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Playing With Science: Exploring How Game Activity Motivates Users Participation on an Online Citizen Science Platform

Abstract

Purpose – This paper examines intrinsic forms of motivation and particular incidents of play, socialisation, fun and amusement on an online crowdsourced citizen science platform. The paper also investigates gamised activity (Greenhill et al., 2014) as a form of intrinsic motivation adding a sense of play to work and tasks (Xu et al., 2012). These concepts are explored through close scrutiny of the online citizen science platform Zooniverse.org.

Design/methodology/approach – Qualitative techniques with an interpretivist approach are used to analyse online content found within citizen science platforms, related forums and social media by examining incidents of play, socialisation, fun and amusement to investigate how these aspects are applied as a form of user motivation.

Findings – We find that when users classify crowdsourced tasks voluntarily it does not matter how users are classifying as long as it is accurately. However, what does matter is why they are doing it particularly because of the complex processes that build relationships between users and the platform. We present a conceptual model to enable deeper understandings of how forms of social interaction and play are motivating users contributing to citizen science project to participate in the online processes.

Practical implications – The findings of this paper provide practical implications for how citizen science, and also other crowdsourcing platforms, can engage with notions of play and gamification to motivate participation.

Originality/value – Using detailed examples of online content, we reveal how participants of the Zooniverse.org demonstrate aspects of 'gamised' behaviour. We argue that the exploration of gaming as well as play provides evidence that contributing to citizen science projects can be both utilitarian and hedonic.

Keywords Citizen Science, gaming, intrinsic motivation, play

Paper type Research paper

Introduction

This study explores examples of fun and play within online citizen science projects and how they can be used as forms of intrinsic motivation. As a means of situating the work, we define user generated play in a digital platform as a 'Gamised' activity (Greenhill *et al.*, 2014). In particular we examine incidents of play, socialisation, fun and amusement and consider these forms of social interaction in relation to tasks undertaken on online crowdsourcing platform. Crowdsourcing platforms including the Zooniverse.org can be understood as an Information System as they are a socio-technical system (Mumford, 2000). Citizen science is the name given to scientific investigations or analysis undertaken by amateur or nonprofessional scientists. Like crowdsourcing, it involves the activity of a large group of people, in this case an online community, collectively contributing towards a project (Howe, 2006). Usually conducted by volunteers, citizen science has been implemented to address the demands of data-rich scientific research, for example, time, material costs and labour incurred, particularly for tasks which are not suitable for analysis using computer algorithms (Silvertown, 2009). Citizen science provides opportunities for people to collectively contribute to investigating large data sets, therefore easing the demands that would otherwise slow the research process (Raddick *et al.*, 2009). The crowdsourcing platform is the means from which the science data is presented, categorised and analysed at a technical level. It is also how the system managers, designers and users can communicate and participate in science together.

Using an analysis of online content, we reveal how participants of citizen science projects demonstrate aspects of gamised behaviour when interacting amongst online platforms and forums. The focus of this study explores the relationship between 'play' as a means for building interest and on-going commitment from the users to contribute towards crowdsourced tasks. The specific platform under exploration is Zooniverse.org; the specific projects discussed include Galaxy Zoo and Snapshot Serengeti. Galaxy Zoo asks participants to classify galaxies appearing in images taken by professional astronomical facilities. The interface of the website can be considered to be fairly self-explanatory, with an image of the galaxy to be classified on one side of the screen and multiple choice questions about the features and characteristics of the galaxy on the other (Lintott *et al.*, 2008). The questions are purposefully kept simple and do not require specialised scientific knowledge in order for the participant to engage with the project. The Galaxy Zoo science team uses the crowdsourced information to search for rare types of galaxies and analyse the galaxy population statistically. Snapshot Serengeti displays images of animals gathered from camera traps at the Serengeti National Park in Tanzania. The purpose is to study how a variety of species interact with each other and how they are distributed across the landscape. This relies on a different interface to that of Galaxy Zoo, but still asks the participant a series of questions on the animals they can see in the photo.

