Patterns of Play: Play-Personas in User-Centred Game Development

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ABSTRACT
In recent years certain trends from User-Centered design have been seeping into the practice of designing computer games. The balance of power between game designers and players is being renegotiated in order to find a more active role for players and provide them with control in shaping the experiences that games are meant to evoke. A growing player agency can turn both into an increased sense of player immersion and potentially improve the chances of critical acclaim.

This paper presents a possible solution to the challenge of involving the user in the design of interactive entertainment by adopting and adapting the "persona" framework introduced by Alan Cooper in the field of Human Computer Interaction. The original method is improved by complementing the traditional ethnographic descriptions of personas with parametric, quantitative, data-oriented models of patterns of user behaviour for computer games.

Author Keywords
Play persona, game experience, game design, user centered design, user experience design, gameplay metrics, game mechanics.

INTRODUCTION: OPEN AND CLOSED GAMES

The practice of designing computer games today cannot refrain from including player-driven issues, considering how standards such as those set by web 2.0 have geared people's expectations towards a higher degree of agency. In many of the critically acclaimed digital games today, it is possible to detect a trend in transferring at least part of the authorship to the players thereby increasing their agency. User-generated content is one of the manifestations of this trend. In a scenario where people are growing used to expect a high level of customization and personalization from entertainment products, players react favourably towards being put in charge of the content, to a smaller or greater degree, as is evidenced by the sales figures of titles such as *Little Big Planet* [5a], *Spore* [7a] and *The Sims 3* [9a].

Other games, such as *Fallout 3* [2a], *Grand theft Auto IV* [4a], *The Elder Scrolls IV: Oblivion* [8a], retain complete creative control but opt for open worlds and modular narratives to increase player's agency.

There seem to be a push for games to become more democratic, the power balance between game designers and players could be shifting. The dictatorship of game designers, holding all the cards and slowly revealing the game at their own pace to the players, is coming to terms with players that need to feel more in control of the experiences that they will go through, in order to be more immersed or "incorporated" [4]. Furthermore, non-trivial choices and ability to express oneself are often seen as determining factors for critical acclaim and are considered by reviewers as being required for a broader appeal of computer games [31].

This trend notwithstanding, there are many games still made by designers with a story to tell, that attempt to provide pre-designed, high quality, cinematographic experiences. Games like *Resident Evil 5* [6a], *Gears of War* [3a], or *Call of Duty 4* [1a], where there are less elements that designers can put up for negotiation with the players. The Aristotelian dramaturgic devices [28] of plot, characters, themes, style and settings are fixed by the designers and the experience they want to craft; these elements are not up for bargain.

This leads to the question about how more linear, traditional and narrative games such as *Tomb Raider: Underworld* [10a] (TRU) can keep up with the "democratising" trend when they lack the proverbial chips to put on the

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negotiating table with the player? In TRU there is no space for players to partake in the creative process, nor there is much of an opportunity for open-world type exploration since the game world is quite straight forward and tightly constrained. Even the storyline is quite tight and does not allow much deviation. Furthermore, players are not expected to create content but to experience what was crafted for them. What elements can designers offer to players expecting some degree of control?

What is left for players is to determine *how* the events unfold, how they perform the tasks set forth by the designers, how they act in the gaps left open by the game, where there is not a single way to solve a puzzle or accomplish a task. Players are left free to decide the modality of interaction amongst those offered by the game. The classic example is *Deus Ex* [11a], which provides a wide variety of means for a player to navigate the tight confines of the game.

Play-personas are here introduced as a modeling tool that aims at ensuring that more restrictive games still allow some degree of influence from the player on the experience generated. This paper showcases the play-persona tool, derived from the domain of Human Computer Interaction (HCI) and experimentally in use at some EIDOS game development studios. The play-persona is a construct that can be used for opening potentially closed game experiences, games that cannot relinquish creative control on the assets nor are willing to let the player wander among disconnected narrative modules and procedurally generated landscapes. These games can instead provide different playstyles [33], diverse means of accomplishing tasks. Play-personas are models that simplify and clarify player behavior, representing essential features and making the abstract concrete. They assist organising cognitively, both in the minds of designers and players alike, the mechanics provided by the game such as different types of weapons, different interaction methods to negotiate the environment or different devices used to deal with non-playing characters. Employing play-personas to transfer agency to players entails the same focus on the user that has dominated the field of HCI for the past years simply by adopting and adapting methods introduced by User-centered and Experience Design [26, 18].

