

# **A MOTIVATIONAL FRAMEWORK FOR ANALYZING PLAYER AND VIRTUAL AGENT BEHAVIOUR**

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## **Abstract**

Today's digital entertainment industry uses different approaches to establish believable agents with personality and to analyze the goal-directed behaviour of game players. Academic research in this area usually focuses on one facet of personality - for example, only on emotions or character traits. The techniques applied to create non-player characters can hardly be used to analyze player interactions or choices in a computer game. The present study proposes a motivational framework to predict goal-directed behaviour of both player and non-player characters in a computer game and explores the opportunities of using a Player and Agent Personality Database (PAPD) based on the same motivational framework to design virtual agents with personality. This article claims that motivation to reach a goal is influenced by both situational and personal factors that are represented with an equation that determines the likelihood of the occurrence of a behavior. The framework represented by this study takes into account psychological needs, interactions between these needs, general behavioral patterns, lower-order and higher-order personality traits for analyzing gaming experiences and player/non-player choices in a computer game.

## **Keywords**

Personality, motivations, player modeling, virtual agents, behavioural architecture

## **1. Introduction**

Game playing is a goal-directed behavior where the needs, motives, and goals of a player interact with the opportunities and rewards of the gaming environment and define the concept of "play." The interpersonal communication domain of "play" experiences two different forms: player-to-player interactions in multi-player environments and the information exchange between the player and a virtual agent or a non-player character (NPC). Therefore, the psychology of gaming is

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concerned with two separate but related areas: defining the building blocks of personality for virtual agents to enable believable interactions and analyzing the goal-directed behaviour of game players. Today's digital entertainment industry uses different approaches to establish virtual characters that behave the most believable way and to analyze the goal-directed behaviour of game players. There is still no integrated or universally accepted model of personality that can be applied to player or non-player characters in a computer game. Academic research in this area usually focuses on one facet of personality - for example, only on emotions or character traits. The techniques applied to create non-player characters can hardly be used to study player interactions or choices in a computer game. This article aims to analyze the goal-directed behaviors and personality aspects of game players and NPCs in relation to their interactions with the environment by using a framework of psychological needs.

Psychological appeal of video games is a popular discussion among scholars, but the diversity of research findings makes it impossible to make generalizations on motivational aspects of gameplaying. There have been attempts to define the basic motivations behind game playing, but different approaches to motivational aspects of player behavior, when applied to computer games with different structures and content, represent different facets of player psychology and define several variables that leave much scope for subjective interpretation [1]. In this regard, the motivational variables defined by the major studies in literature [2,3,4,5,6] are more likely to shed light on the popular question "why do people play computer games," rather than predicting player behaviour or understanding player interactions/choices in a computer game. There also have been many attempts to define play styles or player types of computer gamers. Bartle [7] identified the famous four play styles as: socializers, achievers, killers, and explorers; Mulligan and Patrovsky [8] introduced a grouping based on the relations between players: general players, barbarians, tribesman, and citizens; Pohjola [9], in the context of live-action role-playing defined four categories: immersionist, dramatist, gamist, and simulationist; Dena [10] defined the three tiers of hardcore gamers as: puzzle players, story players, and real world players; and Salen and Zimmerman [11] defined five player types: the standard player, the dedicated player, the unsportsmanlike player, the cheat, and the spoil-sport. The player types defined by these studies are not founded on formal theories of psychology and have never been empirically tested to validate that they are independent player profiles.

There also is a great diversity of approaches on creating believable characters or characters with personality. To analyze the psychology of virtual characters, Paiva et al. [12] and Prada et al. [13] used emotional states and corresponding action tendencies; Lankoski et al. [14] used the the

physiology-sociology-psychology three-dimensional structure with special emphasis on the protagonist of a story; Prada and Paiva [15] used the Five Factor Model of personality by focusing on extraversion and agreeableness dimensions; Mosher & Magerko [16] used the Five-Factor Model of personality to define personality templates; Tychsen et al. [17] used the Personal Attributes Questionnaire - PAQ [18] to examine the relationship between players and characters; Rizzo [19] analyzed believability of virtual characters from an emotional state perspective; Ravaja et al. [20] examined emotional response patterns and sense of presence with the help of mood states and the impulsive sensation seeking dimension of Zuckerman-Kuhlman Personality Questionnaire - ZKPQ [21]; Kshirsagar and Thalmann [22] and Romano and Wong [23] used the OCC Model of Emotions [24] to represent the personality of social characters; and other researchers attempted different combinations of emotions, personality traits, moods, beliefs, and desires [25,26,27,28]. This article does not claim that these studies are irrelevant with the psychology of virtual agents; however, the applicability of these models to human players is still unexplored, and because each one of them focuses on different personality aspects the proposed models are not compatible with each other.

