Colour Dynamics and the Multimedia Industry: It's Role in Video Games

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Abstract

The study examined colour dynamics and the multimedia industry and its role in video games. The study was conducted on the assumption that colour dynamics played a very important role in the development of video games in the multimedia industry. To collect data for the research, two video games, Luxor: the quest for the afterlife and Drawn: dark flight were used. Forty five volunteers between the ages of 20 – 55 were asked to play the two games and afterwards answered questionnaires based on the two games. Game developers and designers from Ghana, Kenya, and the United Kingdom were also interviewed for their opinion on the subject under study. The study proved that, certain emotions are evoked when playing video games because of the colours used, implying that colours used in the design of video games affect the audience and their reactions to the choice of colours used in the specific types of video games. The study also revealed that colour played an important role in influencing audience decision to buy or watch various products in the multimedia industry. However, people's perception of colour was influenced by their environment and culture which was either inborn or learned. Also, people associated certain objects or concepts with certain colours. The study therefore recommends a series of longitudinal studies considering the evolving nature of technology as well as peoples' perception on colour to

help document more accurately these perceptions to build on the trend and opinions of others based on ethnicity, geographical locations, culture, and age-relatedness of specific target groups with supporting data statistics.

Keywords: *multimedia, Colour dynamics, video games, emotions, perception and colour constancy*

Introduction

It should not be denied that technology and for that matter, multimedia technology, has become a huge part of our daily lives, as we live and operate in a digital era where a lot of information is presented to us in a multimedia context. This advancement has supported an increase in efficiency and productivity for jobs in offices, homes, in and outside the classroom thus serving as a practical and useful tool in our daily activities (Rashmi, 2010).

It is also true that multimedia technologies without colour considerations will really be confusing and frustrating. The use of colour adds a splash of fun to these media, thus enriching our lives with joy. In multimedia technology, colour plays an important role in the effective display of design thereby making screen layouts attractive; helping reduce users' interpretation errors; emphasizing logical organization of information on display; and very efficiently drawing the user's attention to a given part of the screen or design (Montañana, García, Royo, Simón & Peris-Fajarnés, 2006). Hence, colours are used in these multimedia technologies to play on the visual perception of users. Equally, colours are also used to play on the emotion of the target group to influence their decision to watch or buy a certain package on display. In other words, colours are used to draw the attention of consumers by using certain colours either hot or cold for images to captivate their minds (Goldstein, 1942) through technology which continues to influence several aspects of human lives in unimaginable ways.

Multimedia technology has become one of the biggest tools for relaying information and as such one of the biggest warehouses of information. As asserted by Sibanda and Maposa (2010, p15), "these multimedia technologies are associated with the emergence of a new knowledge society, largely ascribed to a process called *informatization*" which refers to information technologies such as the worldwide web, television, ipod, video games etc.

Evidently, each and every one of us is affected in one way or the other by the emergence of multimedia technology, and the introduction of the virtual world has made these technologies as realistic as they could be. One of such virtual worlds include, video games which combines almost all the elements of multimedia such as graphics, sound, text, video and most importantly colour (Dobrican, 2009). Studies reveal that colour plays a very important role in the design of any product; be it an artwork for an advert or game design. Colours are desirably used and creatively manipulated to draw attention and work on the emotions of potential buyers and target audience (Singh,

2006). However, people do not just play games because of the colours used. People play games because it satisfies their emotions and put them in charge of their virtual lives, making the virtual world their reality (Joosten et al, 2010). However, most studies carried out have given less attention to how colours impact the fun aspect of life through video games.

Colour Dynamics and the Multimedia Industry

"The perception of colour involves complex interactions between several physical, neural, and cognitive phenomena, which must be understood in order to comprehend color vision completely" (Sharma, Vrhel, & Trussell, 1998 p.1089). The sensation of colour is generated by the physical stimulation of light detectors known as cones in the human retina. Each of these colours produced is an electromagnetic radiation which travels through space on a different wavelength. Some of the wavelengths or light are visible, while others are not. Based on Goldstein's theory, different colour wavelengths arouse various emotions; thus longer wavelength of colour arouse the feeling warmth, whereas shorter wavelength of colour gives the feeling of relaxation or cool (Goldstein, 1942).

The human eye works together with the brain to translate light into colour. Light receptors within the eye transmit messages to the brain, which generates the awareness and perception of colour. However, the acuity of colour begins with specialized retinal cells containing pigments with different spectral sensitivities, known as cone cells. In humans, there are three types of cones sensitive to three different spectra; hence human colour vision is *trichromatic*. This means that there are three independent variables in colour vision which are not physical properties of light but a physiological limitation of the eye. The cones have different wavelengths and are characterized according to the peaks of their spectral sensitivities: short (S), medium (M), and long (L) cone type (Kadihasanoğlu, 2007).

Nonetheless, all of the cone types work well in bright light though response of human cone cells vary from one individual to the other.

However, visualization and perception of colour which starts from the eye to the brain can also be represented and understood by objects or concepts, so that a particular object could represent a specific kind of colour (Belpaeme, 2001). Colour is not part of an object but perceived, which apparently means that we each see and appreciate colour in different ways, either consciously or unconsciously.

The science of how colour affects us is called colour dynamics (Hullfish and Fowler, 2003). Universally, people have beliefs that affect their perception of colour. Colours work on our body and mind causing various sensations such as excitement, aggression, depression, agitation, closeness, warmth and the illusion of distance. Colours are classified as either warm (hot) or cool (cold) by society. The hot and warm colours create the illusion of closeness, excitement, agitation, etc. while the cool and cold colours create

the illusion of depth, distance, peace, humidity, etc. Besides, a study conducted on colour revealed that preferences for certain colours were subjective based on gender, societal and cultural influences (Khouw, 2012; Bear, 2012).

Colour can also be used to create the illusion of things not existing. In the same vein, an image with two different colours can give different moods and feel to the observer or viewer. Similarly, colours in the environment impact on our behaviour, therefore the wrong use of colour can have negative effect on us. The multimedia industry uses many forms of media to communicate messages to their audience. However, aesthetics plays a huge role in this activity; and aesthetics cannot be achieved without the use of a variety of colours. Colours are manipulated in so many different ways to play on the perception and feeling of the target group to influence their decision to watch or buy packages (Lakoff and Johnson, 1999), making colour a vital element for designing in the multimedia industry. Colours influence and prompt reactions based on both instincts and associations. Colours change the meaning of the objects or states with which they are associated, and consumer behaviour can be predicted based on their colour preferences. Consequently, specific colours are chosen depending on the product and the impact the designer wants to achieve to effectively stimulate the senses of the consumer to convey messages to them. Therefore designers use colour to strengthen associations. Significantly, these choices of colour help to create different moods for different products. As the word multimedia suggests, the manipulation of colour does not only involve graphical images but in this case video games as well. Therefore, for video games to be successful as graphical works, they should have strong colours which are creatively manipulated to arrest the attention, minds and emotions of players.

