A Model for Balancing Clarity and Appeal in Serious Game Visuals

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Abstract: In serious game development, graphic design needs to be eye-catching, while also depicting subject matter content in a responsible, accurate, and clear way. Previous research has shown that abstract and symbolic game visuals seem to be preferable for learning and providing an engaging experience. Our research focuses on describing the challenges involved in creating effective visual communication through game graphics in cross cultures. In particular, we're interested in examining if certain styles of visual communication are more or less effective between different cultural demographics. To examine this, we have created a serious game which aims to promote healthy food and nutrition habits to teenagers in both Nepalese and Swedish schools and by doing so also motivate behavioral changes toward healthier eating habits. We are currently conducting studies to see whether preferences and image recognition differ between the two demographical spheres. This paper will only discuss the exploratory study done in Nepal. Ultimately, this paper aims to contribute development guidelines that can aid developers in creating more effective visual communication in their serious games, and we primarily focus on exploring what we call the compromise of 'clarity' and 'appeal' in the creation of game graphics. We present an initial model for choosing at what level in terms of realism/abstraction and taxonomic hierarchy the graphical components of serious games optimally should be produced in order to solve the dilemma of precise, unmistakable, yet appealing visuals in serious games. It all comes down to two primary decisions: defining the taxonomic hierarchy of the items to depict, and choosing the style in which to depict them. With a better understanding of when different game visuals are more or less appropriate, both in terms of style and in which objects are represented, game developers will be able to balance production costs better while also creating something that strikes the compromise between clarity and appeal.

Keywords: Visual communication, Game graphics, Development guidelines, Cross-cultural serious games, Health, localization

1. Introduction

In serious games, digital game-based learning, and gamification research, discussions and guidelines centering around the importance of achieving a good balance between engaging and informative game mechanics is in abundance (e.g., Kiili, 2005; Groff, Howells and Cranmer, 2012; McClarty et al., 2012; Rai and Beck, 2012). The complexity of both communicating a message in a highly engaging way that keeps the player playing, while still being "true to the message" and not distracting from important issues, is certainly at the core of designing the mechanics and systems of these types of games. However, we argue that the creation of graphics constitutes a very similar challenge. They need to be eye-catching, while also depicting subject matter content in a responsible, accurate, and clear way. If one is to look at the graphics of a serious game from a utilitarian perspective, they should essentially be as verisimilitudinous as possible; after all, the higher fidelity with which an object is depicted, the less room there is for misinterpretation. Furthermore, a higher degree of fidelity should also improve transferability of knowledge from the serious game and the real world (Petridis et al., 2012). As soon as layers of artistic interpretation and stylization are applied to a real-world object, room for misinterpretation of the object grows and players might have a harder time connecting the in-game object and its real-world counterpart.

From a less utilitarian and more subjective perspective, stylization and abstraction is sometimes desirable by the target audience: photorealism, while clear, might not always be appealing. Finding the right balance between clarity and appeal requires significant deliberation from a development team. While there are many guidelines (Yusoff et al., 2009; Arnab et al., 2015; Tsekleves et al., 2016) giving advice on how to balance gameplay and "serious" content, there are few guidelines that give advice on how to strike a balance in a game's visuals.

However, full photorealism is itself problematic (Petridis et al., 2012): it is unfeasible to produce photorealistic assets within most serious game development projects' budgets; development teams might not have the skills required to efficiently produce photorealistic objects; and, most end-user hardware is unlikely to meet specification requirements for displaying those types of graphics. There is also the more ephemeral reason that photorealism might simply be unappealing to certain audiences. So there are both practical and subjective

reasons serious game developers need to compromise between and find a way to stylize what they're representing in the game.

The study presents a model aimed at resolving the challenge of creating visually clear, easily recognizable, and visually appealing elements in serious games. It draws upon existing theories, literature findings, exploratory studies, field studies, and practical development. The model has been implemented in a serious game, and we anticipate that it will assist developers in making more efficient decisions while maintaining an engaging game that fulfills its intended purpose. By establishing the optimal level of object representation within the taxonomic hierarchy and determining the necessary level of fidelity between realism and abstraction, development teams can strike the right balance that aligns with their game's objectives. This approach extends beyond regional specificities and can also be applied to subject matter details on a universal-specific spectrum.