1.0 COGNITIVE BACKGROUND FOR PLAY-PERSONAS

The persona framework as a tool for modeling ideal users was originally suggested by Alan Cooper [9, 10]. According to Cooper, personas are detailed, composite user archetypes that serve as main characters in narrative, scenario-based descriptions that iteratively inform the design of a product, so that features emerge directly from the goals. There might be a cognitive background to the immediate success of these narratives. The human mind has often been called an excellent belief-engine or a pattern-seeing device [39]. Pattern-seeing rather than pattern-recognizing, because recognition would imply existing patterns and often that is not the case. When presented with non correlated inputs the human mind still attempts at finding an organizing order behind it and seeing patterns and meanings there where there are none.

Recent work in cognitive- and neuroscience has proven that the human mind abhors void and emptiness and it does everything it can to fill the gaps as it's shown by the phenomenon of scotoma, also known as the blind spot, whose blank field is filled with material produced by the mind [27].

Furthermore the work of human biologist Lewis Wolpert [39] showed how the compulsion to create a story, to weave drama in that blind spot, might actually be biological, it could represent a cognitive imperative, an innate need to have the world organized cognitively. The failure to find causes and to explain in causal ways apparently unrelated events creates anxiety and discomfort. This evolutionary biological imperative to connect the dots and weave stories to make sense of our experiences could explain why, long before the adoption of persona models by HCI practitioners or the abstract user representations utilized in marketing, our past history abounds with attempts at preemptively model behavioral patterns of people.

1.1 Origin and history of personas

In ancient Rome actors would wear a *persona* before going on stage: a mask that embodied socially agreed conventions to represent a certain type of character. Modern sociology speaks of social masks or fronts [15] to address the different roles that we have to play according to the different contexts we are presented with. It is as "self-construed self" that Jung listed persona as one of the archetypes populating the human unconscious. Hypothetical identity-constructs have been recognized as fundamental in many creative practices. In literary theory, Iser [17] introduced the term "implied reader" to address the model of a *"reader that a given literary work requires"*; an individual that, within the frame and the context imposed by the text, is able to make assumptions, has expectations, defines meanings left unstated and adds details through a "wandering viewpoint". By Joyce's own admission, *Finnegan's Wake* should be read by *"that ideal reader suffering from an ideal insomnia"*. Eco [13] expanded on the concept introducing the "model reader" as *"the author's foreshadowing of a reader competent enough to provide the best interpretation of a text"*. The author tries to prefigure a model reader by imagining what could be the actualization of the text. In social sciences, Weber [30] introduced the concept of Idealtyp as *"formed by one-sided accentuation of one or more points of view and by the synthesis of a great many diffuse, discrete, more or less present and occasionally absent concrete individual phenomena, which are arranged according to those one-sidedly emphasized viewpoints into a unified analytical construct"*. The ideal type is a pure mental construct used to assess the behaviour of social groups. It is totally theoretic, almost fictitious and generally

not empirically found anywhere in reality, it is not backed by statistical data nor a model personality profile, it's more used as some sort of unit of measure, a standard much like "meter", "second" or "kilogram" not really found in nature, but useful to measure it.

It is only natural that game designers would attempt at making assumptions on the nature of players; using personas helps them to map the extreme boundaries of the field of possibilities afforded by their game.

2.0 PERSONA MODELING IN HCI

The most recent iteration of pre-emptive user modelling techniques is the persona introduced by Cooper [9,10]. Cooper initially identified cognitive friction as the common problem that plagues computer software products.

He described cognitive friction as "the resistance encountered by a human intellect when it engages with a complex system of rules that changes as the problem changes" [9]. Cognitive friction was referred to the meta-functions arising from the elements composing computer software such as buttons, icons and commands; but those meta-functions happen regularly in videogames where, according to the context, pressing a button might result in the avatar climbing a wall, shooting a gun or opening a door. Cooper suggested a solution to this problem through Goal-Directed method. This method starts with a research phase, in which behaviours, patterns and modes of products' use are identified. These patterns suggest goals and motivations and in turn these inform the creation of personas.

