Crowdsourcing of mobile content has become a major way of populating information-rich online environments. One approach to motivate participation is via games. That is, a crowdsourcing game is built upon the desire of individuals to be entertained while generating useful outputs as byproducts of gameplay. A gap in current research is that actual usage patterns of crowdsourcing games have not been investigated adequately. We address this gap by comparing content creation patterns in a game for crowdsourcing mobile content against a non-game version. Our analysis of 3024 contributions in both apps reveals 10 categories, divided into: (1) those that conform more to the notion of mobile content utilized to learn about a specific place or for navigational purposes; and (2) those that were about the content creator himself/herself, or in relation to other users or other non-playing individuals, with the location as a backdrop, similar to status updates in social media platforms like Twitter. We argue that both categories are potentially useful in that they meet different needs, and together could serve to recruit and sustain participation in the longer term. Further, the distribution of categories varied across the apps, indicating that the features afforded by games shape behavior differently from non-game-based approaches to crowdsourcing.

Keywords
Crowdsourcing games, mobile content, evaluation, content analysis, human computation.

INTRODUCTION
Crowdsourcing of mobile content has become a major way of populating information-rich online environments. Essentially, crowdsourcing harnesses large groups of online users to address specific problems (Doan, Ramakrishnan, & Halevy, 2011). In the domain of user-generated mobile content, examples include content creation to describe locations of interest using text and other multimedia formats, as well as creating and/or verifying maps.

Humans, unlike computers, require incentives to perform crowdsourcing tasks. Typically, crowdsourcing systems employ volunteers or paid human experts. However, recruiting and retaining volunteers are challenging since volunteerism is dependent on individuals’ willingness to devote their time and effort to crowdsourcing projects (Yuen, Chen, & King, 2009). Paying for expertise is thus an alternative and has yielded positive outcomes. For example, Deng et al. (2009) utilized Amazon’s Mechanical Turk, a crowdsourcing platform, to gather tags for images. Workers were paid a small amount of money for identifying objects contained in given images, and in total, 1.2 million images were tagged.

Nevertheless, hiring of experts or paying for crowdsourcing work is potentially costly and this approach is confined to those projects backed with adequate funding. Additionally, an important issue to consider is the appropriate monetary amount with which to incentivize workers in relation to the task complexity to encourage participation (Ipeirotis & Paritosh, 2011). A universally accepted solution for this issue has yet been achieved. Concerns of fraud have also been raised (Thomsen, 2013) due to the involvement of monetary transactions. Put differently, people participate in crowdsourcing projects for a variety of reasons, of which altruism and monetary rewards alone cannot satisfy (Brabham, 2012). Therefore, crowdsourcing projects need to consider alternative motivational mechanisms to widen the appeal to a larger group of users.

Here, computer games are a possible means to attract participants for crowdsourcing projects. According to statistics reported by the Entertainment Software Association (2015), 59% of Americans have played computer or video games. Furthermore, the Casual Games Association (2007) reported that there were more than 200 million online gamers worldwide, and this number is believed to be increasing. Consequently, games layered upon crowdsourcing tasks have emerged. Also known as human computation games, or crowdsourcing games, players contribute their intelligence to a given endeavor through enjoyable gameplay (Goh & Lee, 2011).

In essence, crowdsourcing games are built upon the desire of individuals to be entertained while generating useful outputs as byproducts of gameplay (Doan, Ramakrishnan,
As games for crowdsourcing mobile content gain traction, research has emerged, primarily focusing on game design issues (Tuite, Snively, Hsiao, Tabing, & Popovic, 2011), with some work done on usage motivations (Han, Graham, Vassalo, & Estrin, 2011) and player perceptions (Pe-Than, Goh, & Lee, 2014). One gap present in prior work is that actual content creation patterns of crowdsourcing games have not been investigated adequately. We argue that although the aforementioned areas are crucial, understanding actual usage is equally essential for verifying the outcomes of design and perceptions research, as well as for identifying challenges that users face while using these applications (Rogers et al. 2007). As well, the layering of games into crowdsourcing apps could modify usage behavior because of the entertainment element not found in non-game-based variants.