2. Game Visual Development

The game that we're using as a case study for this broader discussion of visual communication in serious games is *Happy Heart* - a mobile game that aims to promote a healthy lifestyle through diet and physical activity (shown in Figure 1).

2.1 Game Project

This project aims to prevent future cardiovascular disease for teenagers aged 13-15 years in Nepal. As the title of the game suggests, the theme of the game is "taking care of your heart" as the basis for the game. The project includes two "teams" - the game development team, and a team of local researchers in Nepal. The Nepalese team has done research to see what knowledge gaps the target player group has, and we have used their resulting Knowledge, Attitude, and Practice (KAP) report regarding heart disease among the target group to address these knowledge gaps through our game design (Shakya et al., 2023).

Figure 1: The screen prints depict the four levels of the serious game Happy Heart, namely food sorter (top left), salt seeker (top right), activity (bottom left), and master chefs (bottom right)

2.2 Game Visual Research Methodology

To achieve the objectives of this study, the methodology conducted three phases thus far: 1) literature review; 2) exploratory study and field study; and 3) implementation of the serious games.

1. **Literature review:** This phase is meant to reveal the broad outlines of visual communication development and use in serious games context. As a result of this phase, we found that research on visuals in serious games is relatively rare, and one common conclusion is that visual complexity distracts students from the intended learning content. When users are presented with overloaded

information, human visual perception works unconsciously to ignore the least visible parts. Thus, we framed the graphic style into an abstract style.

2. **Exploratory study and field study:** An empirical study was carried out by the game development team to explore the visual recognition and preferences of Nepalese teenagers. The team also delved into the participants' video game habits and media preferences to assess their visual literacy. To gain a contextual understanding of the culture and environment, informal interactions were held with students in schools and households.

3. **Implementation of the serious games:** Following the exploratory and field study in Nepal, the game development team collaborated with the Nepalese team to design the game mechanics and visuals. Using findings and theories identified in the literature, exploratory study, and field study as guidelines when implemented into the visual design of the serious game *Happy Heart.*

3. Targeted Issues

The creation of effective and appealing visual communication is a challenge that has been examined by non-game-related research for quite a while, primarily in the fields of UXD and cognitive sciences. In research focusing on website design, for example, studies have been carried out that investigate color preferences and visual complexity in different parts of the world (Reinecke and Gajos, 2014). As an example, a study comparing color preferences between British and Namibian adults stated that: "We suggest that not only do patterns of color preference vary across individuals and groups but the underlying mechanisms and dimensions of color preference vary as well. The findings have implications for broader debate on the extent to which our perception and experience of color is culturally relative or universally constrained." (Taylor, Grandison and Franklin, 2012). These types of studies are, in our view, highly relevant to the field of serious games. However, visual preferences are an issue that is seldom explored or taken into account in the development of serious games where discussions of the merger of informative content and gameplay mechanics often take center stage.

This "lopsided" focus of serious game research leads to game developers primarily just creating "serviceable" graphics as a general afterthought to suit the game's general theme. However, the creation of "good" serious game graphics comes down to a series of decisions that share similarities with the creation of "good" game mechanics. While game designers are concerned with balancing learning and engagement, artists need to be concerned with clarity and appeal. In addition to that, artists also need to take demographic characteristics and peculiarities into account.

By visual 'clarity' we refer to how recognizable the game object is as a representation of its real-world counterpart. As previously mentioned, the extreme example of a clear visual style would be full photorealism. A fully realized, high-resolution 3D render of a real-world object would be very quickly recognizable by a player. As we move towards the opposite end of the clarity spectrum we find more and more stylized imagery (more cartoony or hand-drawn styles, or pixel graphics), and ultimately approach something akin to abstract art.

Furthermore there is the obvious practical issue of full photorealism being far outside the scope of most serious game projects either due to budgetary constraints, capabilities of the game engine, as well as the expertise of most development teams. This can also be described as visual fidelity, however we find the term 'clarity' to be more useful since it leaves less room for miscommunication as fidelity can also relate to technical properties of an image (e.g., its resolution).