Research Agenda

We suggest such a research agenda shaped by the points raised above would have the following objectives:

1. To provide a range of empirical evidence concerning the relation play has as a form of motivation to a serious networked outcome and a critical examination of extant diverse secondary data.
2. To develop an understanding of the processes of social interaction in the context of online citizen science platform via:
    i. Narratives of play and motivation in relation to online science communities and other organisational communities via content analysis of online material.
    ii. Analysis of examples in order to assess the importance of issues of fun, entertainment, satisfaction, motivation, volunteering continuity, pride in contribution and a sense of connection with other citizen scientists.
    iii. Providing clear evidence of play emerging on a system designed for utilitarian purposes
    iv. Elucidation of instances of play as a form of intrinsic motivation within crowdsourced citizen science platforms in order to inform new business models. Findings from this study will provide practical and policy relevant information informing managers and developers regarding the motivations of users of online platforms. For managers and developers, this will help them as they assist in the management of the task processes associated with the categorization of scientific data otherwise known as crowdsourcing.

Citizen Science, play and motivations

Contemporary interests in crowdsourcing, citizen science and online gaming all have one thing in common, in that they are enabled through the networked capacity (Carr, 2005) of digitized human interaction. All three also tread a fine balance when it comes to keeping their specific community of users coming back and continuing to contribute to a final objective that is predefined by computer and platform developers. In this context the question of what constitutes a game is an important problem. For Abt (1987) games be an activity with an aspect of decision-making, an objective, and rules to limit the structure and activity of the game. Although this definition may be limited, games as a form of entertainment evolve, progress and differ in meaning depending on the context. For example, serious gaming involves these aspects being used for other purposes than entertainment (Michael & Chen, 2006). Serious games are platforms that have been specifically designed to be a game in order to achieve a serious output (Connolly *et al.*, 2012). Serious gaming differs from gamification, which can be defined as "applying game-related ideas to non-game processes, issues and situations" (Shea, 2014:4). This is supported by Deterding *et al.*

(2011), who claims gamification is adding a sense of play and game design to something that is not a game.

The differentiation between 'play' and 'work' is becoming increasingly less clear. Burke (1971:33) concludes that the only way to define either 'play' or 'work' is to find formulations which include as many of their usual uses as possible, especially the most common ones, under as few as possible clear, consistent concepts. In contrast to Burke (1971), Gray (2008:2) argues that 'play is actively conducted primarily for its own sake' believing that all characteristics of play have to do with motivation and attitude. There is a growing body of research examining the blurring of work and play. For example, Yee (2005) discusses the blurring between videogames and work play boundaries. Bundy (1992:217) argues that 'without playfulness, all activities become work.' The relationship has been explored by Greenhill and Fletcher (2013), who argue that as the difference between real and digital environments are becoming less apparent so are the differences between work and play. Anderson *et al.* (2013) supports this argument by exploring how some online gaming platforms may be seen to subtly influence the player into enjoying the work undertaken.

According to Danbridge (1986) the value of organisations is to blur the boundaries between work and play to enable workers to experience the benefits of 'flow' associated with play activities. Furthermore by de-emphasising the dichotomy between work and play within the workplace, workers are then able to draw 'fun' and 'enjoyment' into the ceremonies of work. This de-emphasizing therefore enables the incorporation of elements of playfulness into their daily working lives and improves job satisfaction. Bolton and Houlihan (2009:557) claim 'organic fun is an intrinsic and inherent part of organisational life', as it can be used as a motivational tool to increase performance, creativity and job satisfaction. But they also warn that as fun is 'spontaneous, not neatly packaged with the promise of expected results clearly marked on the label.' Similarly, Paras and Bizzocchi (2005) have found that although the use of games as learning environments has significant potential, but that reflection needs to be integrated into the experience as well as flow, as it is a necessary part of the learning process. As Gros (2007) highlights, games can teach valuable skills to students, including digital literacy, so long as the design includes robust pedagogical considerations. Well designed games can have an important impact across different kinds of teaching, including health and physical education (Papastergiou 2009).