Of the few examples, Goh, Lee and Low (2012) conducted a content analysis of the contributions made in a mobile crowdsourcing game to uncover motivations for sharing, while (Celino et al., 2012) found that the number of contributions in a mobile game for linking urban data was relatively high. However, a potential shortcoming of prior work is that there is no comparative analysis of contributions against other systems. For example, how would a non-game-based crowdsourcing app fare against a game-based app? Understanding the nature of crowdsourced content and differences across application types would translate into a better understanding of user behavior, leading to better designed applications that would benefit users and encourage sustained usage.

We aim to address this research gap by fulfilling two objectives in the present study. First, we develop two crowdsourcing apps for mobile content creation: a game-based version that employs a virtual pet genre where players compete for pet ownership, and a non-game version. Second, we compare both apps to shed light on actual usage patterns, focusing on the types of content created by users. The remainder of the paper is organized as follows. The next section introduces related literature followed by a description of the apps we created. The subsequent sections highlight the methodology and the findings of the study. This paper concludes with a section that discusses our findings and future directions.

RELATED WORK
Crowdsourcing Games
Crowdsourcing may be understood as the act of gathering a large group of people to address a particular task, traditionally executed by a designated person, through an open call for proposals via the Internet (Schneider, deSouza, Lucas, 2014). Crowdsourcing makes it possible to mobilize the competence and expertise that are distributed among members of a crowd beyond the restrictions of time and space (Schenk & Guittard, 2011).

Set in this context, crowdsourcing games may be considered dual-purpose artifacts which are employed to perform tasks and offer entertainment at the same time. These games may also be called games with a purpose (von Ahn & Dabbish, 2004) or human computation games (Goh & Lee, 2011). Crowdsourcing games are driven by the entertainment experience fostered through gameplay. They are built on the premises of collective intelligence and that humans outperform their computing counterparts in certain tasks (Pe-Than, Goh, & Lee, 2013). A well-known example is the ESP Game (von Ahn & Dabbish, 2004) whose purpose is to label/tag images, an activity that is considered difficult for computers to perform but easy for humans, although potentially tedious. Two randomly-paired players on the Web are shown the same image. The game rule is that a player has to guess the words that might be used by his/her partner to describe a given image, and both players will be rewarded when their terms match. While being entertained, players produce labels as byproducts that can be harnessed to improve image search engines.

The accessibility of content and services afforded by mobile devices have resulted in the emergence of mobile crowdsourcing games that allow players to perform crowdsourcing tasks anytime, anywhere. Location-based crowdsourcing games are typical examples that collect content about real-world locations. In MobiMissions (Grant, Daanen, Benford, Hampshire, Dzord, & Greenhalh, 2007), missions are created, solved and reviewed by players. Missions are accomplished by means of creating a series of photographs and text annotations associated with specific locations. Eyespy (Bell et al., 2009) generates photos and texts of geographic locations that can be useful in supporting navigation or creating tourist maps. Players take pictures of locations and share them with others who then have to determine where these pictures were taken. Points are awarded for producing more recognizable images and for confirming the images of other players.

