consider how older people’s life-skills could be incorporated into the gameplay to counterbalance for physiological limitations when playing with teenagers.

**Draw on relevant expertise.** Consider the roles older adults could exert in passing on cultural inheritance and positive life experiences. Likewise, the roles younger adults could have in supporting older adults’ learning of the game mechanics, and help in retaining a sense of youthfulness through play. The challenge of sustaining mutual engagement is reflected by the means of strategizing individual roles between players, while using appropriate game narratives to stimulate common interests [3].

**Consider the scalability and motivational factors of games.** Previous intergenerational research has a tendency to emphasize relatively simple game concepts [9, 20]. Arguably however, to sustain long-term motivational interests between diverse cohorts, intergenerational games require both complexity and challenge. Practitioners should therefore be cautious of directly developing digital games from traditional game concepts by assuming they will be easier to play for older adults. We identified an openness to embrace novel forms of interaction and interest in linking games to new experiences, suggesting practitioners should
investigate what makes intergenerational games ‘socially inclusive’, rather than merely adapt to what is known.

Transform places for play. The concept of an in-transit bus game suggests there is value in exploring opportunities within public spaces for community engagement. This brings into question the roles games have in fostering relationships with strangers, and the extent they differ to a family context. Likewise, the results indicate design opportunities in utilizing attributes of familiar outdoor environments within an exploratory game space, using portable devices to set and monitor challenges between players (e.g. the supermarket in Chore Safari). In addition, while game consoles are widely utilized in the home, a better understanding of domestic practices and routines are likely to identify new spaces for play (e.g. Chomp Chomp!).

Recognize local needs. Practitioners should be aware of contextual issues, which may not be universally applicable, but are socially relevant to local communities in posing particular challenges/opportunities for games. For example, the workshops indirectly highlighted the language barriers that exist in Southeast Asian countries like Singapore, and the difficulties some grandchildren have in communicating with grandparents who only speak local dialects. This issue is also pertinent to other non-English speaking countries. More research should thus be devoted into studying games that can transcend language divisions.

CONCLUSION
In this paper, we present the exploratory findings of three design workshops investigating intergenerational game design concepts through collaborative partnerships. Through applying a range of methods, this paper presents important motivation and design ideas for intergenerational games between younger and older adults. The authors believe the implications of this work extend beyond games design per se, to broader questions of how technology requirements are designed with such diverse groups. Future research will continue to refine the workshop methods, as we seek to develop and subsequently evaluate some of the most interesting intergenerational game concepts presented in this study.

REFERENCES