Colour dynamics and Emotions Evoked in Games

People react in various ways to the perception of colour which is invariably influenced by their upbringing and cultural association with colour. Research indicates a variety of thoughts on how people react to colour. The two major views identified are: colour reaction could be inborn or learned and associated with objects in relation to a person's environment or culture (Sable & Akcay, 2010). However, the colour of an object does not remain the same due to the variance in wavelengths produced at a particular time; an object viewed under two different lighting conditions will surely give two different feels. Humans have the inbuilt ability to adapt to significant changes in colour which is called colour constancy; "a combination of biological and psychological mechanisms" (Balkenius & Balkenius, 2012) which consequently affords a person the ability to make a sound judgment in different lighting conditions when viewing an object to maintain some consistency in the colour of the object. Thus a person is able to recognize the colour of a blue flower irrespective of the lighting condition by allowing the eye to perceive the colour as relatively constant. This coordination can be called subjective constancy; which is used by the brain to aid people see objects in changing situations. Art historian Rene Huyghe (Herman Miller Inc., 2001) asserts that the sensation of colour is stored in our memories at the time of conscious connection, which does not just affect us momentarily

but stays with us for the rest of our lives. Thus a player in a virtual world is challenged to connect with his experiences to make decisions to overcome one task or the other.

However, as humans who live a preconceived world influenced by cultural dynamics, it is virtually impossible to perceive colour without having a presumption. Colourist and art educator Patricia Sloane (Herman Miller Inc., 2001) states that, "response to colour symbolism is a response to color preconception, and is a predetermined response based on literary and psychological ideas about colour, rather than a response to the nature of colour itself. Colours mean different things to people in different parts of the world and our experiences are built on the experiences that occur within the context of our cultural environment which helps us to develop symbolic ways of perceiving colour. Similarly, the attribution of colour is tied to historical and formal connections based on cultural differences which keep evolving (Terwogt & Hoeksma, 1995 in Church, 2002). Thus, the effect and meaning of colour in a particular culture is very important in the way it affects the perception of an image and how it is used.

Basically, there is association between colour and emotions which differ from one culture to the other. While white is associated with mourning in Japan, most Western countries symbolize the colour with purity of mind. Black in Ghana symbolizes death, superstition and fear, whereas it suggests affluence and sophistication in America and other parts of the world (Breidenbach, 1976). Similarly, in virtual worlds or video games, objects are colour coded to indicate their identity. Sensors are also used to measure the reflected light, which means that each coloured pixel is measured and varies according to the colour of its illuminant. Though the resulting colours may not be exactly the same as perceived by the human eye, subjective colour constancy helps us to adjust and link these colours used to our personal experiences in life (Balkenius, Johansson & Balkenius, 2003) which induce certain emotions in players.

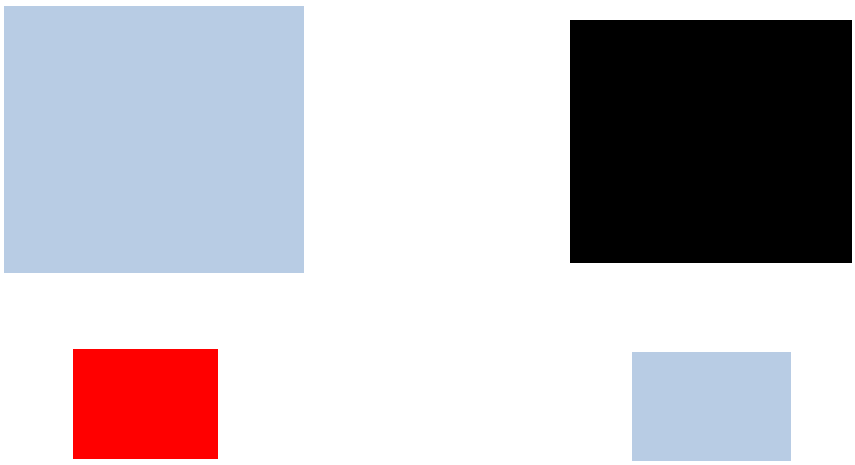


Figure 1: An example of colour constancy

Even though colours are used to play on our emotions, games in general are designed with specific reasons in mind. The human body is designed to take a break after a hectic day which is what games help us to do. Kramer (2000) defines a game as any activity which is performed "only for pleasure and without conscious purpose". Consequently, "every activity that brings pleasure is a game". However, not only do games bring us pleasure, they are made up of set of rules which also give us a sense of accomplishment. Essentially, the main reason people play video games is to experience certain emotions which are linked to the human perception of colour (Birren, 1961; Cherry, 2012). Hence, for many people the sense of accomplishment is why they play and these accomplishments create emotions in their pursuit for a goal. These challenges set in the games focus on rewards for progress to create emotions such as frustration, excitement, fear, joy, anger, etc.

These video games, which take place in a virtual world, require the player to be actively involved by using his or her mind. Thus video games and games in general are "known to improve hand-eye co-ordination and help players gain many skills" (Rudon, 2012). This advancement in the creation of video games has not only impacted the entertainment industry. Video games are used as a form of physiotherapy to help people recover from physical injuries to gain motor skills and coordination in the medical industry. Undoubtedly, these games obviously have colour content which is used to impact a person's mood. Chromo therapy is one of such where colour is used to harness the vibrational energies in people to heal and cure illnesses which aim to restore balance in the body, mind, and spirit (Gul, Nadeem & Aslam, 2015). This confirms the assertion of Oscar Wilde which indicates that the simplicity and purity of colours, with definite form can speak to the Soul in a thousand different ways. On the other hand, colours do not just speak to the soul in a thousand different ways; their use in the design of video games enhance creativity and imagination in players, and also encourages certain behaviours in players.

Studies reveal that "Hostility was increased both in subjects playing a highly aggressive video game and those playing a mildly aggressive video game. Subjects who had played the high-aggression game were significantly more anxious than other subjects" (Kardaras, 2008), although it is not certain whether this was due to the colours used, but one thing is for sure; colour definitely played a role in the design of those games.

All the same, video games which are a highly successful form of multimedia should have certain basic ingredients such as:

- Play: a decision to do something for pleasure which is really involving and aids in developing social interactive skill among players and helps us to learn (Prensky, 2001). Play can also be defined as: "an intellectual activity engaged in for its own sake, with neither clearly recognizable functionalities nor immediate biological effects and related to exploratory processes that follow the exposure of the player to novel stimuli" (Fabricatore, in Mitchell and Savill-Smith, 2004).

- Fun: done for the pleasure and enjoyment of it which relaxes us and at the same time makes us receptive to learn and adapt to new ideas (Prensky, 2001).

Consequently, not only should a game have play and fun but should also have a goal. As asserted by Kramer (2000), "every game has a goal" with two requirements; the victory condition or requirement and the strategy needed to win the game which should be an organized play that gives both enjoyment and pleasure (Prensky, 2001).

On the other hand, "with the exception of educational games, most video games' effects on brain and behaviour are unintentional on the part of both the designers and the players. Nonetheless, research suggests that the effects are real. Video games are neither good nor bad. Rather, they are a powerful form of entertainment that does what good entertainment is supposed to do: it influences us, (Shock, 2009). Therefore a game should be able to challenge the players' emotional attachment to a situation in the game linked to real life experiences or fantasy which serves as a driving force through the appropriate use and choice of colour dynamics. To achieve this, the psychology of colour must be understood since it is an important element of design used to create ideas, send messages, and lay emphasis on areas of interest and most definitely a high predictor for emotions (D'Andrade, 1974). Essentially, the target audience should be considered bearing in mind environmental and cultural influences.