Typically a persona is a description of patterns of behaviour, goals, skills, attitudes, and environment, with a few fictional personal details to make it a realistic character. The tools to create personas have evolved considerably from the beginning, but two key areas have not changed: a emphasis on the initial investigation and lack of ongoing data collection.

Main criticisms moved to personas are:

- Characters are often designed by a committee with little regard for real data;
- Characters are difficult to communicate because they often consist of a resume-like documents presented as a posters;
- Being the characters fictional, they have no relationship to real customer data [2].

Recent developments in persona research has considerably modified the approach of practitioners, Wiggins [35, 36, 37], for example, suggests to corroborate the narrative, ethnographic descriptions of personas with data about usage harvested from *Google Analytics*; Pruitt and Grudin of Microsoft [42] also emphasized backing the construction of personas on real data and maintaining the descriptions with ongoing data collection [1] and Warfel [34] presented practical methods for generating data-driven design research personas.

2.1 From personas to play-personas

It is here suggested that game designers could benefit from procedural, data-backed preemptive models of play behavior. Additionally, game rules and spaces can be used to carve channels in the minds of players for helping them organizing experiences and guiding the emergence of sense-making patterns. Play-personas are offered as such devices, helping the emergence of narratives to make sense of what happens in game worlds. Play-personas can influence and control the ways that players categorize what they experience in game worlds; persona constructs can be triggers that inspire, incite and compel players into certain actions. These mind patterns can be expressed as behaviours undertaken in game worlds using mechanics and rules that the game affords [33]. Play-persona hypotheses emerge as relations between parameters derived from the set of interaction and navigation possibilities offered by the game in terms of rules and spaces.

Play-personas are defined as clusters of preferential interaction (*what*) and navigation (*where*) attitudes, temporally expressed (*when*), that coalesce around different kinds of inscribed affordances in the artefacts provided by game designers [6].

Moving beyond narrative descriptions of motivations, needs and desires distilled in ethnographic interviews, play-personas are expressed also as procedural description of preferential behaviours in terms of game mechanics used. This procedural description augments and strengthens the idea behind personas as formulated by Cooper because, due to the intrinsic numeric nature of procedural descriptions, it is immediately possible to compare different play-personas, provided that they are scored according to compatible parameters. At the same time it becomes possible to compare and evaluate play-personas postulated a-priori as hypotheses by the designers during the production of a game with actual behavior expressed by players engaged with the game, if directly coupled with instrumentation data in the form of gameplay metrics [1] gathered from game engine software during play sessions.

It is in this respect that play-personas are both theoretical models of ideal users (*metaphors*) and data-driven representations of player behaviours (*lenses*).

[1] The term "gameplay metrics" refers to data about players' behaviour in a game (location, use of skills, powers, abilities, interaction with other players, deaths, etc.), automatically recorded during a play session.

3.0 DEFINING PLAY-PERSONAS USING GAMEPLAY METRICS

Initially, during the concept and early design phases [29], persona modeling serves as a planning tool for implying the player behaviors in the design of the game. In this phase of game production, play-personas are metaphors for the actual players, in a manner similar to the way that personas can form metaphors of customers when developing a website [10, 19]. As soon as a playable version of a game is available, play-personas become data-driven rather than theoretical (Figure 1). In other words, actual player behaviors are mapped and any patterns in their behavior located. These form the basis for defining a new set of concrete play-personas which can be compared with the theoretical, initial set. The data utilized can potentially be both qualitative and quantitative, stemming from e.g. surveys, interviews or analysis of gameplay footage. However, an effective approach towards gathering data on the in-game behavior of players in large quantities and with high precision and detail is **gameplay metrics**, an approach that takes inspiration from the data-driven personas used in general HCI [see e.g. 35-37]. Gameplay metrics form objective data on the player-game interaction; these are usually registered by the game engine or a dedicated logging program. In general, gameplay metrics can be recorded for any type of user-initiated behavior where interaction takes place in or with the virtual environment. Additionally, the behaviors initiated by agents or systems operating in the virtual environment outside of the control of the player, e.g. autonomous agents [32], can form the basis for metrics logging. Metrics also include information about the user hardware configuration, game install language, etc. which, in an industry context, is useful for e.g. marketing, as well as in a user-oriented research [38].