The Zooniverse has an online community of over one million registered users, which continues to grow in size and expand across geographical regions (Simpson *et al.*, 2014). As users are contributing to scientific research, which can potentially shape and contribute towards ways of understanding, it may be seen as imperative that the crowd is suitably and successfully managed in order to minimize potential error, as it could have a detrimental effect on future understandings. Individual projects have been specially developed in order to guide and manage users. For example, the Old Weather project included ranking systems to encourage participation and sustain volunteer engagement. Eveleigh et al. (2011) found that while it motivated some users, other found it was too competitive and perhaps went against the ethos of collective

achievement that underpins citizen science. With the exception of Old Weather, none of the Zooniverse projects have been designed to include aspects of gamification in order to motivate users. These systems have been designed for utilitarian purpose in order to maintain organisation of the crowd and their contributions to the platform (Chamberlain *et al.,* 2013).

When exploring the potential motivations of Zooniverse users it is important to consider the difference between intrinsic and extrinsic motivations. Ryan and Deci (2000:55) provide an overview surrounding classic definitions and new directions of these terms and describe intrinsic motivation as 'doing something because it is inherently interesting or enjoyable' referring to doing something because of the internal rewards such as feelings of achievement and the satisfaction at completing a task (Deci & Ryan, 1985; Heyman & Dweck, 1992). Extrinsic motivation refers to being motivated because of the possibility of external rewards such as money or awards. If someone is extrinsically motivated, they are considered more willing to work on something they may have little personal interest in for external rewards (Gagne & Deci, 2005). Generally, games are considered to foster intrinsic motivation in order to engage players (Dickey, 2006). However, the introduction of serious games has arguably created a balance between reaching for internal and external rewards simultaneously (Garris *et al.*, 2002).

Gerow *et al.* (2013) have carried out a thorough literature review within the field of IS and argue that a system can be both utilitarian and hedonic in nature, meaning that it can be both practical and enjoyable (Table one). Furthermore they explain that studies exploring motivational users have existed for some two decades (e.g Davis *et al.*, 1992; Venkatesh *et al.*, 2003; Recker & Rosa, 2012). Gerow *et al.* (2013) explore the concept of intrinsic motivation for utilitarian systems. In the field of IS utilitarian systems are defined as a platform, which has been designed for a practical use (van der Heijden, 2004).

Table one - Gerow *et al.* (2013)

This model developed by Gerow *et al.* (2013) describes the varying forms of hedonic activity when using utilitarian systems. We extend this model of intrinsic motivation to understand the intentions to use play and games within the crowdsourcing platform, Zooniverse.org. Similarly to Gerow *et al.* (2013) we suggest motivation can be both hedonic and utilitarian.

With these thoughts in mind it might be argued that the seemingly blurred relationship between work and play may be applied in a similar manner to the participation and contributions towards citizen science. When a dichotomy is established between 'the process' of data categorization and science as an 'end product' (Danbridge 1986:159), could an understanding of play as categorization and work as science emerge? If the definition is carried through in terms of understanding citizen science participation in an online crowdsourcing platform, a lowering of enjoyment must ensue and the sense of fun and enjoyment diminish. For the Zooniverse we ask 'Are people playing when they are categorising on the Zooniverse? Could the Zooniverse legitimately use examples of fun and play to further motivate participants to build science?'

Method

This research is part of a wider ethnographic study currently being carried out about the Zooniverse and user motivation in crowdsourcing. The aim of the study is to explore the motivations of why over one million users would contribute their time, knowledge and skills to a platform with no tangible reward. The wider ethnographic study reveals a number of disparate yet connecting reasons for this. However, as the researchers became further involved as members of the community, the themes of play and games began to emerge. The researchers actively participated within the citizen science platform Zooniverse.org and keeping a daily diary of findings. This one year virtual ethnography allows a deeper understanding to be obtained about how users engage with the Zooniverse, builds a connection to the online community, as well as providing the researchers with insight into the platform itself. This study focuses on the citizen science platform Zooniverse.org, which is currently the world's leading crowdsourcing citizen science website, in regards to number of participants/users and facilitates a large variety of projects from a range of scientific/research disciplines such as Astronomy, Zoology and History (Banks, 2013).