Indeed, colour is a very powerful tool; it is definitely the first thing we notice about a video game and most possibly the last thing we remember about the game. The power is in the hands of the designer in the multimedia industry to use this great tool to evoke emotions in game players and make their experience of play and fun time in these virtual worlds an unforgettable experience.

The Study

The main objective of his study was to explore colour dynamics in the multimedia industry and its role in video games. The study also analyzed the impact of colour dynamics on video game players and their reactions to the colours used in the video game design.

This study was premised on the assumption that video game players react to colours used in the design of video games. Thus hypothesized: *Colour dynamics affects the emotions of players.* The study therefore sought to investigate the extent to which colour dynamics affect the emotions of players. In seeking an answer to this question, data was gathered from forty five game players. Volunteers answered questionnaires in relation to their reactions of the colours used in the design of the two games they played; Drawn: dark flight and Luxor: after life. The outcome of the study indicated colour dynamics played an important role in design and had effect on players and users of products as well. Colour also played a very important role by affecting people's emotions, reactions and also influenced their decision to buy certain products and play a particular video game.

The research was delimited to game players between the ages of 20 to 55 years who enjoy playing games and can give relevant feedback to support the study which will make it difficult to replicate in another context (Creswell, 2003). It was ensured that responses from players were reflections of their personal experiences while playing the two games.

Methodology

This study sought to gather an in-depth understanding into colour dynamics, its role in video games and its effects on players and their reaction to colours used in the selected video games through the exploration of behaviour, perspectives and experiences of the people under study, (Gray, 2004). Both qualitative and quantitative approaches were used for the study.

The quantitative data was obtained from the questionnaire to complement the qualitative data from interviews. The semi-structured approach was used where the informants were encouraged to elaborate on the issues by providing additional comments, opinions and background information on the subject under study (Gray, 2004; Moore, 1987).

The research was carried out in a short time frame, making the approach cross-sectional rather than longitudinal (Gray, 2004). Also, survey was used for this research because it was the most applicable research method to collect information to describe, compare or explain knowledge, attitudes and behaviour of the volunteers (Gray, 2004). Thus the method consequently helped in the systematic collection of data by employing the use of structured questions to help provide quantifiable results to aid in the analysis of the data statistically (Gray, 2004). For the purpose of the research, the most relevant source of information came from game players. Consequently, the respondents were randomly selected with particular interest in playing video game. This included Master of Science. and undergraduate students, and professionals in the Design and Advertising industry from locations such as the United Kingdom and Ghana.

The study date were analyzed by describing and interpreting the responses of respondents. These included transcription, evaluation, formulation and tabulation of results into an analytical framework to help measure the prevalence of the views and opinions as well as gaining in-depth knowledge on the subject under study statistically (Gray, 2004).

Ethical considerations

The study adapted the Ethical Considerations of the Royal College of Nursing (RCN) Guidance for Nurses (2011) considering certain ethical issues regarding the use of human participation. These ethical considerations were necessary for the purpose of ensuring the confidentiality as well as the security of the participants. These issues were identified and addressed to prevent imminent problems that could have risen during the research process. The significant issues that were considered included consent of

participants, anonymity, confidentiality and data protection.

The questionnaires for the survey were drafted clearly and concisely to avoid confusing respondents thus ensuring that responses were not conflicting. Also volunteers (game players) were given ample time to play the games and respond to the questionnaires to avoid mistakes and inaccuracies in their answers.

It was also important to get the informed consent of the participants. Informed consent is: "The process of agreeing to take part in a study based on access to all relevant and easily digestible information about what participation means, in particular, in terms of harms and benefits" (RCN, 2011). Based on this, it was only appropriate to take all necessary measures to ensure participants or volunteers understood what they were getting into. Volunteers were therefore invited for the study and given the choice to participate out of their own free will. Contact details of the researcher were also made available in case respondents had any enquiries to make with regards to the questionnaires or study.

Additionally, the respondents were given a consent form regarding the confidentiality of their identity and the information they were giving out. This ensured that the identities of the participants were protected and most importantly whatever information they were giving out was not going to affect them in any way or anytime. This was done with the expectation to promote trust between the researcher and the respondents.

Results

The main purpose of this study was to determine the role colour dynamics played in video games. Achieving the set goal for the study called for exploring multimedia and colour and ways these elements are connected in the age of technology in the face of existing literature reviewed. Related to this, it was important to understand certain factors that impacted on people's perception of colour and emotions associated with various colours around the world.

Consequently, the study gave more insight on how colour in the design of video games affect the audience and their reactions to the choice of colours used in the specific types of video games.

Classification of respondents

- *Gender*

Sixty percent (60%) of the respondents were males with 40% being females. This represented a total number of 50 respondents with 30 males and 20 females including game developers, designers and players.

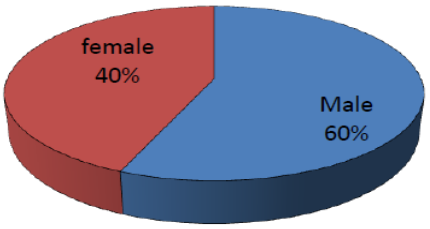


Figure 2: percentage according to gender

- *Age*

The age of the respondents for the games ranged from under 25 to 35 years. The total number of game players were 45 and majority of them, namely 60% (n=27) fell within the age group of 26-34 with 40% (n=18) under 25 years of age.

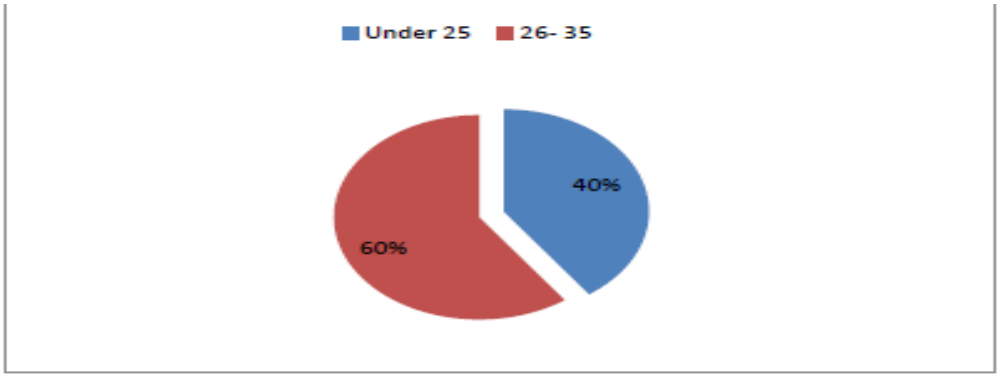


Figure 3: age distribution of respondent

Views and positions on the effects of colours in video games

Respondents agreed that colour dynamics definitely played a role in video games and the multimedia industry. The responses from the game players indicated that certain colours evoked certain emotions in players. They also affirmed that colour as well as design affected game play, interest and response to video games. Additionally, responses from all participants indicated that colour played an important role in the way we think regarding a situation and definitely affects our instincts as well.

From the designers' point of view, colour served as a tool for expressing ideas as a means of communication to their target audience. Colour also played an effective and important role in multimedia. This was emphasized by Ken (graphic designer) who stated that "*Colour helps us to communicate. Indeed colour is multimedia and multimedia is colour. They are inseparable*". Consequently, in this era of multimedia technology, where society is confronted with multitude of information and stimulation, colour helps to

communicate with invigorating simplicity and impact. In addition, colour has strong associative meaning and quickly helps to communicate as well as elicit powerful subconscious response. For instance in Ghana, there are various rites performed to initiate people at every stage of their lives. Ken once again accentuated that these passages of rites were influenced by colour depending on the rites being performed; for example, "*you would expect people to be in white for a naming ceremony or christening of a baby*".