4. Solution: A Model for Balancing Clarity and Appeal

Solving the dilemma of clear, unmistakable, yet appealing visuals in serious games comes down to two primary decisions: choosing the taxonomic hierarchy of the items to depict, and choosing the style in which to depict them. In cross-demographic contexts, it is crucial for developers to give thorough consideration to visual representation, as it has the potential to influence the adaptation of the target group.

It is also important to note that the aforementioned challenges involved in creating appealing visuals is further compounded by various cross-demographic issues. These can be affected by age, cultural background, socio-economic factors, level of education, past media habits, and a myriad of other factors (Reinecke and Gajos 2014). While our specific case centers around differences in preference and recognition in visual communication between teenagers in Nepal and Sweden, similar issues can be encountered when working with two distinctly different age groups in the same region. This is yet another reason we want to present

development guidelines that can aid developers in creating clear and appealing visual communication regardless of which demographic issue they might be facing.

4.1 Choosing Which Objects to Depict

A common mistake among developers and artists alike is that their design decisions - unbeknownst to themselves - are heavily informed by personal biases. If you ask two different people to draw a picture of a computer, one might draw a laptop, while the other might draw a desktop computer. This is going to be informed by many factors, such as their own lived experiences and what types of computers they commonly encounter, their personal media habits, cultural context, interests, level of education, and age. When making a serious game about cars, then, what type of car should we use to effectively communicate with our players? Or, in our case, which food item should we use while considering the factors of personal media habits, interests, cultural context, etc. in Nepal?

Here we have found it useful to use Rosch et al. (1976) concept of taxonomic hierarchies of objects. According to Rosch et al., people recognize objects at different levels of specificity - the *superordinate*, *basic level*, and *subordinate*. Building on Rosch et al., Lakoff (2008) concludes that: "The fact that knowledge is mainly organized at the basic level is determined in the following way: When subjects are asked to list attributes of categories, they list very few attributes of category members at the super-ordinate level (furniture, vehicle, mammal); the list most of what they know at the basic level (chair, car, dog); and at the subordinate level (rocking chair, sports car, retriever) there is virtually no increase in knowledge over the basic level."

To give a brief introduction of the concept, these levels can be understood as: superordinate = animal (the universal level), basic level = horse (a more specific category of animal, but still broad), and subordinate level = Shetland pony (a very specific subcategory of horse). This can also become increasingly complex, with subordinates within subordinates. For the purposes of our work, and for general serious game development, we have translated the hierarchies of superordinate, basic level, and subordinate into a spectrum ranging from '*universal*' and '*specific*' (shown in Figure 2).
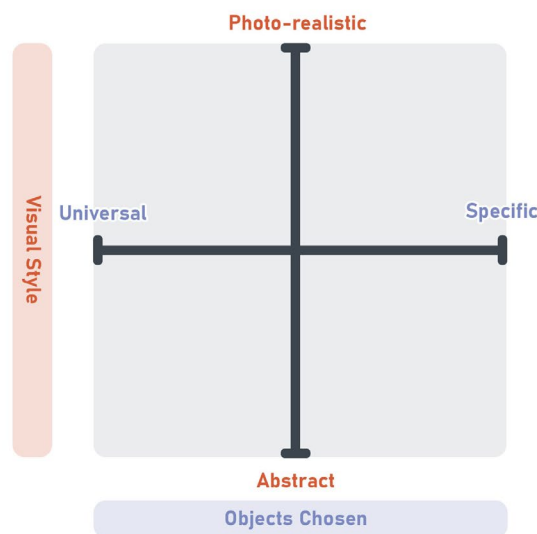

Figure 2: We have developed a model to strike a balance between clarity and appeal in serious game visuals. The model is represented by an X-axis spectrum ranging from universal to specific and a Y-axis spectrum ranging from photo-realistic style to abstract style