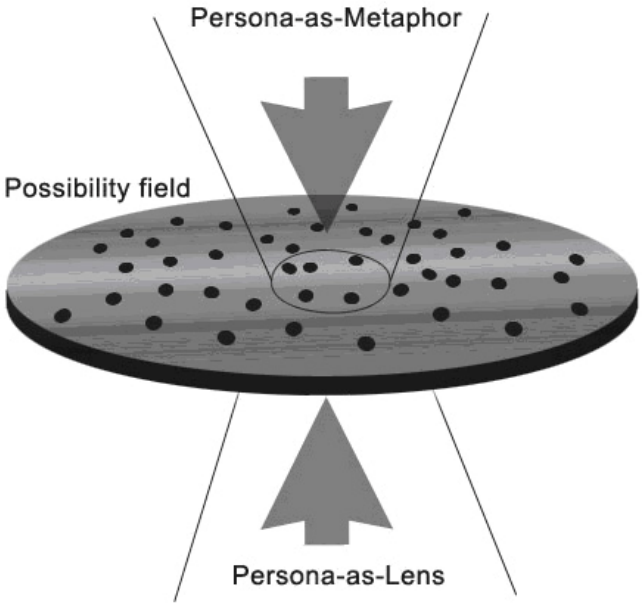

Figure 1: Two sides of the same coin: Play-personas as metaphor and lens. The black dots on the "possibility-field" plane represent game mechanics of the specific game. Thanks to the a-priori description of the persona-as-metaphor a certain subset is individuated. This persona hypothesis can be checked against gameplay metrics data gathered from players and inform the creation of persona-as-lens, in this case the two sides match, but it is not always necessarily the case. [Source: 6]

Gameplay metrics are used by several different game publishers and developers and is seeing increasing interest in the industry [31]. Within the academia, the data type is also being utilized as a tool for exploring player behavior. While a full review of the literature is out of scope in this paper, it should be noted that the current work is generally divided into those originating from the industry [11, 16, 18, 25, 31, 33], a few papers focused on researching player behavior [e.g. 38] as well as a few examples of systems developed for capturing gameplay metrics-like data targeted at Virtual Environments rather than games specifically [3, 7, 8].

Gameplay metrics are a specific form of instrumentation data. Instrumentation data have been utilized in the general software and website development industry for over two decades as a tool for mapping user behavior and draw inferences about cause and effect [18]. In the context of play-persona modeling, gameplay metrics are of interest because they permit the analysis of user behavior in a *detailed* (each user initiated event can be logged), *precise* (events can be logged with a high frequency, and the specific time of the event and location of the player in the world can be logged) and *unobtrusive* manner (playing the game is not affected by the logging systems). In the industry and research, gameplay metrics tracking acts as a supplement to the established user-oriented testing methods: *usability testing* focuses on measuring the ease of operation of a game; *playability testing* explores if users have a good playing experience; and *gameplay metrics analysis* offer insights into how the users are actually playing the games being tested [11, 33, 40, 41]. In short, gameplay metrics form a useful tool for evaluating player behavior, and it is this data type that the play-persona models are based on.

In order to illustrate how this method can be applied in practice, a case study from IO Interactive (IOI), a game developer of EIDOS, is presented. At IOI , game metrics have been utilized for a variety of purposes, not the least in user-oriented testing, and a team at IOI currently functions in an advisory capacity to other EIDOS developers. The case study presented here is based on the game *Tomb Raider: Underworld* (TRU), developed by Crystal Dynamics and one of the major selling titles in late 2008. The reason for choosing this game is that an extensive (terabyte size) library of gameplay metrics data are available, collected via the Xbox Live! service. A sample of these data is used to showcase the principles behind generating data-driven play-personas. Due to confidentiality issues, the design processes applied for TRU cannot be disclosed, however the principles of applying play-personas

during the design phase (personas as metaphor), is described.