Over the last decades, globalization has made the world a small global village. Consequently, the influence of colour in one society has been shared and experienced by others in different parts of the world through multimedia technology such as the x-box.

Eyram, a game developer, affirmed that
I personally can confess I play my favourite game Prince of Persia series on PC and XBOX mostly because of the choice of colour and the ambience. It makes me experience the Arab culture for a moment and makes me play the game for several hours without getting bored.

Companies, game developers and designers are aware of various cultural and environmental influences and variations. They acknowledge that the perception of colour, meanings and preferences vary by culture and ethnicity. Consequently when designing and developing video games, Eyram stated that their choice of colours:

Are mostly influenced by culture and this is actually proven via Asian Art, Western Art and African Art. When you look at the choice of colours, in artworks from the mentioned regions, you would realize it's mostly based on their culture. In order to create an ambience, you need to know the culture to guide you set a scene.

Wesley, another game developer also agreed that *"Colour was one of the most important considerations".*

Players will first judge a game by how it looks and colours play a big part in that.

Ken also acknowledged that his choice of colour when designing was influenced by his target audience, however, contrasting colours worked very well when used appropriately and wisely because "*any mark of colour is an expression*". Makafui, another designer also emphasized that "*Colours bring designs and products to life and helps to distinct one product from another".*

Respondents

Out of the 50 people invited to play, only 45 participated and played the selected games. As asserted by Hussey and Hussey (1997) questionnaire non-response bias is of two types:

- Questionnaire non-response, whereby the questionnaires are not returned which was evident in the study as four never responded, while one agreed to play but never did despite persistent follow up by researcher.

- Item non-response, where some of the questions in the questionnaire have not been answered, which was the case in three of the questionnaires.

On the other hand, out of six people invited for the interview, only five responded hence, altogether there were 50 respondents for this study which was more than 50% of the response which makes the research valid.

Gillham (2000) agrees that if the response rate is less than 30% the value and validity of the method and results are in question. Therefore, it is reasonable to conclude that a satisfactory response rate should be at least 30%. In this study, this target was met with a response rate of 90%, these are discussed and analyzed.

Table 1: Number respondents invited and number who responded

Group	**Invited**	**Responded**
Game players	50	45
Game developers	2	2
Designers	4	3
Total	56	50

Interviews, questionnaire and Analysis of data

The findings on the interviews and questionnaires by respondents are presented below in the following pages. The respondents have been classified into three groups in order to highlight the possible differences in their views and opinions. The analysis is preceded by a short summary of the responses, followed by a more detailed account of replies and comments presented by each group of respondents.

Summary

All the respondents acknowledged colour dynamics played an important role in design and had effect on players and users of products as well. From the responses gathered from the game players, every colour has many aspects; one colour made a person happy while that same colour made another person feel low. Moreover, different kinds of drive were associated with each and every one of the colours whether consciously and subconsciously. There was no doubt that colours played a vital role in effecting the emotions and sentiments of players. The study also indicated that the stronger the colours, the more impact they had on players. All respondents acknowledged gender played a very important role in the selection of colours for products.

Evidently, game developers and designers acknowledged that cultural and environmental factors influenced people's perception of colour, invariably; their target audience affected their choice of colours during designing and game development.

Motivation and the inclusion of an addictive component were very essential when designing and choosing colours for a game in order to sustain the interest of the player.

Responses from game players

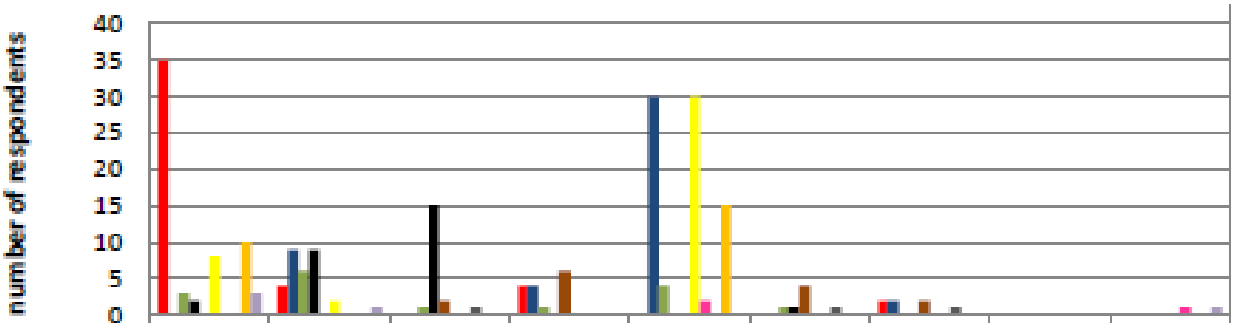
The following paragraphs represent the analysis of data from the questionnaire from game players given by 45 respondents who shared their experiences.

Question 1: What emotions did you feel playing the game? Please tick all that apply and match the corresponding colours

- *Emotions felt while playing the games with associated colours:*

- The responses indicated colours transformed intended visual impressions of design elements of a product and affected people's emotions. Interestingly, all the game players felt more than one emotion and associated these emotions with a particular colour or another.

The figure below represents emotions players felt with associated with colours.



	Excited	Anxiety	Frightened	Bored	Happy	Confused	frustrated	Angry	Overwhelmed
Red	35	4	0	4	0	0	2	0	0
Blue	0	9	0	4	30	0	2	0	0
Green	3	6	1	1	4	1	0	0	0
Black	2	9	15	0	0	1	0	0	0
Brown	0	0	2	6	0	4	2	0	0
Yellow	8	2	0	0	30	0	0	0	0
Pink	0	0	0	0	2	0	0	0	1
Grey	0	0	1	0	0	1	1	0	0
orange	10	0	0	0	15	0	0	0	0
Purple	3	1	0	0	0	0	0	0	1

Figure 4: colours with associated emotions

The responses indicate that the colour red stirred the most emotion by exciting game players by 77% (n=35) with pink and grey stirring the least emotions in players (n=3 for each colour). However, comparing the responses with the table below which is a summary of the psychology of colour from literature indicates that emotions differ from an individual to the other. So one colour cannot be used to represent a definite emotion of a person but there can be some generalizations.