We have tied this model to our own project (shown in Figure 3). The first category comprised of 'Specific' Nepalese food items like roti (a type of flat bread), barfi, and samosa, which were selected to elicit a sense of daily familiarity. However, in a different cultural context, these items may need to be substituted with other appropriate options. The second category included 'Universal' food items that have a universal visual representation, such as fruits (apple, mango), vegetables (broccoli, pumpkin), and meat. The third category consisted of food concepts that have different visual representations in various cultures and may lean more towards either the 'Universal' or 'Specific' category.
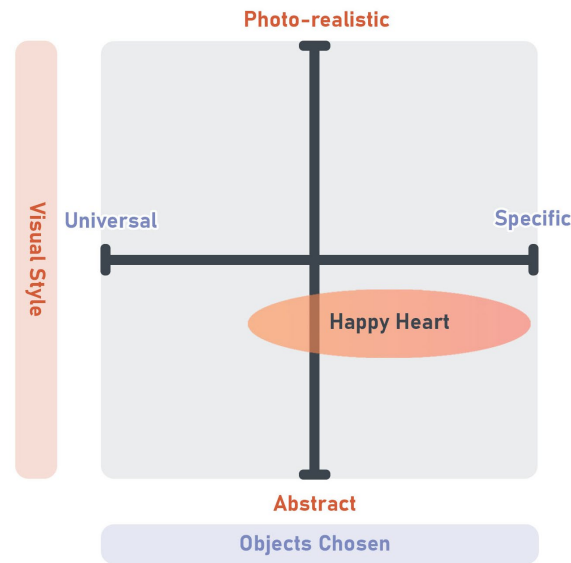
Figure 3: The range we have chosen for our serious game Happy Heart is denoted by a red oval on the model

The most complex aspect of compromise lies in the third category, illustrated by the example of beer. Beer as a general concept can be a very broadly recognizable visual representation, while in Nepalese culture it has a different type of look. There are three aspects of concern when we make compromises. First, as we found in earlier studies conducted in this project, localizing serious game images should take players' pre-existing visual experiences into account (Bai, Berg Marklund and Zhang, 2022). Participants in this previous exploratory study preferred familiar images from games. Therefore, a more universal representation might be better suited for the games they typically play. Second, based on Biederman's (1995) research that "Most of our knowledge of the visual world can be accessed through the basic level", specifying the subordinate-level class—for example, that something is European brand beer versus Nepalese type of beer—provides only a slight increase in informativeness at an enormous loss of distinctiveness. That is, the difference between the two types of specified beer is much smaller. While a specific type of beer bottle is prevalent in Nepal, an image of a beer glass filled with beer might be more quickly recognizable. From a learning perspective, it might not be detrimental to acquire knowledge by utilizing either. Additionally, the visual representation of this issue would also be of concern. We should notice that beer is one of the basic objects presenting a superordinate level of "alcohol" to discard into a trash bin in the game. The target group has low knowledge of alcohol-related health problems according to the KAP study. As a result, we depicted beer falls under the 'Universal' category based on our analysis.

An example of selecting more specific items to be depicted in the game is roti. In the exploratory study in Nepal, we found that participants could easily recognize almost all "natural" food items (unprocessed food). It was, however, difficult for participants in the test to recognize many cooked food items (Bai, Berg Marklund and Zhang, 2022). For example, the cooking methods for a roti can include folding, flattening, inflating, or filling it with other ingredients. Recognition might very well be tied to how similar it is to how the participants are accustomed to eating the specific food. Based on this, we took more care to select the appropriate shape of local food items.

When considering other visual elements in the game, such as background design and interaction elements, we encountered a dilemma in making a choice. During a field study in Nepal conducted by members of the game development team, we found that steel-made tableware is common in the kitchen. Therefore, we chose steel plates as part of the interaction element in the level Master Chef whereas we identified contrast issues. When players move the food elements on the plate, the graphics could not provide a solid contrast between the plate and the food items due to the overall color scheme. The lack of contrast made it difficult for players to properly make the right decision in the game and navigate the screen. Value (Brightness) between objects is too close. According to Norman (2013), people can understand how things work based on their visible structure, such as affordances, constraints, and mappings. Although participants may have never seen or used other types of plates, they could recognize that the number of possible actions were limited. As a solution, the game graphic team replaced the steel plate (gray) with a regular porcelain (white) plate in this case.

4.2   Choosing the Visual Style

Once appropriate objects have been identified and categorized according to the purpose of the serious game, it is then important to choose the level of stylization that best suits the players' preferences while still maintaining clarity and making objects easy to identify with a minimal risk of misinterpretation. This is where the correct balance between clarity and appeal needs to be found.