TRU is the eighth installment in the long-running series featuring one of the most-well known game protagonists, Lara Croft, a combination between an action heroine and Indiana Jones. The game, played in third-person perspective, sees the player controlling Lara Croft on a series of missions to exotic locations, entering tombs and lairs and solving more than 200 puzzles along the way, unfolding a fairly linear storyline. TRU is at heart an advanced platform game, where players need to adopt strategic thinking in planning their way through levels (Figure 2). The core game mechanics are based around jumping between platforms and eliminating mobile enemies. Another threat is the environment itself – players risk drowning, electrocution, falling into a trap, catching fire etc. Navigating the environment, surviving dangerous enemies and solving puzzles form the core gameplay components.

Figure 2: Screenshot from Tomb Raider: Underworld. The screenshot captures two of the ever-present dangers in the game: Mobile computer-controlled agents and platform-style jumping.

3.1 Play-personas as metaphors of players

A metaphor is a rhetorical device that allows describing something unknown by transferring attributes from a known entity. Metaphors are utilized before the accumulation of experience, in a similar way personas allow designers to "imply" unknown player behavior in the process of creating digital games, i.e. by pre-defining the intended play-patterns in the game in question and design to accommodate these.

According to Lakoff & Johnson [20, 21, 22] cognitive metaphors allow mapping a more familiar *source* conceptual domain onto a less known *target* conceptual domain in order to better understand the latter. For example: "love (target) is a journey (source)". These mappings are considered to be pre-linguistic and concern time, space, movement and other core elements of embodied human experience.

When players control an avatar in a game world, the process of modeling the avatar's behavior through a metaphor is strikingly less abstract than attempting to understand "love" through "journey". That is because the avatar, as the medium that transfers agency from the player to the game world and receives feedbacks from the game world on behalf of the player, is a representation of the player's body.

The play-persona metaphors are models of possible patterns of behavior in the game world that are wished by the designers and embody different ways of behaving in the game. These models are not necessarily enforced: they emerge as clusters of preferential usage of game mechanics. Designers can utilize these models to plan experiences of play: shaping the spaces of the game world and distributing challenges and rewards. By opening up the negotiation of the game space to multiple, consistent alternatives, designers allow players the freedom to express themselves by choosing to behave in the game as they prefer, even if the choice means combining mechanics in ways that were not considered optimal. At the same time designers can maintain control on those variables such as plot, characters, themes, style and setting, that determine what kind of story is told, therefore still being able to deliver pre-designed, cinematographic experiences. The freedom experienced by the player is not expressed by deciding what characters take part to the story, what the task to complete is or where is the setting, the freedom lies in deciding how the action takes place and seeing this difference acknowledged by the game world.

Play-personas as design tools represent an expectation of how players would like to craft their experience. In practice, when developing metaphorical play-personas during the concept/design phases, the first step taken consists of mapping and unfolding the possibilities that the player is to be allowed within the confines of a specific game, thus creating a comprehensive list of game mechanics. These are used to define initial **play-persona concepts**. One play-persona might be interested in jumping, sneaking and navigation, another in fighting enemies and using very big guns. The goal is to ensure that the personas encompass the interests of the players, but operate within the confines of the design that cannot be affected by player agency.

The second step is relating the mechanics to specific gameplay metrics. For example, for the mechanic "shooting guns" the metrics "accuracy", "weapon choice", "weapon carrying time" etc. could be defined. At this point each game mechanic is scrutinized in terms of relevance to the gameplay, descriptiveness of players' behavior, interest of the design team, and resources needed to track, transmit and store that game variable as a game metric [18]. There are different ways that mechanics can be categorized and related to player behaviors. This will depend heavily on the game genre and the specifics of the gameplay. An example was published by Tychsen & Canossa [33], who focused on character-based games, defining a set of categories of metrics that relate to specific character traits and abilities: **Navigation** metrics, **Interaction** metrics (with the game world, with non-playing characters and with the player-

controlled character), **Narrative** metrics and **Interface** metrics.

One way to apply a focus is to consider the key mechanics of the game. For example the "jump" mechanic is very relevant to TRU; is one of the foundational mechanics of the game, and one that players will be using consistently throughout the game. It is therefore descriptive of a major part of the player behavior. However, it might be expected that players approach jumping differently and/or with different levels of success. Furthermore, it is of interest to the design team to monitor the different layers of player's proficiency at jumping and finally, being a triggered mechanic and not a continuous variable like tracking the location of the player avatar, it is comparatively simple to capture.