Next, Indagator (Lee, Goh, Chua, & Ang, 2010) incorporates gaming elements into content-sharing activities. Players can share and browse media-rich
location-based information, and earn points by rating and creating content. Using these points, they can play mini-games, lay traps for other players, and obtain valuable in-game items. Using geospatial data from OpenStreetMap, Urbanopoly (Celino et al., 2012a) challenges players to participate in mini-games in which information creation or verification tasks are embedded so they can conquer the venues and become rich landlords. As a side benefit of gameplay, players contribute geospatial data that is useful for other locative services. SPLASH employs a collaborative pet-based game genre to share location-based content (Pe-Than, Goh, & Lee, 2014). In particular, locations are represented by pets and players “feed” content so that they can evolve. The appearance of pets changes depending on the quality, quantity, recency and sentiment of content feed. The content associated with pets describes the respective locations and is accessible by other players. Finally, GEMS or Geolocated Embedded Memory System (Procyk & Neustaedter, 2014) allows players to document location-based stories for personal reflection as well as for future generations to find. During gameplay, players receive directives from the game character. They can complete these directives by creating a memory record, which includes a combination of text, audio, photographs or video clips, to capture a particular experience and the place of origin. As players create records, they earn points and access tokens that can be used to unlock secret information about the game character.

Understanding Usage Patterns
As mentioned earlier, research is currently focused on the discussion of novel game designs. In contrast, investigations of usage patterns are comparatively fewer. Nevertheless, in line with the objectives of this paper, available research on usage patterns of games for crowdsourcing mobile content will be discussed.

One example is UrbanMatch (Celino et al., 2012b), whose aim is to find the most representative photos related to points of interest (POI) in Milan, Italy. Players are presented with a photo of a POI from a trusted source, and they have to link it to a selection of other photos from non-trusted sources. If more players couple an untrusted photo with the trusted one, the former becomes a strong candidate to represent the POI as well. Based on the contributions of 54 players who tested 2006 links, an accuracy rate of 99.4% was obtained. That is, 99.4% of links between a trusted source and untrusted source were found to be correct. Moving beyond simply determining accuracy of content, (Bell et al., 2009) examined the images contributed via Eyespy (described earlier) to uncover nine categories including those relating to shops, signs and buildings. These categories were consistent with the games' purpose of generating content for aiding street navigation. Additionally, the authors compared the photos contributed in Eyespy against similar photos in Flickr, and found that the former were more helpful for navigation.

Next, Procyk and Neustaedter (2014) organized content contributed in GEMS into different axes including writing style (e.g. accounts of specific events or descriptions of a location's significance) and location types (e.g. public places, countries/cities, vehicles). Interviews with participants suggested that the act of creating and accessing location-based stories in GEMS was useful in learning and connecting with the places being described. Further, in an analysis of crowdsourced SPLASH content, Goh, Razikin, Chua, Lee and Tan (2011) found 15 categories of contributions ranging from food, emotions, places of interest as well as people. Interestingly, nearly 10% of the content was nonsensical in nature. Two possibilities were mooted, with one being that users were new to the game and were testing its functionality with short posts. However, another was that users attempted to "game" the system since contributing content earned points. This was verified by follow-up interviews where some users admitted to wanting to earn as many points as possible to either purchase in-game items and/or rise in rankings. Finally, Massung, Coyle, Cater, Jay, and Preist (2013) compared three mobile crowdsourcing apps for pro-environmental community activities to collect data on stores. One app used points and badges as virtual rewards for data collected, another used financial incentives, while another served as a control and did not use any incentive mechanisms. Results suggest that the quality of the data collected was similar across all apps, but the app with financial incentives yielded the most data, followed by the app that used points and badges, and the control.

APPLICATIONS DEVELOPED
For our work, two mobile apps for crowdsourcing location-based content were developed: Clash, a competitive crowdsourcing game; and Share, a non-game application. The reasons for developing our own apps were that we would have better control over the look-and-feel of the interfaces and easy access to the contributed content.

Both mobile apps shared a similar purpose of crowdsourcing location-based content. The content model was based on an earlier crowdsourcing game we developed called SPLASH which is briefly described here. More details about SPLASH may be found in (Goh, Lee, Chua, Razikin, & Tan, 2011). Crowdsourced content are known as “comments”, comprising a title, tags, descriptions, media elements (e.g. photos) and ratings. SPLASH organizes content on two levels: “places” and “units”.