It is important to note that this decision should not be taken lightly, and a developer needs to be fully aware of the compromises they're making when choosing their visual style. We suggest that the primary factors guiding this decision are: audience characteristics (e.g., age, level of education, cultural background, media habits, etc.), end-users' hardware, the game's purpose and area of application, development budget, and the development team's skillset. Take our project as an example, we began with a literature review that indicates realism and too much detail might be counterproductive in the serious game (Bai et al., 2022). Considering our target platform as Android smartphones, we were also aware of the constraints it imposes on graphical design. Thus we framed the graphic style into an abstract style. The exploratory study in Nepal tested the recognition and preference of different levels of fidelity among the target group. The results suggested using the abstract style with color and hard shading, without the outline.

Returning to the "beer" example, even the 'basic level' we chose for its shape (a glass with yellow-ish liquid with foam on top) can still be drawn in different styles. It could be a high-polygon count, photorealistic glass of beer with simulated liquid physics, or it could be a stylized or highly abstracted style. For the context of Happy Heart - given its audience, purpose, end-users' hardware, and the development budget, a cartoon style was deemed the most appropriate. A more abstract visualization could lead to a lack of both clarity and appeal. The beer might, for example, be confused for a soft drink - and the higher level of abstraction would also be unsuitable for the target audience's visual preferences. And while an even more realistic style may have been more appealing (for example a 3D object with more detailed textures), the level we chose provided the optimal balance of appeal and clarity according to the audience, budget, hardware, and purpose factors of our project.

5.   Outcomes and Results

What we consider to be innovative is, however, the development process and the examination of factors that inform the way a game should look and function to be successful in different use contexts. From a broader theoretical perspective, the innovation resulting from our work is a methodology that can improve decision-making in development processes. This methodology comes down to tackling two particular dilemmas: choosing between established taxonomic hierarchies for what you're representing in your game, and choosing between realism and abstraction for how to represent it.

We, in particular, hope that the model helps developers make more efficient choices while still making an appealing game that achieves its purpose. Establishing the right level of object representation (i.e., which level in the taxonomic hierarchy is necessary), and the necessary level of fidelity (in the continuum of realism and abstraction), will help a team find the right compromises fitting their games' purpose. This does not just have to be limited to specificities found in geographic regions - the universal-specific spectrum can also apply to subject matter details. If you are making a game about car repair for an 18-year old who got their first car, depicting basic level objects like engine, battery, and the fuel tank in a stylized way might be sufficient. If you're making a game about car repair for a mechanic, you need to dive deep into the subordinate level representations and clearly represent a 2.0-liter hybrid inline-four gasoline engine, and clearly make the car parts visually identifiable (e.g., belonging to specific car manufacturers). Making misinformed choices about what graphics to use for either case can, at best, lead to an unnecessarily inflated budget, at worst, lead to the player learning the wrong things or a fundamentally unappealing game.

It is important to note that we would not have been able to make these choices for Happy Heart, and understood the problems with our original assumptions about what type of graphics our game would benefit from, if it wasn't for our access to a research team in Nepal. Without that team, we would not know where a 'subordinate' (i.e., specific) object was necessary, and where a 'basic level' (i.e., more universal) object was sufficient. With access to insights into Nepalese teenagers' reference frameworks, we could find the compromises that made our development cheaper and more efficient, while still communicating valuable information and decreasing risks of misinterpretations of the subject matter. In our own research examining the preferences the target audience has in terms of the game's visual style, we were also able to identify which level of stylization hit the right compromise of being appealing and clear. Knowing that a cartoony style hit a

good balance between clarity and appeal, we could then be sure we didn't "waste effort" in pursuing a higher degree of realism in our game objects than was necessary.

6.   Conclusion

While all game-based learning solutions are complex and need significant deliberation and communication between stakeholders to be successful, creating even mechanically "rudimentary" game-based learning solutions become even more complex when they are intended to be used in cultural settings outside of the developers' lived experiences.

A serious game's graphics should not be decided upon haphazardly. It should not just be thought of as a facilitator to a serious game's gameplay, it needs to be understood as a fundamental pillar that supports the game in achieving its ultimate goals. With a better understanding of when different game visuals are more or less appropriate, both in terms of style and in which objects are represented, game developers will both be able to balance production costs better while also creating something that strikes the compromise between clarity and appeal.

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