Colour		Cultural Significance
	Red	**China** - celebration and luck, for cultural ceremonies ranging from funerals to weddings. **India** - color of purity (used in wedding outfits). **United States** - Christmas combined with green, love, danger **Eastern cultures** - signifies joy when combined with white. **Egypt** – power, passion, life, victory, anger and rage. **Ghana** - heightened spiritual and political mood, sacrifice, struggle, seriousness and blood shed

	Yellow	**Asia** - sacred, imperial. **Western** cultures - joy, happiness. **Egypt** - eternal and untouchable, bright and all-powerful. **Ghana** - sanctity, preciousness, royalty, wealth, spirituality, vitality and fertility.
	Blue	**China** - immortality. **Colombia** - associated with soap. **Hindus** - the color of Krishna. **Jews** - holiness. **Middle East** - protective color. *** Note:** Blue is often considered to be the safest global color. **Egypt** - the symbol of the floods, sky, life, birth, fertility and creation. **Ghana** - spiritual sanctity, good fortune, peacefulness, harmony and love related ideas.
	Orange	**Positive:** Physical comfort, food, warmth, security, sensuality, passion, abundance, fun. **Negative:** Deprivation, frustration, frivolity, immaturity.
	Green	**China** - not a good color choice for packaging, green hats mean a man's wife is cheating on him. **France** - not a good color choice for packaging. **India** - the color of Islam. **Ireland** - religious significance (Catholic). **Some tropical countries** - associated with danger **Egypt** - vegetation, re-birth **United States** - safety, environmental awareness, St. Patrick's Day. **Ghana** - growth, vitality, fertility, prosperity, fruitfulness, abundant health and spiritual rejuvenation.
	Purple	**Western cultures** - royalty. **Ghana** - feminine
	Gray	**Ghana** - healing and spiritual cleansing rituals, spiritual blemish
	Brown	**Colombia** - discourages sales. **Ghana** – rot, shame, earth (soil)
	Pink	Positive: Physical tranquillity, nurture, warmth, femininity, love, sexuality, survival of the species. Negative: Inhibition, emotional claustrophobia, emasculation, physical weakness. Pink is a powerful colour, psychologically which soothes rather than stimulate. It represents the feminine principle, and survival of the species; it is nurturing and physically soothing. Too much pink is physically draining and can be somewhat emasculating.
	Black	**Western cultures** - mourning, death. **Ghana** - intensified spiritual energy, communion with the ancestral spirits, antiquity, spiritual maturity and spiritual potency, evil, misfortune.

Table 2: cultural significance of colour sources: wikispaces.com, 2011 and colour-affects.co.uk

Question 2: What parts of the game did you like?
Question 3: What parts of the game did you not like?

Use of colour in relation to preferences and context

Colour preferences and responses are entirely subject to settings (Elliot & Maier, 2007 in Rider, 2009) and have significant implications on responses in those different situations.

- *Likes / dislikes of the two games and colour preferences with reasons*

The various responses from the game players undoubtedly indicated that majority of the players liked or disliked a part of the game. Three persons did not dislike any part of the *Drawn* game. The following explain why the players liked, disliked and preferred certain

colours with reasons for the Drawn game:

- *Likes:* the respondents commented they liked the game because of the colours used to depict the moods and emotions of the various scenes and stages of the storyline which made it interesting for example various shades of blue to depict the sad mood of the game. Also, the puzzles were interesting and challenging, and lastly, because of the realism of colours associated with low lights of the environment.

- *Dislikes:* Players felt there were too many dark colours that made the game boring at times and that the introduction of some lighter colours would have taken some of that heaviness away. In relation to the dark colours, one player felt scared while playing. Another reason given was that, "*the actual mechanics of the game and its development seem not very related to the story told in the introduction.* Again, another response indicated too much time was spent looking for clues with not much choice to navigate; it made playing the game stressful and boring at times.

- *Preferences:* responses from the players indicated they were happy with the range of colours used for the game, they commented that the colours fit perfectly well and gave an interesting mood and feel to the game. Thus the comment "*I liked the dark colours (i.e. Blue, dark purple, grey) because it set the mood and emphasized the aim of the game that you had to progress into the game to see lighter colours which ties in with a happier environment*". In addition, the black colour employed for the person disappearing made it seem so real; one player stressed "*I could feel how evil that character was*". Another reason was that players connected more to the game because of the choice of colour thus the comment: "I *related more to the situation in the game because the colour purple made me feel rich and royal as well as the intensity of the battle*", i.e. between good and evil, and also "*pink related to me more as a female*". Another also commented, "*I felt some heaviness lifted off me when I saw the colourful town square, because it had been dark and cold blue colours for so long*".

On the other hand, six players had no dislike for the ***Luxor*** game; every part of the game worked well for them. The following paragraphs present players' likes and dislikes and preferences of the colours with reasons.

- *Likes:* responses indicated that the initial background history of the game given by Nefertiti, the queen, whipped up the interest of players before they even started playing. Also the collection of treasures and rewards in the various stages played an important role in sustaining the interest of the players. Coupled with this were the various effects employed in the game which contributed to the likeability of the game. More than half of the players registered their excitement and pleasure whenever there were fireworks, explosions or gold coins falling. One player stated, "*The falling treasures reminded me of when I was a kid, toffees will be thrown for us to catch.*" Another player commented addiction to the game, stating "*the colours made me addicted. I could see the balls rolling even when I closed my eyes*". Added to this, players' response indicated that the variation and mixture of colours in the various scenes and stories fit and worked really well thus making the designs look so real

and rich.

- *Dislikes*: responses indicated that too many colours used in some stages of the game confused players as well as the repeated action of "click and throw" made the game boring without much motivation. Lastly, players disliked the battle of defeat and the river stage because it was almost impossible to finish that stage of the game; *"too much time spent at that stage tending to make the game boring".*

- *Preferences:* all the same there were preferences for colours used with reasons. One reason was that, players felt connected to the game because of the colours such as blue, green and purple. Players stated these colours made them feel calm and at peace. Another colour preferred was red because it stood out while another preferred these colours for the following reasons: *Light blue*: gave the feeling of being in a river; *Green*: was refreshing for the fields and grass; *Brown*: good colour for the rocks. While another commented *"I liked the blues and yellows in the settings because it made a nice environment to look at and went well with the Egyptian theme of the game"* and also because the mixture of colours such as yellow, white brown, red etc. created different moods and feels such as excitement, happy, calm, and peace at the same time. However, another response was that "*although the blue, green and red looked unnatural for the surrounding, they made the whole scene colourful"*.

Question 4: Comparing scene one to three, what colours do you think worked very well in relation to the settings?

- ***Scenes***

Comparing the various scenes in the two games the respondents (game players) agreed the colours were in context for the scenes. They indicated these through their choice of colours with comments.

- *Drawn: dark flight*

a. **Underground:**

The most dominant colours here were various *shades of blue*, *black, dark purple* and *grey with red* and *yellow* making an appearance. According to the psychological moods associated with these colours, the players affirmed the cold dark colours worked perfectly to depict the mood of sadness and loneliness. While playing, one player commented*; "the dark blue colours used made me feel I was stuck in a place I couldn't get out which made me feel nervous",* while another said *"dark colours made the situation so real and lifeless and disserted."* Another commented, *"I was getting depressed after a while thinking I was stuck in there for all eternity".*

b. **By the sea shore:**

Colours usually found at the sea shore include *blue, green* and *yellow* with occasionally *brown, grey* and *black*. Players identified these colours with such expressions as: *"I love the way the shore lighted up with sunshine and freshness of blue and yellow for the sun and breeze; I loved the refreshing greens and blues used. They made me want to go to the beach; the blue, green*

and yellow colours made the shore look so real and calming". Another stated, *"Finally arriving at the sea shore was like light at the end of the tunnel"*.

c. Small cottage in the painting at the shop

Yellow and *orange* colours are usually associated with brightness and activity. It is no doubt players felt this way after eventually arriving at the cottage through the dark tunnels. They expressed their relief by stating: *"I like the way the cottage came to life with bright yellow and orange colours. I could all of a sudden feel some life in the game*", they also indicated the *yellow "brought the scene to life and made it look friendly and welcoming*" and also "*The bright colours recharged my enthusiasm to go on playing"*.