## **2. Proposed Need Framework for Analyzing Gaming Experiences**

A unified personality model that takes into account psychological needs, emotional states, moods or feelings, general behavioral patterns and personality traits would be a major advancement, leading to a whole new set of opportunities for analyzing entertainment experiences and individuals' motivation to use entertainment products for enjoyment. In this regard, this article is oriented toward neither behavioral models that focus on behavior patterns from an evolutionary biology perspective nor neurobiological models that focus on brain structures and neurotransmitters. The idea is to use a personality model based on the needs framework of Murray [29], which defines psychological needs by matching them with actions and feelings, appropriate desires and effects, emotions, personality traits, actones (motones and verbones), different forms of need activity (intravertive, subjectified, semi-objectified, egocentric, infravertive, etc.), pathology, social forms and common relationships with other needs such as fusions, conflicts, and subsidiations. Although several classifications of needs [1,30,31] exist in literature, this study regards each need as an individual variable of personality and uses twenty-seven needs of Murray's study: *Acquisition* (nAcq), *Construction* (nCons), *Order* (nOrd), *Retention* (nRet), *Aggression* (nAgg), *Blamavoidance* (nBlam), *Counteraction* (nCnt), *Defendance* (nDfd), *Deference* (nDef), *Dominance* (nDom), *Abasement* (nAba), *Affiliation* (nAff), *Nurturance* (nNur), *Rejection* (nRej), *Succorance* (nSuc), *Achievement* (nAch), *Autonomy* (nAuto), *Harmavoidance* (nHarm), *Infavoidance* (nInf),

*Recognition* (nRec), *Exhibition* (nExh), *Cognizance* (nCog), *Exposition* (nExp), *Understanding* (nUnd), *Play* (nPlay), *Sentience* (nSen), *Sex* (nSex).

Murray's three-year study at the Harvard Psychological Clinic was conducted by twenty-eight psychologists of various schools, among whom were three physicians and five psychoanalysts. The psychogenic needs of Murray, which are psychological in nature, are not static entities but the result of both internal and external forces, and are concerned with mental and emotional states of a person. Twenty-seven needs of this framework already have been analyzed by Bostan [1] in relation to the gaming situations of a computer game. In an attempt to take this study one step further and to identify the common interaction patterns between these individual needs, Bostan and Kaplancali [32] applied the same motivational framework to another computer game and analyzed psychological needs by defining the driving game mechanics behind them. The same authors also analyzed user-created content (mods) of a popular computer game within the same motivational framework in terms of the needs they satisfy [33]. It is shown that, although the restrictions imposed by the game mechanics significantly reduce the number of player needs satisfied by a game and trap the player within the common motivational cycle of *Achievement*, *Aggression*, *Harmavoidance*, and *Acquisition* [32], but game mods created by users attempt to compensate for this by satisfying the needs of *Sentience*, *Exhibition*, *Recognition*, *Sex*, *Play* and *Affiliation* [33].

The critical component of modeling player or virtual character personality is to correspond the psychological structures with individual actions. If the aim is to analyze player behavior, the system will be monitoring player actions and collecting data about his/her preferences. If the aim is to create believable non-player characters, the system will use a personality model to decide on the actions of virtual agents. In this regard, Laurel [34] commented that dramatic characters are better suited to the roles of agents than full-blown simulated personalities, and these characters can be represented by personality aspects that are appropriate to a particular set of actions and situations [35]. Murray's framework [29] gives the matching actions, desires, and effects of each psychological need. According to this framework, single action pattern may satisfy two or more needs; one or more needs may be activated in the service of another need and the needs also may conflict with each other. These interrelations, which depend heavily on the game mechanics and how they are used, may exhibit very complex combinations in the game world. For example, Player A may wear an expensive trendy suit because he/she does not wish to make a bad impression (*Infavoidance*) and instead wishes to win B's friendship (*Affiliation*) so that he/she will learn the secret location (*Cognizance*) of the celestial map and use the map for finding the lost city of Atlantis (*Acquisition*) to unlock the secrets of the Mother Civilization (*Understanding*) and thus level up