Other top-level core mechanics involve the following:

- **Navigation** in 3D environments
- **Shooting** enemies
- Avoiding **traps** and **environmental hazards**
- Solving **puzzles** (including using the native Help-on-Demand system to solve puzzles)

The core mechanics are generally defined in the game design document in a commercial context; however, design teams can add to this list or modify it when defining the play-personas – it is important to keep in mind that personas are about behavior, experience and motivation. After the game mechanics of interest have been defined and expressed as gameplay metrics, it is possible to condense them in fewer, higher-order parameters such as gameplay gestalts [24].

Converting the mechanics of interest into concrete gameplay metrics is not always a straight-forward process and can require the logging of multiple metrics. For example during design it was wished to permit players both to combat and avoid mobile enemies. In order to define these behaviors in terms of gameplay metrics, information such as the number of deaths caused by enemies, the number of times a weapon was fired, and the path of the player through the environment, needs to be logged. It is necessary to strike a balance between the need for play-personas to be defined in real behaviors which can later be tracked, logged and analyzed; and avoiding excessive logging.

It is possible to utilize the play-personas directly, basing them on decisions about the kinds of playstyles that the design team would like to promote in the game in question. For example, the TRU team could define a set of personas, each with different dominant behaviors in relation to navigation, shooting, jumping and puzzle solving. An alternative approach is to consider player skill or use of, specific metrics. This essentially involves generating a multi-variate space where each metric (or higher-order group of metrics/gestalts focusing on the same game feature), is mapped along an axis (Figure 3). Combined, the axes span a conceptual possibility space (with as many dimensions as there are variables) within which players must operate, and behaviors can be defined as combinations of the selected metrics. In this space it will be possible both to hypothesize possible patterns of play a-priori, in terms of play-personas as *metaphors*, and to chart the patterns of real players a-posteriori, in terms of play-personas as *lenses*. The axes can be defined abstractly such as "+" and "-" prior to a playable version of the game, when personas are used to imply user behavior patterns in the design. However, the axes can also be defined based directly on collected gameplay metrics. For example, the percentage of total puzzles solved. This provides a means for defining detailed quantitative components of the persona models.

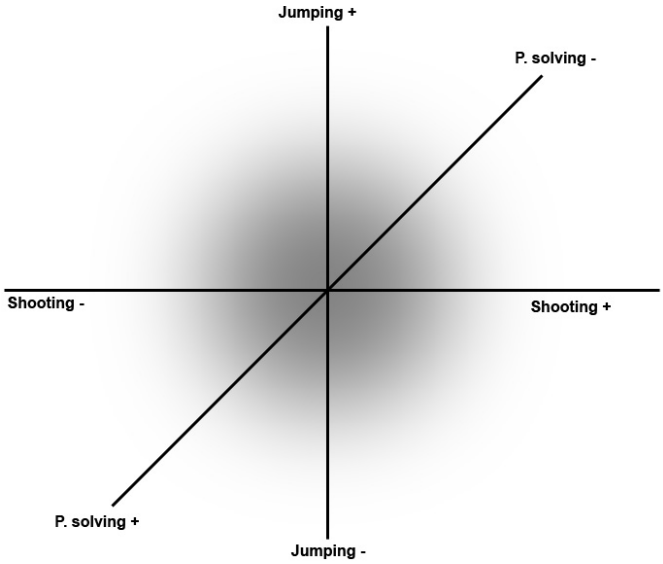

Figure 3: The conceptual space identified by the three axes: jumping, shooting and puzzle solving.

In the case of TRU, the three parameters *shooting*, *jumping* and *puzzle solving* could be selected (figure 3). These are higher-order groupings of more detailed game metrics, but serve to provide an idea about what the operational space is for the players. For example, players could either spend a lot of time solving puzzles, preferring to solve them, or conversely use the Help-on-Demand system, largely ignoring the puzzle element of the game.