- ***Luxor: quest for the afterlife***

a. **Palace surrounded by water**

The colours that worked for this level included *red, yellow, blue, blue turquoise, grey* and *black*. The comments associated with these colours were:

- *I love blue because it is my favourite colour. I connected more with that colour.*
- *The blue used for the water was refreshing and made me happy*
- *The colour brown worked well for the wooden parts of the palace, as well as the light blue colour for the water.*
- *Blue and yellow because it made me feel relaxed, calm and precious.*
- *Blue and yellow because it was relaxing and made the palace look rich.*
- *It was just as you would expect a palace with water surrounding it; serene.*

b. **In the field**

The colour to expect in a field is green. However, in this case, it was not because it was expected but because it was used appropriately with other colours such as *red, blue, yellow, black* and *brown*. Players commented as such: "d*ifferent shades of green used for the grass really worked well. The yellow used for the sunshine was great and lighted up the whole scene. Also, brown used appropriately for the rocks. Light shades of black used to cast shadows brought the whole scene to life; added a bit of mystery to the game play"*. For other players, red worked well because it stood out among the rest of the colours. It is amazing how colours affect us, another player commented as; *"I could smell the fresh green grass while I was playing. That was how good it felt"*.

c. **Under water**

Water is refreshing and associated with blue. Responses indicated players felt calm and at peace playing this level and thought the colours used were just ok. However, five players indicated other colours apart from red and green could have worked better if there some yellow and green coral reefs for a more realistic look.

Question 5: What attracted or sustained your interest in the game?
Question 6: What colours do you like about the design of the game and why?

- ***Effect of colour based on interest and design***

For the first game, Luxor, the responses indicated that visual effects and aesthetics played a major role in engaging players in the video game. On the other hand, intellectual motivation played the least role in engaging players in the game.

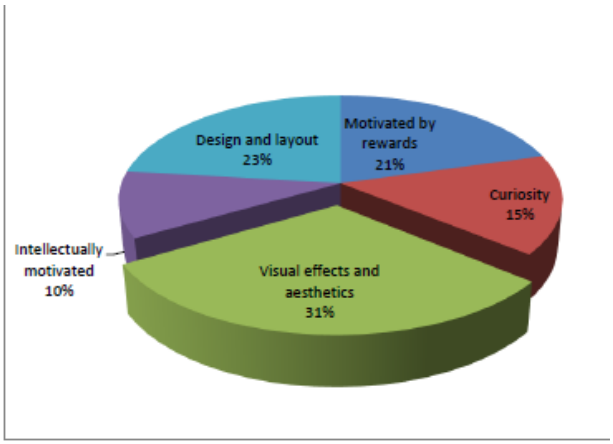


Figure 5: Luxor: quest for the afterlife

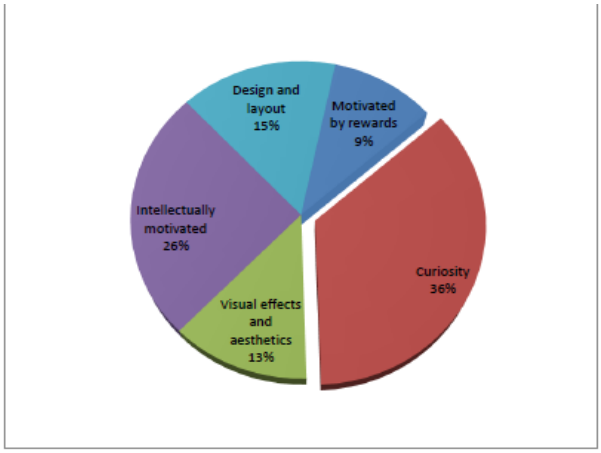


Figure 6: Drawn: dark flight

Effect of colour based on interest and design

However, the responses from the second game ***Drawn*** indicated that players were driven by curiosity rather than design, and layout and were less motivated by rewards.

All the same, it was important to note that colour was not the only drive to play the games but design as well as the genre of game played an important role. For example, the puzzle game Drawn aroused the curiosity of players thereby engaging them where as the 'click and throw game', Luxor basically influenced players by its visual effects and aesthetics.

Question 7: How well do you think the game connected with different genders? Please give your reasons

Connection of games to different gender

It was evident from the responses that each of the players acknowledged gender played a very important role when selecting colour for a design or product. The figure below illustrates the results of the responses.

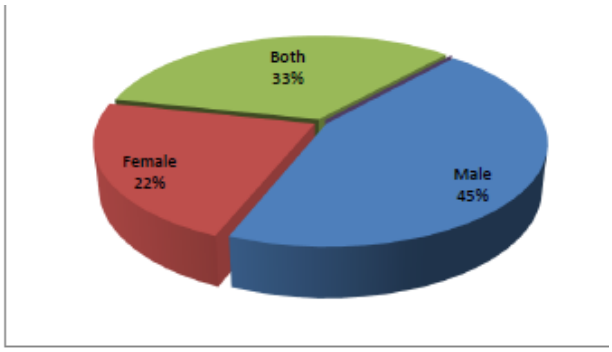


Figure 7 - Drawn:% of connection to different gender

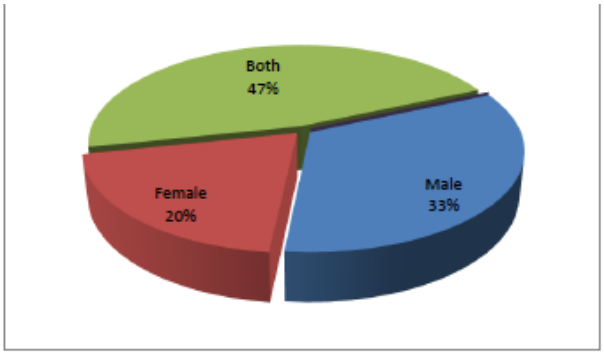


Figure 8 - Luxor:% of connection to different gender

From figure 7, 33% (n=15) of respondent indicated the game related to both gender, while 22% (n=10) said it was more related to females. On the other hand, 45% (n=20) of respondents agreed ***Drawn*** was a male domineering game. 47% (n=21) of respondents from figure 8 indicated ***Luxor*** related to both gender. While 20% (n=9) indicated it was more female related with 33% (n=15) indicating it was more related to males.

Players also indicated thus by stating for example, for **Drawn**; *"males will prefer this game because of the various dark colours used to portray the mystery surrounding the storyline. And also it is also very intellectually motivating"*. Another player also stated that it was *"more of a male game because of the many dark and dull colours used"*. On the other hand, a player stated it was more of a girls' game than boys *"because it is more based in mental challenges than in visual stimulation"*. Again another player asserted *"both genders would enjoy playing this game because there were puzzles to solve and the storyline was entertaining, motivating the player to achieve levels"*. However, this player emphasized *"girls would tend to play this game because it's not too much action and gore but enough gloom to make the experience enjoyable."*

For the **Luxor** experience, players indicated thus: *"Don't think it's designed for one gender or another, it's more a question of the aim of the aim of the game and if you enjoy that type of experience"*. Another indicated *it is for both genders, as you could find all the colours that relate to both*. However, another player was of the opinion; *'I think this game is going to be liked more by girls, since females tend to prefer arcades over different kinds of games like FPS, Strategy or racing games'*.