(*Achievement*). Murray analyzed common relationships between needs in terms of fusions, conflicts, and subsidiations. Recent studies conducted by Reiss [36,37] proposed a theory about the 16 basic needs that guide nearly all human behavior and showed that Murray's framework is still applicable to analyze personality aspects of humans.

Murray defined matching traits for each need; however, because these are lower-order personality traits, it can be argued that it is not possible to make connections with higher-order personality traits or popular trait models of personality. In this regard, popular trait models of personality are Cloninger's theory [38,39] that analyzes the relations between the three neurotransmitters (dopamine, serotonin, and norepinephrine) and various personality dimensions (novelty seeking, harm avoidance, and reward dependence); Eysenck's model of personality [40,41,42], which consists of three dimensions: extraversion, neuroticism, and psychoticism; Gray's sensitivity theory [43,44,45], which analyzes the relations between brain structures and various personality dimensions (Behavioral Activation System, Behavioral Inhibition System, Fight or Flight System); and Big Five, which is widely accepted as the most current, valid, and reliable means of assessing personality. Big Five personality traits originated from the analysis made by Tupes & Christal's [46] on Cattell's [47] trait descriptors. However, it was Costa & McCrae [48,49] who constructed the NEO Personality Inventory and the NEO Five-Factor Inventory and identified the five factors as neuroticism, agreeableness, extraversion, conscientiousness, and openness to experience. Even when conducted in different countries [50] and with different clusters of adjectives [51], the questionnaire produced the same five facets of personality. Although the HEXACO Personality Inventory [52], which is measured by the HEXACO Personality Inventory [53,54], identified six personality facets in languages other than English, Big Five is still the most popular trait model of personality.

Murray's framework does not make connections to higher-order personality traits, but various studies in literature use personality inventories to define the relationship between psychological needs and higher-order personality traits/popular trait models of personality. It is important to note that needs described by Murray has formed the basis for a number of inventories, including the Personality Research Form (PRF) [55], Edwards Personality Preference Schedule (EPPS) [56], and Adjective Check List (ACL) [57]. Several researchers attempted to define the relationship between these personality inventories and the Big Five [58,59,60,61]. Although the NEO-PI and the aforementioned inventories have different conceptual origins, joint factor analyses showed that the needs measured by these inventories can be meaningfully organized within the framework of the five-factor model. Statistically, PRF, EPPS and ACL show slight differences in factor loadings with

the NEO-PI because they have different sets of needs with different definitions. The factor analysis conducted by creators of the NEO Personality Inventory shows that PRF (which will be further emphasized in the next sections) has the following connections with the Big Five personality traits [58]: individuals high in Neuroticism have higher needs of *Recognition*, *Defendance* and *Succorance*; those high in Extraversion have needs for *Affiliation*, *Exhibition*, and *Play*. Those high in Openness appreciate *Understanding*, *Sentience*, *Autonomy* and have low need for *Hardmavoidance*. Individuals who score high on Agreeableness have lower needs of *Dominance* and *Aggression*; they have needs for *Nurturance* and *Abasement*. Finally, those who score high on Conscientiousness value *Order*, *Achievement* and *Cognizance*.

### **3. Predicting Player and Virtual Agent Behaviour in Computer Games**

Human behavior aims to cause changes in the environment that are possible through the attainment of goals or disengagement from unattainable goals and are facilitated by the coordination of perceptions, skills, activities, and emotions [62]. Goal-directed human behavior is made up of the interactions occurring between individuals and their environments that triggers actions. Game players also experience different gaming situations with different rewards within a virtual world and then decide on an action based on their motives, needs, and goals. Similarly, virtual character's computational processes also are driven by their goals and preferences. There are situational and personal factors that influence the motivation to reach a goal. Personal factors are a person's needs, desires, motives, and goals. According to Hollenbeck and Klein [63], some situational factors are publicness (the extent to which significant others are aware of one's goals), volition (the extent to which an individual is free to engage in a behavior), and explicitness (determines a goal's clarity and understandability). Opportunities and possible incentives provided by the environment also are situational factors. A positive incentive (reinforcer) motivates the behavior and a negative incentive (punisher) motivates avoidance behavior. Personal factors represent the person and the situational factors represent the environment. Thus, Behavior (B) is a function of the Person (P) and his or her Environment (E) (see Lewin's equation [64] below).