At this point it is possible to select which play-personas will guide the design process. Play-personas can be defined as extreme cases, one-sided accentuations that delimit a set of variables (e.g. players who never fight enemies), however, experiences from TRU indicate that most players will fall outside of the extremes. It appears more useful to define the play-personas as covering segments of a variable axis. For example, defining the "Athlete" play-persona as a player who does not do well with shooting or in combat with enemies, but navigates carefully and dies very seldom from jumping errors. The gameplay metrics component of the persona provides quantitative information about the

expected behaviour of the play-persona – which can later be tested.

At this point it is useful to define a narrative description, which serves to anchor the play-persona in game design language. *"Athletes enjoy exploration of the environment; they will try to avoid fights if at all possible. They are players with experience and are comfortable with navigation controls. Athletes will rarely lose direction and will display relatively fast completion times, which is also reflected in few requests for help with spatial puzzles"*.

3.2 Play-personas as lenses for analyzing player behavior

Play-personas defined during the design phases form the basis for selecting which gameplay variables that should be monitored during later-phase testing.

The term "lens" is here intended as the choice of a context from which to sense, categorize, measure or codify experience. As lenses, play-personas are derived from gameplay metrics gathered from players. Play-personas can be used as tools when evaluating games by comparing the patterns of player behavior with the defined play-personas. By comparing designers' and players' goals it is possible to evaluate whether the game design actually supports and facilitates the planned behaviors and experiences in practice, and if any new personas emerge from the user-interaction.

Alternatively, during testing and following game launch, logged metrics data can be analyzed to discover patterns in the behavior of the players, thus enabling the building of a-posteriori personas of how players interact with the game.

In TRU, several hundred variables are being tracked through custom-build software. Via this system it is possible to collect data from players around the world, in the current case more than one million. Every time players ask for help solving puzzles, die from a bad jump, etc., the information is logged. These data can subsequently be analyzed and form the basis for detailed persona models. This information also helps designers answering straight forward questions such as: "Where do players get stuck more often?", "Which parts of the level maps do players experience?" etc.

Considering the core compounded mechanics, "shooting", "jumping" and "puzzle solving", and the play-personas that can be constructed from these, a selection could be made that considers the following:

- **Causes of death:** These can be grouped into three higher-order variables, e. g. death by falling, by mobile enemies and by environmental factors. These gameplay metrics provide tacit information about how well players handle different kinds of threats in the game. For example, a player who dies often from mobile enemies, can be hypothesized to have low skill in terms of combating mobile threats
- **Shots fired:** TRU includes a variety of weapons. Tracking weapon use involves registering what type of weapon was fired, location of the player and whether the shot hit a target, and number of different types of target killed (kill-score). These data allow the construction of weapon-use profiles, that can be cross-correlated with e.g. causes of death.
- **Puzzle solving:** The number of times a player requested help for solving a puzzle from the TRU Help-on-demand system. This metric informs about how well the player in question handles the puzzle-solving element of the game.

Additional variables could be added to support these, as follows:

- **Total number of deaths occurring to a player:** This provides a measure of the skill level of the player in general. The fewer deaths, the better the player navigates the dangers of the game. This information can be cross-correlated with the causes of death metrics.
- **Completion time:** Basically the time it takes the player to complete the game. In the metrics database, information can be extracted as to completion times of the entire game, each level or each sub-level unit. Long completion times can mean different things – the obvious conclusion is lack of skill compared to players who complete faster, however, it can also mean that the player in question has a preference for environment exploration.
- **Navigation:** Usually the path of a player in a 3D game is logged as a series of coordinate positions (X,Y,Z) with a given frequency. Analyzing the path taken by players provides insights into which sections of the levels that players utilize, and can also be used to locate areas where players are confused about how to progress.

Note that higher-order variables such as these selected here can sometime mask underlying details in the behavior of the player – it is important to consider exactly what inferences that can be made from a given gameplay metric. For simplicity, in this case study it is assumed that such underlying patterns do not occur in the gameplay metrics data.

There are several approaches that can be applied to locate patterns in sample-based datasets (such as gameplay metrics datasets). The majority of these are based on multivariate inferential statistics, for example variance analyses, clustering techniques, ordination methods and similar approaches from population studies. Additionally, factor-based algorithms and neural network algorithms can be utilized to find the patterns of play in game metrics datasets (provided that any patterns are present).