Places represent arbitrary geographic areas such as schools, parks and points of interest, and each of these can be further divided into more specific units, which hold the respective comments. For instance, if a mall is considered as a place, a particular store within it will be one of its units which attracts comments. Both mobile apps offer a map-based interface to facilitate creation of, and access to, comments. Specifically, places are indicated by map
markers in the shape of mushroom houses (see Figure 1). Each house has a number of units, and each unit contains the crowdsourced comments.

Returning to the two apps, Clash is a game in which players compete with others for pet ownership. Each unit within a mushroom house is represented by a pet. Once a player has entered a house, a list of pets residing within is presented. Selecting a pet will display information such as the name of the current owner (e.g., “gigo”, in Figure 2), the comments associated with the pet and the cumulative rating of the comments. The player can challenge the current owner to a duel, and he/she will win the pet if the total sum of his/her strength and daily luck (i.e., a random number generated at the first login of each day) is greater than that of the challenged player (see Figure 3). The strength of each player is based on the quantity and recency of comments, and the number of ratings received from others. In other words, to win ownership of a pet in a duel, a player has to contribute location-based content. Clash differs from the original SPLASH in that the latter adopts a collaborative virtual pet approach to gaming and offers other features such as avatars, virtual chat rooms and mini-games. In the present study, we wanted to have a simpler game to make better comparisons against a non-game variant. Specially, this meant focusing only on the feeding of virtual pets and excluding the other game-based features of SPLASH mentioned previously. In doing so, both Clash and Share (described next) would have one primary task of generating content.

Share is a non-game-based mobile app for crowdsourcing content that serves as a control. It does not have any game elements, and offers commonly found features for contributing and accessing mobile content. A user accesses content by tapping on a mushroom house on the map, after which a list of units is presented. When a unit is selected, a list of comments associated with it is displayed (Figure 4). Users can view and rate a comment by tapping on it. They can also create new comments by tapping on a “Add Comment” button displayed in the top panel of each unit. Players are not awarded with any game points or rewards for their activities. Instead, players can view statistics such as the number of comments and ratings created.
**METHODOLOGY**

**Participants**
A total of 160 participants, of which 89 were female, were recruited from two large local universities. Their ages ranged from 21 to 46 years (M=23 years old, SD=3.77). Participants were from backgrounds such as Computer Science/Information Technology (47.8%), engineering (38.8%), and arts and social science (10.4%).

In the sample, 88.1% surfed the Web via their mobile phones while 80.2% used them for map navigation. Further, 72.5% used social network applications to share text and multimedia information via their mobile phones, while 52.5% used the location check-in feature of such applications. The majority of the participants (81.3%) indicated that they were game players.

**Procedure**
Before the study began, participants attended a 30-minute briefing session in which the concept of mobile content sharing was introduced. The usage of each application was then demonstrated, followed by a short practice session. To help participants better understand how the applications worked, usage scenarios involving competing for pets by dueling with the owners (for Clash), as well as creating, browsing, and rating content (for Share) were presented.

Participants were required to use both applications on Android-based mobile phones on two different days, each spaced one day apart. The study was counter-balanced to account for possible sequence effects. That is half the participants used Clash followed by Share, while the other half used Share followed by Clash. They could either use their own mobile phones or borrow ones from the researcher. Participants using their own phones had to ensure these phones met minimum requirements in terms of screen size and processor power to ensure a similar user experience. Participants were also told to use the application at any time where convenient to create and rate content, but the minimum usage was two half an hour sessions a day. Participation was voluntary and anonymous.

**Analysis**
All comments created using the two mobile apps (Clash and Share) were extracted, analyzed and coded via an iterative procedure common in content analysis (Neuendorf, 2002). The unit of analysis was a comment. First, content was classified based on categories derived from related earlier studies (e.g. Goh, Lee, & Low, 2012; Naaman, Boase, & Lai, 2010). Next, for those not classifiable into these categories, we inductively constructed new categories by identifying similarities across entries and coding them into logical groupings (Heit, 2000). This addition of new categories required that entries that were previously categorized be reviewed to check if they needed to be reclassified. This process is repeated till all comments could be consistently categorized. Categories and their definitions were recorded in a codebook where they were fully explained to coders.