$$B=f(P,E) \tag{1}$$

The strength or appeal of an incentive is an important factor that affect goal-directed behavior. This article defines the strength of incentive as Goal Valence (GV), which can be positive (reinforcers) or negative (punishers). According to Lewin [64], the strength of the motivation to strive a goal is a positive function of the valence of the goal. The positive or negative valence denotes the attractive

or repulsive properties of a goal. Individual's expectancy of goal satisfaction or punishment, which is based on past history, determines the relationship between goal preference and behavior, and the potential occurrence of a behavior. According to the theory of planned behavior [65], perceived behavioral control (PBC) or a person's belief as to how easy or difficult performance of the behavior is likely to be determines the relationship between intention and action. This article defines the individual's expectancy as Expectancy Value (EV). Because the difficulty of a goal is directly influential on the subjective probability of success and the specificity of the goal determines its clarity and understandability, EV is associated with difficulty level of gaming challenges and goal explicitness. Behaviors will vary from situation to situation, and this is referred as psychological situation in literature, which is referred as Gaming Situation (GS) in this study. In this regard, this article does not aim to predict behaviour in an abstract way regardless of the gaming situations but in specified situations.

The personal factors affecting goal-directed behaviour are the needs and motives of the player. For each GS, one or more needs will be dominant, which will be referred as Primary Needs (PN). Because some needs are in the service of others, whereas some others are opposing it, fusions of needs will be described with Secondary Needs (SN) and conflicting needs will be described with Opposing Needs (ON). The strength of the fusion or conflict is represented with a multiplier of  $\gamma$ . This article does not claim to have identified all of the personal and situational determinants of human behaviour, but it does try to express the potential uses of psychological needs to calculate the probability of the likelihood of a behavior. For any gaming situation, the probability (Pr) of the likelihood of a behavior (B) is represented as Pr(B/GS) in Eq. 2. This probability is dependent on the personal factors (PN,SN,ON) that represent the Person (P) and the situational factors (EV,GV) that represent the Environment (E).

$$\text{Pr}(B/GS)=f(P,E) \quad (2)$$

$$\text{Pr}(B/GS)= \sum \text{PN} + \sum \gamma_{\text{SN}}.\text{SN} - \sum \gamma_{\text{ON}}.\text{ON} \pm \text{EV} \pm \text{GV} \quad (3)$$

Determination of the likelihood of the occurrence of a behavior requires constant monitoring of the player actions within the virtual world. Player actions shall give an idea about his/her preferences or psychological needs, but it should not be forgotten that the restrictions imposed by the game mechanics significantly reduce the number of player needs satisfied by a game. For instance, if a quest requires the player to befriend a person when he/she has no other option, then the act of befriending cannot be considered inclination toward affiliative behavior. It can be considered so

only when the player has other options. For example, in popular CPRG titles, when the player faces enemies, it is up to the player how he/she overcomes obstacles. Some alternatives are to ignore the enemy by hiding in shadows and moving silently from a safe distance (*Harmavoidance*), to attack the enemy with a melee weapon (*Aggression*), or to eliminate the enemy from a distance by using ranged weapons (fusion of *Aggression* and *Harmavoidance*). It is these choices in a computer game that determine the play style of a player and indicate his/her trends in motivation. Monitoring player actions within a virtual world is called Player Profiling. As the player makes more and more choices in a computer game, a profile of several variables is built to describe his play style. Every choice makes a contribution (usually a positive addition) toward a variable of the player profile. For example, every time the player threatens to kill a NPC to acquire an object or to learn some piece of information, *Dominance* and *Aggression* values can be increased by some value because the player is using “autocratic power” (fusion of *Dominance* and *Aggression*).