Question 8: Do you think the colours used for the various effects worked? Please give reasons

- ***Context of colour in relation to effects***
- **Effects**

Visual effects are used in various productions to provide a wide range of enhancements. The figures below represent the responses of players as to the effectiveness the various

effects used in the two games.

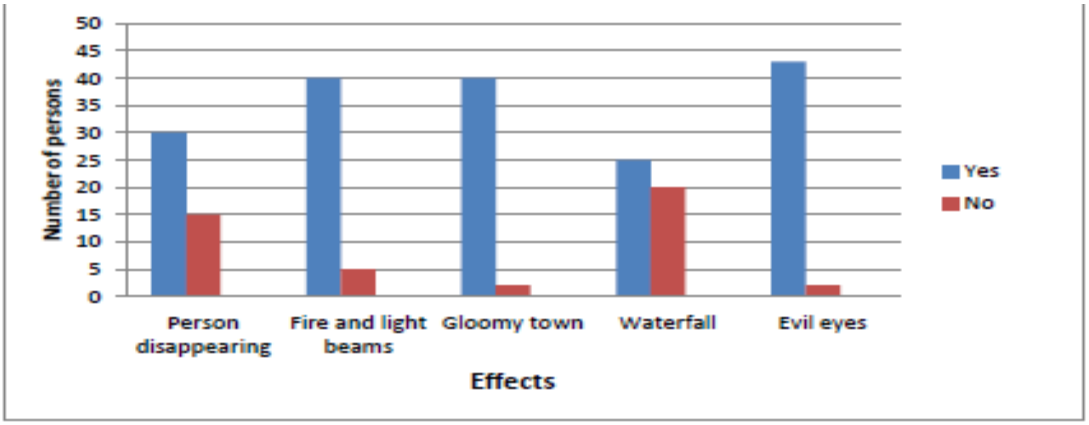


Figure 9 – Drawn: effectiveness of colours for effects

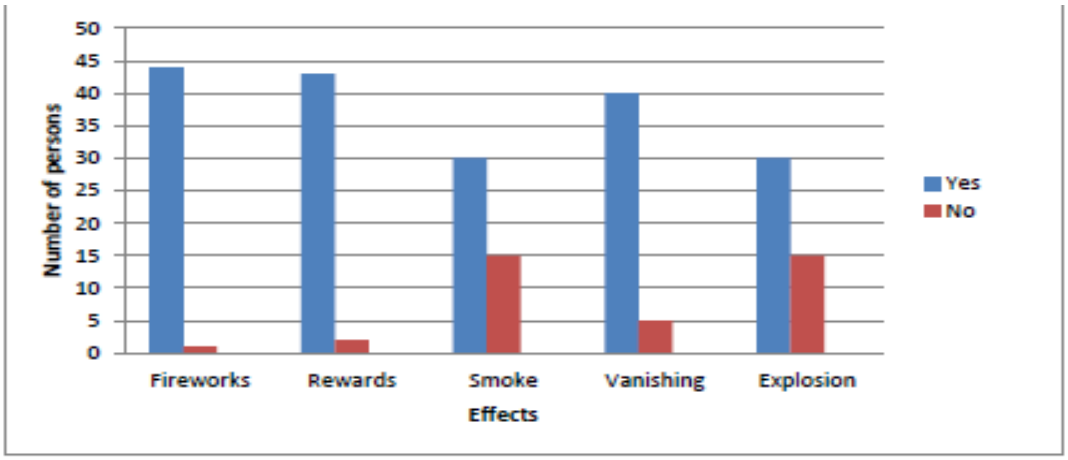


Figure 10 – Luxor: effectiveness of colours for effects

The responses indicated that the special effects achieved their purpose. For the *Drawn* game, the most effective effect was the representation of evil eyes with the colour red. Whereas the representation of the waterfall was the least effective because the colour used for the water made it almost impossible to notice its presence.

For the Luxor game, the most effective visual effect was the fireworks because of the various colours of red, blue, yellow etc. used. The least effective were the smoke and explosion due to the following reasons; the colour of *"the smoke was too dark and also lingered too long making it almost impossible to play the game for some time"*, also the explosion was *"expected to cover a much wider area leaving much to be desired"*.

Responses from game developers and designers

The responses in this section include 7 Interview questions from 2 game developers and

3 graphic designers based on the following: choice of colours, target audience, emotions of target audience, cultural and environmental influences and gender respectively. The answers are preceded by interview questions with statements made by more than one respondent in italics.

Interview Question 1 : How did you decided to choose scheme for your game (i.e. kijiji and iwarrior)? Please identify main considerations and inspiration.

- Iwarrior was inspired by the urge to create a graphically appealing simple game, which portrayed a typical African setting without a second look. During the game design processes, we really wanted a setting that could best be digitally represented thus the safari since it's one of the prominent identities of Africa. Leveraging on the rich bright contrast colour setting between the tribes - Massai culture - and the wild, this was greatly achieved.

- We look at the target audience and the colors that might appeal to them. The colors also have to look realistic for the items they represent. Children would be more attracted to simple colours, for instance.

Interview Question 2: Does your target audience affect the choice of colours in your game? Please give reasons and explain.

- *Yes*. The target audience really matter. Especially when building a casual game. Games that are targeted at both genders need to have a very good colour balance. We perform a lot of tests during this process especially with a colour that works for both. For example in Street Soccer, Our colour theme used to be Red i.e. our avatars wore read jerseys as well as our mascot. However, from subsequent tests, we realized red was hot, and since soccer was geared towards male, it was becoming an all-male game. This made us decide to tone it down a bit by introducing green or blue. We eventually went with green since from our tests, we realized the game appealed to female as well and we introduced more female avatars in the game.

- Children are more visual and simplistic while adults may want more realistic and intense colours that reach out to their emotions.

Interview Question 3: What emotions do you want your players to experience?

- We always want our players to experience if not all at least one of the following: addicted, have fun and get their minds blown away in every game we design.

- The emotions depend on the game play that is taking place. An Action game will have more intense and screaming colours while an adventure game will have cooler and more natural colors.

Interview Question 4: Studies show that emotions to colour are influenced by our culture and environment. How did you consider this before developing the game?

- As explained earlier in Q1 how 'iWarrior' colours were chosen, colours are mostly influenced by culture and this is actually proven via Asian Art, Western Art and

African Art. When you look at the choice of colours, in artworks from the mentioned regions, you realize it's mostly based on their culture. In order to create an ambience, you need to know the culture to guide you set a scene.

- We have partially considered this. However it's difficult to actually say this because we may be doing it unknowingly since we are in the environment of our audience. Perhaps it becomes a more serious consideration when building for audience on different continents.

Interview Question 5: If you are aware, how did this affect your choice of colours for the various scenes?

- For example iWarrior actually has about 7 scenes. These scenes were built from the habitat of whatever animal present in that stage. The goal was to design an African setting within the habitat of the animal. This affected the type of homestead to design as well as the type of trees or props present in that stage.

Interview Question 6: Are your games targeted at both males and females? Do you have any statistics to support your answer?

- Yes. As our mantra says; mobile fun for all. Currently we have an environmental game launched in Kenya and South Africa and has over 100,000 downloads on nokia S40 only. *The game is targeted at both sexes* and has an African setting where you protect our trees.