In the present study, two coders were independently involved in the content analysis procedure, and the intercoder reliability using Cohen’s kappa was found to be 0.841 for Clash and .927 for Share. These values are above the recommended average (Neuendorf, 2002).

**RESULTS**
In total, 3024 comments were contributed by our participants and analyzed. Of these, 2059 were created using Clash and 964 were created using Share. Interestingly, even though participants used both apps, there were significantly more comments for Clash than Share. The final set of 10 categories derived is shown in Table 1 while their percentage distribution is depicted in Figure 5. New categories that were uncovered in this study were “App-related” and “Complaints and suggestions”. A description of these categories is presented in the following paragraphs, together with excerpts from relevant comments contributed by participants.

<table>
<thead>
<tr>
<th>Category</th>
<th>Clash (N=2059)</th>
<th>Share (N=964)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities and events</td>
<td>187 (9.08%)</td>
<td>147 (15.25%)</td>
</tr>
<tr>
<td>App-related</td>
<td>462 (22.44%)</td>
<td>25 (2.59%)</td>
</tr>
<tr>
<td>Complaints and suggestions</td>
<td>81 (3.93%)</td>
<td>58 (6.02%)</td>
</tr>
<tr>
<td>Food</td>
<td>220 (10.68%)</td>
<td>101 (10.48%)</td>
</tr>
<tr>
<td>Humor</td>
<td>82 (3.98%)</td>
<td>53 (5.50%)</td>
</tr>
<tr>
<td>Places</td>
<td>449 (21.81%)</td>
<td>254 (26.35%)</td>
</tr>
<tr>
<td>Pleasantries</td>
<td>190 (9.23%)</td>
<td>84 (8.71%)</td>
</tr>
<tr>
<td>Queries</td>
<td>162 (7.87%)</td>
<td>97 (10.06%)</td>
</tr>
<tr>
<td>Spam</td>
<td>61 (2.96%)</td>
<td>17 (1.76%)</td>
</tr>
<tr>
<td>Status updates</td>
<td>165 (8.01%)</td>
<td>128 (13.28%)</td>
</tr>
</tbody>
</table>

Interestingly, the category showing the greatest difference between the two apps was "App-related", that is, postings that were about the software or gameplay. In Clash, it
attracted the largest proportion of comments, at 22.44% of all contributions. It would appear that comments were used as a means to achieve *Clash's* objective of winning pets, and thus contained little informational value of the location apart from perhaps commentary about the gameplay experience. Examples include "I just defeated the owner!", "stop stealing my pets", and "I have 2 fat pets now lo!". In stark contrast, this category was the second-smallest in *Share* at 2.59%. It would appear that without a gaming objective, participants did not see much need to create content related to the app. As in *Clash*, comments were primarily commentary about the usage experience such as "this is my first session, same for everyone?"

The category that attracted the largest proportion of comments for *Share* was "Places" (26.35% of all contributions and was a strong second for *Clash* (21.81%). Comments were descriptions of locations that participants found interesting or meaningful, and both apps were similar in this regard. Examples included a participant recommending a park for taking photos ("Yunnan Garden is a good place for a photoshoot") and another suggesting a place to study in a university ("Fantastic place to study or chill with friends during long breaks between lessons."). Comments could also be personal, such as participant who wrote "this is where I met my boyfriend last year".