The variables of Eq. 3 should be better understood with a concrete gaming example. Assume that the player sees a treasure that can only be reached by jumping on a series of platforms over a chasm. Also, assume that the player has the following profile on a scale of 0-100: *Harmavoidance*: 14, *Retention*: 36, and *Acquisition*: 45. The treasure composes of diamonds. For this gaming situation (GS), the primary need depends on the game mechanics employed. If the player has to collect all diamonds on a level to proceed to the next level, the game mechanics do not give the player an opportunity to dismiss this treasure because the player has to collect the diamonds to level up (*Achievement* overriding every other need). If it is not mandatory to collect diamonds and if diamonds have only monetary value, the primary need (PN) is *Acquisition*. *Retention*, the desire to retain possession of things or to hoard them, fuses with *Acquisition* as a secondary need (SN) for this GS. However, there is still the need for *Harmavoidance* as the opposing need (ON) to consider, which conflicts with the PN. The strength of the fusion (nAcq-nRet) and conflict (nAcq-nHarm),  $\gamma$  values, are assumed to have a default value of 0.5. So using only personal factors, Eq. 3 gives us the likelihood of an attempt to take the treasure as 56%.

$$\Pr(B/GS) = \sum PN + \sum \gamma_{SN} \cdot SN - \sum \gamma_{ON} \cdot ON$$

$$\Pr(B/GS) = 45 + (0.5 \cdot 36) - (0.5 \cdot 14) = 56$$

For this GS, if we use the number of diamonds as the reinforcement value, the probability will increase with a goal valence ( $GV_1$ ) that equals to the number of diamonds. If there are 10 diamonds, the likelihood of an attempt to take the treasure increases to 66%. It also is important what happens if the player fails to jump from one platform to another. If the player dies, it depends on the game



mechanics whether this is a punisher. If the player simply starts from the beginning of the level when he/she dies, this may not be a severe punishment. However, if the player loses one life and has a limited number of lives, it decreases the likelihood of the attempt. Assuming that the player has 5 lives and he/she will lose one if he/she fails, this will have a 20% life loss and will be represented as a -20 (GV<sub>2</sub>). Now, there is a 46% chance that the player will try to take the diamonds. And finally, what is the player's expectancy of success? If the player failed the platform jumps in his/her 7 of 10 attempts throughout the game, the player knows that it is not easy to reach the treasure. When compared with a base success chance of 50-50, there is 20% less chance of success, which will be represented as an expectancy value (EV) of -20. Now, with the added situational factors, the likelihood of an attempt to take the treasure decreased to 26%.

$$\text{Pr(B/GS)} = \sum \text{PN} + \sum \gamma_{\text{SN}} \cdot \text{SN} - \sum \gamma_{\text{ON}} \cdot \text{ON} + \text{GV}_1 - \text{GV}_2 - \text{EV}$$

$$\text{Pr(B/GS)} = 45 + (0.5 \cdot 36) - (0.5 \cdot 14) + 10 - 20 - 20 = 26$$

For every gaming situation, Eq. 3 facilitates the calculation of the likelihood of a behaviour, but the player's actions before and after the choice also are important determinants for understanding his/her motivations. For example, if the player is facing a time challenge (i.e., finding the exit of the gaming level in 30 seconds to proceed to the next level) when he/she sees the treasure, it is understandable why he/she avoids the treasure (nAch inhibiting nAcq). One who exchanges diamonds with weapons or ammo (nAgg superseding nAcq) is not like the one who exchanges diamonds with potions of healing (nHarm superseding nAcq). This is the macro level of a choice and represents the long-term goals of the player. However, if the player is constantly monitored throughout the game, it is possible to anticipate the macro level trends of the player and replace the motivational variables of Eq. 3 above with appropriate ones. Using the example above, if the player always exchanges diamonds with weapons/ammo, thus nAgg supersedes nAcq, and the PN will be *Aggression*. If the player always exchanges diamonds with healing potions, then *Harmavoidance* will be included in Eq. 3 as a PN.