To gain an in depth understanding of aspects of fun and play within online citizen science projects, we use qualitative methods in order to collect data which have been analysed with an interpretivist approach (Walsham, 1995). We employ virtual ethnography for data collection and analysis (Hine, 2000; Ruhleder, 2000). Contrary to traditional ethnography, virtual ethnography allows the observing of an audience's expressions of thoughts and virtualized behaviours that are not easily accessible in the physical world (Lopez-Rocha, 2010; Sarker and Sahay, 2004; Vodanovich et al. 2010). Four steps (Hine, 2000) in data collection and analysis were involved. First, we selected three online projects that had suitable for scientific and community engagement. Second, we obtained permission to study the platform. Third, we sought to communicate with forum participants at the outset, but due to platform design and relayed form of content the later component of the ethnography remained unobtrusive observation. Finally, we conducted iterative rounds of data collection and analysis until theoretical saturation was reached. Specifically, we employed the Straussian version of a grounded theory (Boudreau and Robey, 2005; Locke, 1996; Strauss and Corbin, 1994) that allows the use of prior theory to guide data collection and analysis.

In addition to the virtual ethnography encompassing three specific projects, we include findings from sixteen interviews and a content analysis of examples found across the Zooniverse site and held within its historical documentation. The interviews provided further details about the platform, while the content analysis focused on games created specifically for the citizen science projects, blog posts, discussions on forums and other examples of play found within the domain (Herring, 2010). Permission obtained to study the site included access to documentation and one developer who had access to all stored data and content. Drawing on Walsham's (1995)

interpretivist approach, content pertaining to gaming and play was sourced from the documents and exemplar examples were chosen to illustrate the breadth of game and play activity that has occurred.

This particular study also includes examples taken from the content analysis of the games created specifically for the citizen science projects, blog posts, discussions on forums and other examples of play found within this domain (Herring, 2010). The analysis of the content was iterative drawing on content that was revealed in the ethnographic study, sources then confirmed as legitimate through the interviews on the topic of gaming with the web developers of the Zooniverse. The gaming contents existence was revealed through discussions with the web developers of the Zooniverse. The examples in the study were chosen based on their suitability as excellent examples of self described gamification or play. These examples are used to further illustrate points and support arguments throughout.

The findings of the study are drawn upon demonstrate how play can be used as means to organise and motivate from both the developer and user perspectives. It will also build a robust body of work to further understand the importance of 'Gamised' and or 'Gamification' for citizen science and others considering using crowdsourcing a platform for online engagement. Examples of fun and play outlined in the analysis are then applied within a table to create a model of intrinsic motivations based on understandings created by Gerow *et al.* (2013)'s understandings of utilitarian and hedonic systems.

Findings and analysis

When exploring the surface of the Zooniverse, it may at first appear to be a straightforward platform to conduct citizen science. The Talk forum is the main way that different users can interact with each other directly on the Zooniverse platform. There are two main routes into Talk. The first takes place during the classification process. On Galaxy Zoo, for example, after answering the branching questions, the user is offered the following option: 'Would you like to discuss this object?' If the user selects 'yes' they are taken to the specific talk page for the project. In the case of Galaxy Zoo, the picture of the galaxy is then posted to the forum with options to tag, add the picture to a collection, or discuss in various ways. In addition to these project specific discussions, there is also a more general Zooniverse Talk that allows discussions with users and scientists across the platform. The Talk forum is now in its third version and operates like other internet forums: users are able to start new discussion threads within subsections sorted by different topics. It would be possible to participate in the Zooniverse without ever looking at either version of Talk. However, due to the legions of committed contributors residing within an active and developed community, as well as the opportunities provided for rich social interactions throughout its forums, blogs and other forms of social media, it appears that there is far more hidden activity being carried out within the Zooniverse than an initial view may imply. Evidence of unconventional forms of fun and play surrounding the practice of citizen science has been found

within official examples of social media created by the Zooniverse team and even in some cases created by the citizen scientists on the platform itself.