Next, categories that attracted less than 10% of contributions for either mobile app were:

- "Activities and events" (9.08% for *Clash*, 15.25% for *Share*), which refer to descriptions of activities or events that have occurred ("tea party at the lounge - free food") or will occur ("there is a seminar on the Chinese diaspora here tomorrow"). Comments made were from the participant's perspective, and may contain opinions about what happened or will happen (e.g. "it was super crowded" when referring to an event).
- "Status updates" (8.01% for *Clash*, 13.28% for *Share*), which involved making personal updates in relation to the current location. This may involve what the participant did or is currently doing ("tried to buy [it] today but the queue was so long", "bye I'm going home"), or how he/she feels or thinks ("a little hungry now", "feeling stressed").
- "Food" (10.68% for *Clash*, 10.48% for *Share*), which discussed food and food-related establishments. Typical comments were recommendations ("recommend the mocha skinned milk latte"), food reviews ("the green curry is not bad"), or experiences about the establishments visited ("to be honest, it is quite expensive but the cupcakes look really nice").
- Queries (7.87% for *Clash*, 10.06% for *Share*), where participants asked questions or requested for assistance about various locations. For example, a participant was impressed by the views in park and asked, "Have u guys been to this awesome place before?" Another participant asked about a museum ("what is in the Chinese heritage center") while another asked the opening hours of a store ("does it open on weekends or not?").

Following these, the next few higher-ranked categories which attracted 10% of comments or more, for at least one mobile app were:

- "Pleasantries" (9.23% for *Clash*, 8.71% for *Share*), which included greetings, well-wishes and other polite remarks (e.g. "hi guys", "haha good night!", "see you tomorrow!", "LOL at the comments"). These were associated with specific locations, often with the expectation that certain participants would visit and reciprocate. Thus, user names were also sometimes included in such comments ("hello mg33").
- "Complaints and suggestions" (3.93% for *Clash*, 6.02% for *Share*), which involved participants making complaints ("the Internet connection here is quite bad at times", "music is a bit distracting", "the toilets here spew water when flushed") or sharing suggestions pertaining to specific locations ("Bring your jacket. The air-conditioning is rather strong here", "the water fountain will give you a better mood for reading than the eerie interiors!")
- "Humor" (3.98% for *Clash*, 5.50% for *Share*), which were jokes or humorous remarks, often related to a location. Examples included "Went twice. No one. Great place to make out #justkidding", "Alcatraz of NTU!")

At the other end of the scale, "Spam" was surprisingly the smallest category across both apps (2.96% for *Clash* and 1.76% for *Share*). This category refers to comments with meaningless words or irrelevant content. Such comments were used as a quick means to make contributions with
little effort. Examples include terms such as "fgfgfg" or punctuation characters ("?????").

DISCUSSION

The results of our study showed that participants using Clash created more than double the number of comments (2059) than those using Share (964). Since all participants went through the same study procedure and used both apps, this suggests that game-based approaches to crowdsourcing could better motivate contributions as opposed to non-game-based ones. This concurs with prior work demonstrating that the enjoyment derived from gameplay fostered further usage of crowdsourcing games (Pe-Than, Goh, & Lee, 2014). On the surface, our content analysis also shows that both apps yield similar categories of contributions, although their proportions differ, indicating that the features afforded by games shape behavior differently from non-game-based approaches.

In particular, Clash produced more “App-related” content than Share. As noted previously, such content served to achieve the game's objective of winning pets via feeding, and typically included a running commentary of the game's progress or the players' feelings during gameplay. Unsurprisingly, an examination of the contributions indicates that most were low in information value in terms of describing/discussing specific locations. Nevertheless, they may serve alternative purposes of entertainment through colorful commentary or providing insights into various players through the types of postings made (Lee, Goh, Chua, & Ang, 2010). One outcome of such contributions is that they may serve to draw and sustain interest in the game (Goh, Lee, & Low, 2012) as they invite others to respond, thus creating a mini-community lasting the duration of a gameplay session. In other words, gameplay led to social interactions among players. For example, one Clash player defeated a pet owner who user name began with "mg". The player first announced the victory ("I JUST DEFEATED THE OWNER") and also wondered what "mg" stood for. Almost immediately, another player congratulated the winner ("congrats") while someone else joked that "mg" meant "mindless gamer".