#### **4. Player and Agent Personality Database (PAPD)**

Now that the applicability of the motivational framework and Pr(B/GS) equation is investigated, the discussion will follow with the opportunities provided by this framework for creating NPC characters. If an NPC is a major character of the story or an important individual of the virtual world, the motivational variables that define his/her personality require careful planning. However, every single character's personality does not have to be designed meticulously, and computer games

require rapid prototyping techniques that will quickly give them minor characters of the virtual world. In this regard, it is possible to use the original study of Murray, but the personality inventories mentioned before (Personality Research Form: PRF, Edwards Personality Preference Schedule: EPPS and Adjective Check List: ACL) also provide extensive opportunities. For example, to broaden the scope of information about the nature of needs, Jackson's Personality Research Form [55] presents different correlates of PRF scales with Strong Vocational Interest Blank [66], California Psychological Inventory [67], Allport Vernon Lindzey Study of Values [68], Jackson Personality Inventory [69], Jackson Vocational Interest Survey [70], and Bentler Psychological Inventory [71]. Using these correlations, it is possible to build a quick character profile according to vocations, such as doctor, mathematician, and engineer; interpersonal behaviors, such as flexibility, communality, and tolerance; human values, such as social, politic, and religious; personality aspects, such as risk-taking, self-esteem, and social participation; vocational interests, such as medical service, teaching, and sales; or character traits, such as generosity, stability, and trustfulness. For example, it is possible to come up with a quick profile for a female character (A) working in creative arts or a male character (B) with religious values.

**Table 1**

Sample Character Profiles

	<i>nAba</i>	<i>nAch</i>	<i>nAff</i>	<i>nAgg</i>	<i>nAuto</i>	<i>nCog</i>	<i>nDfd</i>	<i>nDom</i>	<i>nExh</i>	<i>nHarm</i>	<i>nNur</i>	<i>nOrd</i>	<i>nPlay</i>	<i>nSen</i>	<i>nRec</i>	<i>nSuc</i>	<i>nUnd</i>
A	01	-14	-11	-05	23	-11	-09	-25	-16	-18	-14	-08	02	19	-17	-14	-11
B		16	05	-34	-22			-12	-15	21	27	17	-22		-13		-02

Another critical issue for game designers is to represent different aspects of each psychological need so that they will be able to: (1) see matching actions, feelings, desires, emotions, personality traits, actones (motones and verbones), pathology, and social forms; (2) analyze different forms of need activity (intravertive, subjectified, semi-objectified, egocentric, infravertive, etc.); and (3) monitor need fusions, conflicts, and subsidiations that will give an idea about common need relations. To serve this purpose, a database is being built to bring together several studies from the social sciences that focus on different aspects of psychological needs, and a web interface is being designed to display database query results easily on a web browser. The database is called Player and Agent Personality Database (PAPD), and it can be either used as a knowledge base for designing characters of a computer game or employed temporarily to rapidly test the personality aspects of a player or a virtual character. Because virtual characters are usually expressed in terms of character traits, vocations, and archetypes, the database makes it possible for designers to make

connections with the personality inventories previously described. Assume that we have the following information regarding a virtual agent: “male lawyer, high conscientiousness, character traits of agility and stability.” The challenge now is to describe this character with psychological needs. In this regard, numerous opportunities of using PAPD to design virtual agents can be better demonstrated with sample database queries that provide the psychological variables/findings [29,55,58,60,61] on psychological needs.

**Table 2**

Correlations of the vocational interest of “law” with all needs.

	<i>nAba</i>	<i>nAch</i>	<i>nAff</i>	<i>nAgg</i>	<i>nAuto</i>	<i>nCog</i>	<i>nDfd</i>	<i>nDom</i>	<i>nExh</i>	<i>nHarm</i>	<i>nNur</i>	<i>nOrd</i>	<i>nPlay</i>	<i>nSen</i>	<i>nRec</i>	<i>nSuc</i>	<i>nUnd</i>
Law	<b>-21</b>	06	-03	10	-09	18	15	<b>44</b>	11	18	-01	08	<b>-21</b>	<b>-50</b>	11	-06	-09

**Table 3**

Correlations of “conscientiousness” for PRF, EPPS and ACL scales.