The first example of an intrinsically motivating game on the Zooniverse platform is Voorwerp Pong, introduced by the web developers on the Zooniverse team. The game recreates a surreal version of the classic retro video game Pong based on the discovery of Hanny's Voorwerp; a rare astronomical object discovered by a volunteer of the Galaxy Zoo project (Christian, 2012; Lintott *et al.*, 2009). The original version of Pong has two digital representations of paddles at either end of the screen that hit a digital ball back and forth. This game is traditionally designed for two players or can be played against the computer. The aim of the game is to gain as many points as possible by continuously hitting the ball back to the other player/computer. Voorwerp Pong uses these same rules but instead of a paddle and ball it uses images of galaxies and the Voorwerp. To make things even stranger, the image of the Voorwerp also evolves as the score progresses. This demonstrates to the player the different stages of the Voorwerp and helps them to recognise the various stages of development. The primary objective of the game is hedonistic, with no external scientific projects aligned with it. However, the interactions with the game take place on the Zooniverse platform and it does contain an element of scientific teaching, albeit somewhat abstracted. This increased participation on the platform illustrates that a bespoke game like this can have a broader purpose than simply the immediate fun, while also including extrinsic rewards in the form of high scores.

Figure one - Voorwerp Pong (2013a)

On the Zooniverse blog, the team fully acknowledge that this could be considered a strange adaptation of the game, citing the reason for creating it as 'a bit of fun' (Daily.zooniverse.org, 2013). This involves appropriating aspects of Internet culture, as well as building upon the familiarity of the original game in order to appeal to a wider range of people. There is no scientific reason for users to engage with games like this in the Zooniverse, yet this was not the only instance of activities inspired from a wider Internet culture on the platform. This indicates the importance of other forms of motivation for users across the platform. For example, rather than just participating in Galaxy Zoo to satisfy extrinsic motivations for deepening the collective understanding of the universe, activities like Voorwerp Pong begin from more playful intrinsic motivations.

The Zooniverse team have also re-appropriated the familiar in order to captivate new and existing users through the use of the LOLcats meme (icanhas.cheezburger.com). This is an extremely popular image macro phenomena originating on the Internet. An image macro is 'an image superimposed with text for humorous effect' (Trotta & Danielson, 2011:395). LOLcats involves the superimposing of humorous text over photographs of cats using unique syntax known as "LOLspeak" for comic effect - and as a result became an Internet sensation (Gawne & Vaughan, 2011). As Shirky (2010: 18) has explained, this could be understood as 'the stupidest possible creative act', but it is also possible to conceive that people 'actually like making and sharing things,

however dopey in content or poor in execution.' It is an example of what Shirky (2010) calls 'cognitive surplus', the use of spare for useful or creative acts - in this example producing and sharing content for collective enjoyment rather than passively consuming paid-for content - something that is particularly important in the context of the Zooniverse.

Inspired by this phenomena members of the Zooniverse team developed their own LOLcat memes related to citizen science for the Zooniverse advent calendar. The image below is an example of a LOLcat meme created by members of the Zooniverse team. It shows a cat perched upright at a laptop as if it is classifying data on the Zooniverse, the text imposed on the image is written in LOLspeak and it says 'Citizen scienz kitteh classifiz.'