In contrast, Share did not offer any incentives to contribute content apart from a count of the number of posts made. This resulted in two outcomes. One, participants produced fewer contributions. Two, there was little need to create posts related to the app posts unless perhaps participants had nothing else to write about. Even then, because content creation was a solo activity in Share, unlike the competitive social environment in Clash, contributions did not garner any replies, signaling an absence of community. For example, the participant who created a post that asked "this is my first session, same for everyone?", but it did not attract any responses. As such, the majority of contributions were personal expressions related to using Share and were non-conversational in nature. Examples include a participant who compared Clash's gameplay with Share, "no more feeding pets" and another who happily noted the conclusion of his/her participation, "woohoo last session".

We were somewhat surprised that there was a low quantity of nonsense or "Spam"-related posts in both apps (less than 3% for Clash and Share). We postulate a couple of reasons. One, the novelty of the apps in the study could have made participants less prone to generate nonsensical content, and perhaps causing them to put in effort to contribute to the community of players. Two, other categories of content obviated the need for spam-related postings. This included the "App-related" category especially for Clash, but also others such as "Status updates", "Humor", and "Pleasantries". Stated differently, instead of posting meaningless or irrelevant content, players treated both apps as an alternative social media platform to share whatever came to mind, much like Twitter (Humphreys, Gill, Krishnamurthy, & Newbury, 2013). Here, the primary difference was that the contributions were mostly tied to specific locations. In fact, the total percentage of posts within the "Status updates", "Humor" and "Pleasantries" categories comprised 21.22% for Clash and 27.49% for Share. For ease of writing, we group these categories under the term "location-based personal sharing".

Next, categories of crowdsourced contributions that conform more to the notion of location-based content being utilized as a means to learn about a specific place or for navigational purposes (Yap, Bessho, & Sakamura, 2012) include "Activities and events", "Complaints and suggestions", "Food", "Places", and "Queries". Here, we group these categories under the term "location-based content" since the focus was less on individuals and more on the location itself. These categories constitute 53.35% of total content in Clash and 68.15% in Share. Contributions included what a particular location was about, what could be found there, what was happening around the location or in relation to the location, what would be the best time to visit the location, what was the best way to get to the location, and what was the weather like. In contrast, the location-based personal sharing contributions were about the player himself/herself, or in relation to other players or other non-playing individuals, with the location as a backdrop. In other words, the location is less of an interest and simply becomes a setting for which the player expresses himself/herself. Examples include a participant who arrived at a building and posted "I never knew such a cafe existed" or another waiting for a train and pleaded to no one in particular, "train pls don't breakdown".

A further comparison of the proportions of categories in Table 1 show that in most cases, Share had a larger percentage than Clash. This was due to the fact that for the Clash, the "App-related" category was 18 times larger than Share. In other words, this category attracted comments that could have otherwise been made elsewhere. This again reinforces the notion that Clash players likely sought an efficient way of generating content to win pets. Further, the
location-based content categories had a larger differential across apps than the personal sharing categories. Speculatively, we reason that to contribute meaningfully to the location-based content categories, participants had to be familiar with what a particular place had to offer (FitzGerald, 2012). This was less of a requirement for content in the personal sharing categories since it primarily required drawing from one's own experience, thoughts and feelings. Put differently, generating content in the location-based content categories was more cognitively demanding, and because participants in our study were tasked to win pets by competing against others in a specified timeframe, they perhaps turned to personal sharing.

Finally, an important concern of crowdsourcing apps is the quality and usefulness of the contributed outputs. In order to ascertain this for Clash and Share, the intended purpose of the mobile content is required. In the present study, participants were not constrained in terms of the types of content contributed, and could use the apps as they saw fit. If one takes a stricter definition of mobile content for wayfinding, which includes tasks such as navigation and knowledge acquisition (Wiener, Buchner, & Holscher, 2009), then it would appear that Share generated more potentially useful content since 68.15% of contributions fell into the location-based content category as opposed to 53.35% for Clash. Whether these contributions were actually useful was not investigated in this study but would be instructive for future work.