	<i>nAba</i>	<i>nAch</i>	<i>nAff</i>	<i>nAgg</i>	<i>nAuto</i>	<i>nCog</i>	<i>nDfd</i>	<i>nDom</i>	<i>nExh</i>	<i>nHarm</i>	<i>nNur</i>	<i>nOrd</i>	<i>nPlay</i>	<i>nSen</i>	<i>nRec</i>	<i>nSuc</i>	<i>nUnd</i>	<i>nDef</i>	<i>nSex</i>
PRF	08	<b>64</b>	11	-21	-10	<b>52</b>	-05	32	-03	09	06	<b>64</b>	-37	-09	10	-14	16		
EPPS	-15	<b>28</b>	24	-22	<b>-26</b>			13	01		24	<b>68</b>				02		20	-05
ACL	-25	<b>73</b>	17	-07	-03			38	-23		16	<b>87</b>				<b>-40</b>		12	-09

**Table 4**

Correlations of “agility” and “stability” with all needs.

	<i>nAba</i>	<i>nAch</i>	<i>nAff</i>	<i>nAgg</i>	<i>nAuto</i>	<i>nCog</i>	<i>nDfd</i>	<i>nDom</i>	<i>nExh</i>	<i>nHarm</i>	<i>nNur</i>	<i>nOrd</i>	<i>nPlay</i>	<i>nSen</i>	<i>nRec</i>	<i>nSuc</i>	<i>nUnd</i>	
Agility		11	09	18	05	02	-27	02	<b>56</b>	34	<b>-37</b>	13	-23	00	16	00	<b>-30</b>	-04
Stability		-01	18	05	-23	-04	07	<b>-31</b>	22	-18	-08	04	09	<b>-27</b>	-07	-21	<b>-30</b>	08

The first query points to four variables as dominant needs. If a character is a lawyer, this indicates a high *Dominance* and lower values in *Abasement*, *Play*, and *Sentience*. The second query gives information about having high conscientiousness using three different personality inventories. High *Order* and high *Achievement* are common findings in three studies. However, correlations with PRF indicate high *Cognizance*, correlations with EPPS indicate low *Autonomy*, and correlations with ACL indicate low *Succorance*. Also, correlations of *Abasement*, *Play*, and *Sentience* are consistent

with the vocation in question. The final query compares psychological needs with lower order personality traits of agility and stability. This query also emphasizes the importance of having high *Dominance* and indicates lower values in *Succorance*, *Harmavoidance*, *Defendence*, and *Play*. When the findings are combined together, it is apparent that this character is high in *Dominance*, *Achievement*, and *Order* and low in *Succorance* and *Play*. *Sentience* and *Autonomy*, as well as *Aggression*, also show low tendencies but not as much as *Succorance* and *Play*. Because findings on *Defendence*, *Cognizance*, *Harmavoidance*, and *Abasement* has minor differences with each other, additional queries might be needed to understand the nature of these needs, but five dominant needs (three high, two low in value) have already been determined by three queries. Once the dominant needs are identified, it is possible to see matching actions, to analyze different forms of need activity, and to monitor need fusions and conflicts with additional queries (see the structure of a sample need given in Appendix A).

## 5. Conclusion

This study proposes a motivational framework for analyzing player and virtual agent behaviour in computer games, an equation to predict the likelihood of the occurrence of a behavior in different gaming situations and a Player and Agent Personality Database (PAPD) to design characters with personality. This article is unique in that: (i) it does not focus on one facet of personality but takes into account psychological needs, interactions between these needs, general behavioral patterns, and higher-order and lower-order personality traits associated with each need; (ii) the proposed motivational variables suit the purposes of both creating non-player characters that behave realistically and analyzing player interactions or choices in a computer game; (iii) the equation that predicts player and non-player character choices takes into account both the personal and situational factors that affect a behaviour; and (iv) the Player and Agent Personality Database (PAPD) combines the psychological variables/findings of various studies on psychological needs to provide an extensive knowledge base for character design and rapid prototyping. This article does not claim to have identified all the personal and situational factors that affect human behaviour, but it does try to address how the proposed psychological needs should facilitate the prediction of player and agent behaviour in computer games. It can be argued that interpretation of the correlations of psychological needs with other personality structures that are stored in the Player and Agent Personality Database (PAPD) is not an easy task, but this trade-off is acceptable because the database provides virtually limitless opportunities to design virtual agents with personality.