Figure two - Zooniverse blog – Cats love the Zooniverse (2013b)

This example demonstrates how the popularity of Internet culture and the dynamics it involves can be re-appropriated to promote citizen science projects and motivate users. The team behind Snapshot Serengeti also realised the popularity surrounding Internet culture and understood how it could be applied to their project in order to have an impact on their community. To encourage play, they drew on photographs that existed on the project and built a meme generator to allow contributors to create their own memes. Although a meme is not 'a game' per say the Zooniverse development team introduced it as a way to enhance the fun for users - intrinsic motivation - while also being utilitarian and external to the system. The memes provide an opportunity for users to engage their 'cognitive surplus' (Shirky, 2010) rather than simply clicking through to classify further images. This entails a social output as users share modified images, while also containing an extrinsic and instrumental use, as users click through to classify more images to provide the raw photo input for their memes. The use of popular culture provides a new avenue for users to engage with the projects, drawing on something more accessible for users to identify with. This could be particularly useful when considering that many non-expert users may have found the thought of contributing to a science project as too daunting otherwise. It also does not limit user experience to only this aspect, providing a potential route into the subject matter more broadly. The image below is a meme which has been created by a participant portraying a photo of a leopard looking like it is laughing with the caption "LOLZ", which is also a reference to the LOLcats phenomenon.

Figure three - Meme generator, Snapshot Serengeti blog (2013)

The use of photos beyond their original context has led to further examples of play on the Zooniverse. Another example is a website called MyGalaxies (www.mygalaxies.co.uk). It was created by a Galaxy Zoo team scientist and allows participants to create messages from photos of galaxies that resemble letters. Below is an example created through the website spelling the word "Zooniverse" through images of galaxies:

Figure four - www.mygalaxies.co.uk (2014)

The element of fun using this format was developed further by Pedbost *et al.*, (2009). For an April fools prank, they claimed that a new galaxy cluster had been discovered which spells "So long and thanks for all the fish", a reference to the 'Hitchhiker's Guide to the Galaxy' science fiction book series (Adams, 1984). These particular examples of fun and play within and around the Zooniverse platform were created by the developers and science teams. This complicates the notion of intrinsic motivation as it is in this instance being led by those seeking to encourage participation for other reasons. However, the users themselves can also be seen to introduce element of fun, gaming and play into the process of scientific classification.

It has been highlighted that some members have found the classification systems within online citizen science projects to be dull and repetitive (Prestopnik & Crowston, 2011). In response, it has been reported that some Zooniverse users have invented their own games or have gamised their experience within the classification process to make it more interesting and to help motivate themselves. For example, within the Snapshot Serengeti project, some users attempt to find and collect photos of all forty-eight animals listed by the scientists, while others focus on trying to find the rare Zorilla in order to complete their collection (Daily.zooniverse.org, 2014c). This form of play emerges organically from the process of classification as the scientists are trying to document all of these animals to better understand the ecosystem. However, the original intention is extrinsic to the individual user, seeking to build an aggregate data set to model behaviour on a macro scale. The drive of individual users to "complete the set" has no impact on the scientific project itself, but this intrinsic drive has the subsequent effect of raising the overall number of classifications.

Figure five - Photo of Zorilla - Snapshot Sunday (2014c)

Other examples of users creating or perceiving serious scientific projects as games have also been referred to throughout other projects on the platform. Penguin Watch (Penguinwatch.org) involves users counting how many penguins are featured in each picture by marking them on the image, which some users have described as being like the finding game 'Where's Wally'; a popular children's book where the reader has to spot the eponymous character within the scenery (BBC News, 2014). The potentially cute imagery of the penguins along with the aspects of fun created by comparing it to a game, creates a very accessible project for a wide range of users.

Figure six - Screen Shot from Penguin Watch (2014)

The image below is a screenshot taken from the now archived Galaxy Zoo Forum (www.galaxyzooforum.org). This is an online space originally created for users to discuss images seen on the website in further detail. Over time, these interactions became deeper and a rich, vibrant and dedicated community emerged as a result. This led to other topics being discussed within the forums and most notably the development of sophisticated games and wordplay.