Interview Question 7: What is your opinion on the influence on players' emotions in video games?

- *Colours do contribute a lot to emotions and it's one of the most important considerations.* I personally can confess I play my favourite game Prince of Persia series on PC and XBOX mostly because of the choice of colour and the ambience. It makes me experience the Arab culture for a moment and makes me play the game for several hours without getting bored. Though this is with a PC game, we try our best to get this to work on the mobile as well.

- Players will first judge a game by how it looks and colours play a big part in that.

 Responses from Graphic Designers

Interview Question 1 : Does your target audience affect the choice of colours in your design? Please give reasons and explain.

- *Yes*. Colours have influence on audience because the main consideration of every design is the target audience; therefore they play a huge role in the choice of colours. For instance, "I use RED which is LOUD for danger and warnings".

- For instance, "Designs meant for children, parties, clubs, entertainment programmes are more colourful and vibrant while those meant for formal events or older people are more toned down in terms of colour choice and usage".

Interview Question 2: What emotions do you want your audience/target to experience?

- Graphic Designers indicated they wanted their audience to experience *Reality!* Consequently, *"When I am designing for a happy day by the beach, I want my target audience to experience that excitement of being at the beach on a sunny day. I therefore use colours that will help bring out that feeling".*

- And also depending on the message the design is meant to convey. *"If it's a wedding, I want the audience to feel that this is a beautiful, special occasion and as such I try to convey that in the design and choice of colour. If the intention of the design is meant to provoke action, then I will similarly pick colours that convey such emotions, such as red, orange, yellow etc".*

Interview Question 3: Studies show that emotions are influenced by our culture and environment. What environmental and cultural influences do you think affect the way people perceive colour?

- *All the designers agreed colours were influenced by culture and environment*. These statements emphasized their thoughts: "In Britain, pink is associated with girls, while blue is associated with boys". However in other cultures like Ghana, society is influenced by colour mostly based on the age, gender and various rites.

- Another designer stated, *"I've generally found that when designing for people from the African and Caribbean continent or cultural background, the choice of colour generally leans towards bright, vibrant and sometimes contrasting colours such as yellows, greens, blacks, reds. People from some parts of the European continent generally prefer muted colours such as blues, grays and don't generally like using lots of different colours in a design. People from Latin and Spanish speaking countries also generally like vibrant and earth colours like ochre, yellows, greens and red. Again, when designing for people from Northern Ireland, it is important to be careful of the choice of colour as particular colours represent certain political persuasions and misusing the appropriate colour leads to problems".*

Interview Question 4: What choice of colours do you thinks reflect those cultural and environmental influences in your designs?

- Contrasting colours white and black play a dominant role.

- *People's understanding of colour is influenced by so many factors*. For instance in the Ghanaian community, it will be unwise to design for a funeral using colours such as white and green. This is because colours are associated with meaning; white is associated with good luck and purity. Green is associated with new growth and vegetation. Death is viewed as a bad thing.

Interview Question 5: Do you believe certain colours are associated with males and females? Please explain.

- *All the responses indicated and affirmed the related literature that suggested certain colours were associated with one gender or the other.*

- *Yes*. Males are usually associated with and prefer hues of blues, grey, green etc. whiles females are linked to such bright colours as pink, reds, yellow etc.

Interview Question 6: What is your opinion on the role of colours and how they influence our feelings with regard to multimedia industry?

- Colour helps us to communicate. "Indeed colour is multimedia and multimedia is colour: they are inseparable".
- *I believe the colours used for various multimedia packages influence our choice of products.*
- Colours are very powerful tools for visual communication and are therefore indispensable in the multimedia industry. They can be used to set the tone, mood and appeal of virtually anything. That's why a whole industry is built around the creation and selling of colour for example the Pantone Company.

Interview Question 7: How well do you think colour helps in design and how well do you think it affects the target audience?

- Colour is an impression. Any mark or impression on a support is a form or appears in colour.
- Colours bring designs and products to life and helps to distinct one product from another. It also helps to communicate effectively to the target market.
- Without the use of colours, some designs will look flat, uninteresting and the message the design is intended to carry will not travel anywhere. It is very important to understand colours and target audiences. For example if a book or multimedia device is to directed at children and the design behind it is not colourful and vibrant, it will not become a success no matter how brilliant the book or the device is.

The objective of the research revealed the following based on this set aim: *How colour in the design of video games affect the audience and their reactions to the choice of colours used in the specific types of video games.*

- Colour is a very persuasive tool in design and affects different personalities; extroverts and introverts alike. Our reaction to colour could either be inborn or learned and associated with objects in relation to a person's environment or culture (Sable & Akcay, 2010). Psychologically, people respond to colour with varying emotions. The colour red might stimulate flight in one person while the same red will stimulate joy in another.
- Thus in the two games played, players experienced different emotions in view of the mood of the game in relation to the choice of colour. ***Luxor*** was set with an Egyptian theme; therefore, the choice of colours included various shades of yellow, brown, red, gold, purple, red etc. Players indicated they were happy and excited playing

this game and also felt '*rich*' playing. They also connected and experienced the rich cultural heritage of Egypt while playing the various stages of the game.

On the other hand, players experienced anxiety, nervousness and boredom while playing the second game; this was attributed to the storyline and the choice of colours such as the various shades of blue, black, grey and browns which set the mood for a lonely disserted kingdom in the hands of an evil tyrant.

- Colours are great when designing to achieve a set of emotions. Although factors such as design and layout with target audience are considered, the impact is greatly achieved if the appropriate and suitable colours are used. Consequently, emotions of the player depend on the game play taking place; an action game will have more intense and screaming colours while an adventure game will have cooler and more natural colours (Joosten, Lankveld, & Spronck, 2010).

Conclusion

The aim of this research, conversely, has not been to produce a definitive answer on the role of colour dynamics in video games and its influence in the multimedia industry but rather to explore the views and responses on the psychology of colour (emotional content) in video games (products) by taking into consideration cultural and environmental influences. Having identified and discussed these regarding the role of colour dynamics in the multimedia industry, it is established colour plays a huge and significant role in the multimedia industry.

The application of colour in design and development of video games in the multimedia industry is built upon the fundamentals of the psychology colour, game play and the fun aspect instilled in humans. On this basis, colour choices based on game developers or graphic designer's own preferences are generally not as effective as choices that give careful consideration to message, audience, and context. Thus, understanding the basic scopes of colour dynamics and their influence on humans is invaluable. Apart from these, another factor is motivation by engaging the player through a series of accomplishment and helping the players personalize and identify with the games by giving them the freedom to choose and make decisions that affect them in one way or the other.

By exploring colour dynamics and its influence in the multimedia industry, the study has focused on the role of colour dynamics in video games, as well as its emotional impact on game players. The research has highlighted potential areas for further study including a wider range of larger participation group sampled from the multimedia industry to explore deeper the role colour dynamics play in the various divisions of this industry.

Recommendation

The following recommendations are offered for further research related to the study.

- Given the evolving nature of technology as well as people's perception on colour, a series of longitudinal studies, based on research, would help document more accurately these perceptions to build on the trend and opinions of others.

- While colour plays a significant role in the multimedia industry, it may be advantageous to conduct research which considers the distribution of these views based on ethnicity, geographical locations, culture, and age-relatedness of specific target groups with supporting data statistics.

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