It is hereby important to note that Murray's psychogenic needs are not static entities but are result of

both internal and external forces. Because the proposed psychological needs arise from the continuous interactions between humans and their environments, this framework is more suitable for analyzing the motivations game players who are not passive entities but continuously participate in the action. The applicability of this motivational framework to gaming contexts has already been discussed by researchers that analyze psychological needs in relation to various gaming situations [1], define the driving game mechanics behind each need [32], and identify the needs satisfied by user modifications to an existing commercial game [33]. In this article, the biggest challenge in proposing a unified personality model is to relate these needs with trait models of personality in literature; however, in this context, several personality inventories (PRF, EPPS, and ACL) are utilized, and a solution in the form of a Player and Agent Personality Database (PAPD) is proposed. To arrive at a complete database for relating the proposed needs with other personality aspects and coordinating them with lower level sets of actions will be a long and arduous but rewarding task. The Player and Agent Personality Database (PAPD) provides a solid foundation for future research in computer games by providing a knowledge base for designing virtual agents and a tool to assess the motivational aspects of player/non-player characters. If the behavioural equation and the character profiles created by database queries can be validated by future empirical studies, the framework defined in this study should significantly improve our understanding of player and non-player behaviour in computer games.

## Appendix A

Structure of a psychological need, the need for dominance [29], is given below:

<i>n Dominance ( nDom )</i>	
<b><i>Desires and Effects :</i></b>	To control one's human environment. To influence or direct the behavior of others by suggestion, seduction, persuasion, or command. To dissuade, restrain, or prohibit. To induce someone to act in a way which accords with one's sentiments and needs. To get someone to co-operate. To convince someone of the rightness of one's opinion.
<b><i>Feelings and Emotions:</i></b>	Confidence.
<b><i>Trait names and Attitudes :</i></b>	Dominative, forceful, masterful, assertive, decisive, authoritative, executive, disciplinary.
<b><i>Actions :</i></b>	<i>General :</i> To influence, sway, lead, prevail upon, persuade, direct, regulate, organize, guide, govern, supervise. To master, control, rule, over-ride, dictate terms. To judge, make laws, set standards, lay down principles of conduct, give a decision, settle an argument. To prohibit, restrain, oppose, dissuade, punish, confine, imprison. To magnetize, gain a hearing, be listened to, be imitated, be followed, set the fashion. To be an exemplar.

	<i>Motones</i> : To beckon, point, push, pull, carry, confine.
	<i>Verbones</i> : Commands : “Come here”, “Stop that”, “Hurry up”, “Get out”, etc.
	<i>Mesmeric influence</i> : To hypnotize.
	<i>ideo Dominance</i> : To establish political, aesthetic, scientific, moral, or religious principles. To have one's ideas prevail. To influence the climate of opinions. To argue for one cause against another.
	<i>socio Dominance</i> : To govern a social institution.
<b>Fusions :</b>	The commonest fusion is with nAgg ( Autocratic power ) .
	<i>Coercion</i> : To force someone ( by threats ) to do something.
	<i>Restraint</i> : To put up barriers. To limit motion. To forbid certain acts. To enforce the law.
	Also with : n Ach ( to achieve things as leader of a group ) , n Exh ( to be dramatically forceful in public ) , n Aff ( to be a genial, humane leader ) , n Sex ( to take an assertive erotic attitude ) , n Nur ( to guide and correct a child).
<b>Needs which may be subsidiary to the n Dom :</b>	nAgg ( to punish in order to control ) , nExh ( to dominate someone by fascination ) , nSuc ( to control someone by exciting pity ) , nAff ( to be friendly to voters ) , nSex ( to control through sexual attraction - femme fatale).
<b>Needs to which n Dom may be subsidiary :</b>	nAch ( to persuade a group to get something done ) , nAuto ( to argue for freedom ) , nAff ( to bring about harmony within a group ) , nAcq ( to put over a business deal).
<b>Conflicts with : intraDom :</b>	nAba, nInf, nSuc, nAuto, nAff, nNur, nPlay, nDef. Will power. To develop self-control. To restrain instinctual drives. To be master of oneself.
<b>Subjns and Semi-objns :</b>	Magic and sorcery. To control the gods.
<b>Pathology :</b>	Delusions of omnipotence.
<b>Social forms :</b>	The government of a country : King, President, Congress, Parliament, Legislature, Courts of Law. With n Agg : Army, Navy, militia, police.

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