Figure seven - Word Games in Galaxy Zoo Forum (2014)

Figure seven shows a list of titles for threads within the Galaxy Zoo Forum all representing examples of fun and play such as 'Word Association' 'Acronyms Game' and 'The Song Title Game' or opportunities for relaxation such as 'Just Chat'. These individual threads proved to be extremely popular with pages of replies of up to 936 pages for the 'Word Association' game and up to 7003 pages of responses from users on 'Just Chat'. The majority of the examples of games presented in the screenshot above relied on responses from other users in order to play. Examples such as the 'Acronyms Game', illustrate gamised activity where users would take the last word from the previous post and create a new acronym and challenge the next user to come up with a new sentence based on it. The example shows how users take a forum that was originally created to discuss citizen science and then adapted their interactions to play and relax, it also indicates that the users of the platform may create their own opportunities to connect with each other by using fun and games. The instances of these non-classifying activities could be understood as problematic for the platform if conceived of in terms of an immediate opportunity cost; time spent on Talk or games is time not classifying. However, if these other interactions encourage and motivate users to spend more time overall on the platform - including increasing classifications in the longer term - then it can be understood as a beneficial and complementary activity. The examples presented in the paper demonstrate how instances of intrinsic motivation, particularly in a game-like form, have different uses within an organisational setting. The forum itself produced a number of discoveries from the discussions created by citizen scientists interacting with science teams in order to reach conclusions (Reed *et al.*, 2014; Tinati *et al*., 2014). It could be argued that the use of gaming and fun had a role in making the forum a more welcoming place to be as well as a place to relax, allowing for ongoing motivation to be built within this vibrant community.

As the intention of the platform was primarily designed for the practice of scientific activity, other examples of play can simply involve doing things that are unrelated to science in this context. An important reason for users to do 'fun' activities external to the data categorization could be to provide respite from the potential monotony of repetitive classifications. For example, the Zooniverse offers a space to save, share and discuss objects users have found particularly interesting through the Talk system. Some users in Galaxy Zoo have used this function as a means to apply different meaning to some of the photos they have seen.

The Talk picture sharing function has been repurposed by users to collect and discuss examples that could be mistaken for pieces of artwork, rather than assessing them on the basis of scientific qualities. The users collectively brought these photos together in a curated list named 'Pure Art'.

Figure eight - Example image taken from 'Pure Art' discussion thread - Galaxy Zoo Talk (2014)

These examples provide citizen scientists, developers and science teams with opportunities to have fun and be creative with the images and data collected through the platform. They demonstrate how citizen scientists actively engage in play and gaming when participating within the Zooniverse.

Table two provides a summary of each of the examples of play found within and relating to the citizen science platform the Zooniverse.org. All these examples of play have been addressed and discussed throughout the analysis. Understandings of varying forms of intrinsic motivations addressed by Gerow *et al.*, (2013) (See Table one) have been applied in order to create new understandings as to how the Zooniverse.org can be recognised as both a utilitarian and a hedonic system.

Table two - Summary of analysis

Table two shows that the examples of intrinsic, extrinsic, hedonistic and utilitarian activity examined throughout the analysis can be classified as examples of 'Gamised' or 'data categorising'. After exploring examples of play and fun within the online citizen science platform Zooniverse.org, it has become apparent that play can be used not only as a form of entertainment but also as a form of intrinsic motivation by participants. Evidence presented in examples of social media, blog posts and the platform itself there are indications of the fun, play and joy created by the developers and members of the Zooniverse team as means to create a form of intrinsic motivation and that the system can be used for both utilitarian and hedonic purposes simultaneously. Gamised activity refers to when a sense of play is used as intrinsic motivation within the confines of a utilitarian system.