However, if we were to expand the concept of content usefulness, then contributions in the location-based personal sharing group may potentially meet other needs. Prior research has demonstrated that people use crowdsourcing games to meet various needs beyond information seeking and sharing (Lee, Goh, Chua, & Ang, 2010; Schenk & Guittard, 2011). This includes the expression of one's thoughts and feelings, influencing how others view oneself, building new and/or maintaining existing social relationships, competitive gameplay and killing time. Set in this context, the "App-related" category for example, might fulfill participants' desire for competitive gameplay or killing time as we saw expressions of triumph when pets were won ("DEFEATED AND OWNED THIS PET WOHHO"). Further as described previously, transient communities were formed around conversations of pet ownership. Likewise, contributions in the "Pleasantries" categories may serve as a means of relationship building while those in "Status updates" may fulfill this purpose plus self-expression and self-presentation. Interestingly, these contributions also seemed to suggest that participants were comfortable enough to share and express their inner thoughts which might lead to deeper emotional connections among community members. In sum, this ability by Clash and Share to meet information as well as other types of needs may bode well for recruiting and sustaining participation for the longer term.

**CONCLUSION**

In this paper, we extend current work in understanding perceptions and behaviors pertaining to crowdsourcing games by analyzing the content created by users of two mobile apps, a competitive mobile game and a non-game version, for generating mobile content. Arising from our findings, the following implications may be drawn.

First, games can attract participation in crowdsourcing tasks because of the enjoyment derived through gameplay. Greater participation can be accomplished in two ways: (1) the generation of more content over non-game-based alternatives as demonstrated in our study and described earlier; (2) recruitment of new players by existing ones through word-of-mouth. Evidence for the latter has been seen in prior work showing that heightened perceptions of enjoyment of crowdsourcing games increases the likelihood of them being recommended to others (Goh, Lee, & Low, 2012). Second, while games may be entertaining and encourage participation better than non-game applications, the contributions may not always conform to the intended goal of the crowdsourcing task. We contend that the layering of a game changes users' behaviors as they respond to the excitement and challenge of accomplishing its objectives (Goh & Lee, 2011). A side effect is that the actual crowdsourcing objective potentially becomes secondary. Thirdly, people participate in crowdsourcing for many reasons (Brabham, 2012) and some of these motivations may not always align with the objectives of the project. The use of games may introduce or enhance unintended motivations, such as socializing in the case of our present study, which could dilute the original crowdsourcing effort. Nevertheless, these motivations may also serve as a means to attract new users and sustain existing ones better than non-game-based variants.

A practical implication of our findings is that developers of crowdsourcing games need to carefully strike a balance between entertaining game design and the production of useful contributions since an over-emphasis in one may lead to a weakening of the other. One possible way to address this issue is via concerted messaging that stresses the intended goal of the crowdsourcing game. This includes features for building communities where relationships can be established, categorization of contributions to facilitate future access, as well as customization of player profiles to support self-presentation.

Despite the insights uncovered, there are some shortcomings that could limit the generalizability of our
findings. The first concerns the profile of our participants. For example, participants were recruited from local universities, and most came from technical disciplines and were game players. Outcomes could differ with participants from other backgrounds such as different age groups or working adults. Further, our crowdsourcing game was based on a virtual pet genre with a particular set of rules and objectives which may have influenced the perceptions and behaviors of our participants. Investigating other game genres would be helpful to ascertain if the content categories uncovered in this study are stable. Our study was also carried out within a short period of time in which all participants were new to the application. This may introduce novelty effects that could influence our findings. Hence, conducting a longer-term, longitudinal study may yield different outcomes and would be a worthwhile area of investigation. Finally, the present study examined the types of content that was created, and implicitly, we derived a number of possible motivations for doing so. Explicitly uncovering such motivations and validating them would be another fruitful area of future work.

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