One of the most direct approaches towards evaluating if there are any underlying patterns (or clusters) in the collected data is to use a clustering method. K-means clustering and Ward´s method, the latter utilizing Euclidean coordinates, form two possibilities. A cluster analysis will inform whether there are any strong groupings in the way that the underlying variance of the metrics dataset is organized.

A different approach considers dividing the ranges of each variable into categories (after removing outliers). For example, if the "number of deaths" varies between 1-100, a simple binary division could define two ranges: 1-50, 51-100. Care must be taken when manually devising these ranges to ensure that they are meaningful. If for example 99% of the players die between 80-90 times during the game, the remaining 1% could be considered outliers (or a very minor group of players behaving in a non-typical fashion). By allocating ranges to all variables of interest, it is possible to allocate players into play-persona categories based on the requirements defined in the design phase. Experiences with TRU and other games suggest that there will always be some players who fall outside the defined personas. This may or may not be an issue, depending on the nature and number of these outliers. However, the ulterior goal is to evaluate if the play-personas intended, actually manifest in the metrics data for a statistically significant portion of the players. If not, this means that there are problems with the game design, and in-depth analysis of the data may be necessary. It is possible for example that certain game-levels facilitate the kinds of behaviors aimed for, while others restrict the players´ agency more. This may or may not be a problem and always requires case-by-case evaluation.

In a quantitative approach towards finding clusters of player behaviours, Drachen, Canossa and Yannakakis [12] utilized an Evolving Self-Organizing Map (a form of Korhonen neural network) to analyze data from a small sample of 1365 players of TRU, all of whom had completed the game. The analysis considered six variables (completion time, numbers of deaths, death by falling, death by enemy, death by environment and the use of the Help-on-demand system). Four clusters of behavior were located based on the core mechanics of the game encompassing more than 90% of the examined players. One example was labelled "Runners", they completed the game in record time, but also generally had very high help request rates, indicating a lack of interest or skills in the puzzle-solving element of the game. Each behavior pattern was rated on a low-average-high scale, which is based on the underlying range in the gameplay metrics. Each group was given a metaphorical label, which serves to provide an illustration of the core behavior of the group, and is essential when communicating results of an analysis to the design team in a game development company. As mentioned above, this can be supplemented with a narrative description.

The categories of Drachen, Canossa and Yannakakis [12] provide a direct example about how gameplay metrics can be used to define data-driven patterns of player behavior in computer games. While the study is based on a limited number of variables, they indicate the kind of approach necessary to develop data-driven play-personas.

Summarizing, combining gameplay metrics with persona modeling provides a powerful tool for game design and –testing, permitting game developers to test if their games are being played the way it was intended. Running these analyses on a per-level basis, enables level designers to achieve better balance and facilitate the different play-persona models; to obtaining a greater insight on the landscape of possible player types and eventually make games that can cater for a broader audience.

4.0 CONCLUSION AND DISCUSSION

Using game mechanics as the underlying driver for defining play-personas as metaphors is not the only way, however, it provides a means for defining personas during the design phase that are directly testable in the later production phases where actual gameplay metrics can be logged and analyzed.

It should be noted that gameplay metrics cannot inform how players relate to the character of Lara Croft, or similar kinds of psychological effects. Simply put, gameplay metrics can reveal what players are doing, not necessarily why, for that a more qualitative approach is needed. An alternative means is to use for example personality profiling of the target audience, and use these profiles to define the expected behaviors [5]. These behaviors can then subsequently be defined using gameplay metrics.

There are a few delimitations on the applicability of the framework proposed: for puzzle games with one solution or extremely linear games such as point-and-click adventures it makes limited sense to employ play-personas: the player's sole duty is to second guess the designer's mind and therefore push forward the story.

The method described is intended to assist in the design and production of closed, narrative games that run the risk of failing to provide non-trivial choices, i.e. collapsing all the potential personas into only one profile that players have to conform to in order to proceed. For these types of games a key design challenge is to ensure varied experiences and playstyles in order to reach as broad a target audience as possible [23, 26]. Play-personas attempt to address this requirement both by modelling preliminary hypothesis of in-game behaviour and by categorizing and analyzing character-bound gameplay metrics variables. In this paper a case study has been presented that shows how play-personas allow designers to aggregates data in a way that binds ludic and narrative aspects of the game.

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