Discussion and future research

This study has presented a number of examples of play, socialisation, fun and amusement that takes place on the Zooniverse citizen science platform. They are predominantly examples of 'gamised' activity illustrating how play is being used on a citizen science platform as a form of intrinsic motivation within a utilitarian system. We have provided a range of empirical evidence relating to aspects of play surrounding the citizen science platform the Zooniverse.org. This evidence was critically examined to demonstrate the relations of intrinsic motivation in regards to self-organisation and participation. The close observation of interactions on the web site allowed us to develop a deeper understanding of social interactions within the context of citizen science platforms. It also allowed us to position play, socialisation, fun and amusement within the existing studies on motivation, drawing particular attention to the differences between intrinsic and extrinsic practice.

The balances between intrinsic and extrinsic motivation in gamised activity can become an important factor to inform new business models, as it may be usefully applied within organisations that do not have the resources to compensate participants for their time, knowledge and/or skills. Gamised activity introduces a sense of play to otherwise serious tasks making them more appealing to users. One key emergent way that this has been achieved on the Zooniverse is through reference to or re-appropriation of popular culture that increases user familiarity. This contributes to demystifying certain aspects of science that might otherwise put off some users

lacking a formal background, something that is common with citizen scientists. However, it also entails a contradictory process as these activities seek to engage user's intrinsic motivations, yet they were developed by members of the Zooniverse team seeking to further participation for extrinsic goals. We argue that these examples highlight the complex processes that build relationships between users and the platform, often becoming multidimensional, rather than simply straightforward interactions.

These kinds of complex activities can also be found amongst the users who have been seen to create their own games within the projects, everything from 'collecting' rare animals in Snapshot Serengeti to users comparing Penguin Watch to the game 'Where's Wally'. It is also clear from the examples presented that play, amusement and entertainment, as forms of social interaction are concerned are important for some of the participants of the citizen science platform to build and maintain a sense of inclusion. This sense of inclusion can be used to both intrinsically and extrinsically motivate and encourage users to continue contributing towards the platform, by allowing them to feel a greater sense of ownership over their work and therefore take pride in doing the task correctly.

The separation between hedonistic and utilitarian objectives on the platform – despite the interrelation at certain points – has similarities with the blurring relationship between work and play. We argue that this comparison draws out a number of important conceptual points. When a dichotomy is established between 'the process' of data categorization and science as an 'end product' (Danbridge 1986:159), the professionalism associated with work and science does not necessarily carry over into the classification process. It does not matter how users are classifying – other than the accuracy – but to what extent does it matter why? If users are classifying photo datasets on Snapshot Serengeti to complete their collections, rather than to contribute to somewhat abstracted scientific work, it is necessary to ask how this affects the relationships on the Zooniverse platform. This does not preclude a learning dimension. For example, users playing Voorwerp Poong learn about the development of the phenomenon and the process of collecting photos from the Serengeti requires learning to differentiate. The institutional hostility to playful approaches to "serious" activities is therefore questioned in our research. The instances of user initiated play and games is rarely utilitarian in purpose, while they are always intrinsic and hedonistic. On the other hand, the games developed by the Zooniverse team seek to mobilise the intrinsic motivation and playful approaches of users to further utilitarian goals.

Our study contributes to the field of Information Systems (IS) by presenting a conceptual model to enable deeper understandings of how forms of social interaction and play motivate users to participate in online processes, and in this case using an online citizen science platform. By drawing on the work of Gerow et al. (2013), we provide empirical evidence that a system can be both utilitarian and hedonic in nature, meaning that it can be both practical and enjoyable. The paper has also illustrated how gamised activity (Greenhill et al., 2014) as a form of intrinsic

motivation has added a sense of play to work and tasks (Xu et al., 2012), therefore improving the user experience of contributing to a citizen science platform.

The task for future research is to develop methods to quantitatively measure the motivation from games on online platforms and provide a mechanism to compare different approaches in terms of the output. Additional quantitative research could examine the role of non-verbal learning in citizen science and interrogate the learning aspect in various ways. Other aspects which could be considered in future studies is the balance between 'real' and 'citizen' science; and secondly the need to further consider the balance between 'work' and 'play' when attempting to design for a serious objective within an online platform.

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