Semi-Autonomous Avatars in Virtual Game Worlds

Mirjam Palosaari Eladhari
Gotland University
Cramergatan 3
Gotland, Sweden
mirjam.eladhari@hgo.se

ABSTRACT
This paper is concerned with approaches to semi-autonomous avatars in virtual game worlds, and degrees of autonomy in relation to player-control. Approaches to semi-autonomous avatars can be divided into three groups based on the design goals of using them: relief, expression and impression. Players can be relieved of cognitive and operational load by for example automating the animations of body-language of avatars. Means of expression through body-language, types of actions performed, and reaction tendencies can express the nature of specific avatars to other players in the same world. Character-information available only to avatars’ own players and personalised, subjective world-representations create individual impressions of worlds and avatars’ parts in them. A shared aim of these approaches is to increase the believability of elements in the game worlds and the sense of presence and immersion for players. In this paper the prototype Pataphysic Institute is used to illustrate how expression and impression can be utilized by consideration of the implementation of possible characterising action potential of avatars.

1. INTRODUCTION
Semi-autonomous avatars are agents whose actions are controlled partly by users and partly by artificial intelligence (AI) components. Virtual game worlds (VGWs), or massively multiplayer on-line games, are realised by networked computers that simulate persistent virtual environments which allow large numbers of users to act in the worlds simultaneously, represented by avatars (playable characters). What players can do in a given moment is determined by the action potential of their avatars, which in turn is determined by the game design of particular VGWs. Avatar-specific properties can be used in the design to represent the world in individual ways for different players. The same data can be used to automate avatar behaviours, such as reaction tendencies or subtle body language.

In this paper it is suggested that approaches to semi-autonomous avatars in games, particularly VGWs, can be divided into three categories depending on the aims of the development: relief, expression, and impression. Players can be relieved of cognitive and operational load by for example automating the animations of body-language of avatars. Means of expression through body-language, types of actions performed, and reaction tendencies can express the nature of specific avatars to other players in the same world. Character-information available only to avatars’ own players and personalised, subjective world-representations create individual impressions of worlds and avatars’ parts in them. A shared aim of these approaches is to increase the believability of elements in the game worlds and the sense of presence and immersion for players.

In VGWs it is desirable that not only the autonomous agents, or non-player characters (NPCs) are believable in Bates’ [2] sense, but also that the avatars are believable for players, both when they control their own avatar and when they interact with others’ avatars. In VGWs player may use methods from role-playing [19] in order to ‘stay in character’, that is, to act in ways that are consistent with the nature of their avatars. By applying this method of playing users aim to increase the immersion in the game worlds fiction for themselves and for those interacting with them by not breaking the “magic circle” of play [24], that is, not break the illusion of the game world. I have previously suggested that semi-autonomous avatars may be used as an aid for players to express consistent characters, describing how the semi-autonomous agent architecture the Mind Module (MM) have been used in the VGW prototype the Pataphysic Institute (PI) [16]. In this paper the MM and PI are used to illustrate how expression and impression can be utilized by consideration of the implementation of possible characterising action potential of avatars in VGWs. Due to the limitations of text-length, and to this paper’s focus, the MM and PI are described in a low level of detail. More information is available in [14].

2. RELATED WORK
As described by Gillies et al. [21] the work in the field of semi-autonomous agents is inspired by the AI agent community and uses two main approaches: top-down, planner based deliberative or symbolic architectures on the one hand, and autonomous control architectures that are bottom-up and come from non-symbolic AI (referred to as behavioural architectures). The former approach is often used for simulated multi-agent systems where users can give high level
commands to actors [51, 18], while the second is most often used for avatars in virtual worlds. Both types of approaches often use psychological models as part of the agent architectures, providing agents with personalised behaviour preferences. Gillies [21] describes two approaches to combining user control with autonomous behaviour: users giving high level instructions to agents on the one hand, and shared control on the other, where users control some aspects and some are autonomous. Gillies describes Mateas’ Subjective Avatars [36] as an exception in that the aim is to influence the users’ perception of the game world by representing the world differently depending on avatar state. In games however, this is not an exception but a common feature (see for example [3, 49, 43]).

A majority of semi-autonomous agent architectures for virtual environments use psychological models which provide agents with a framework that can result in individualised responses. The nature of the psychological models are dependent on the aims of the research and of the success criteria for particular implementations. A common nominator for many projects along with the MM, such as [56, 22, 10] is that inspiration is taken from the OCC model [44]. Another common source of inspiration is (personality) trait theory, pioneered by Allport in the 1930s [1]. The Five Factor Model (FFM) is a standard personality trait model in psychology; the clustering of traits via factor analysis into five factors has been repeatedly empirically validated. A prominent assessment test for the FFM is the NEO PI-R questionnaire, which uses 30 traits [38]. While the FFM was originally developed to describe the personality of individuals in real life, it has been applied to a number of autonomous characters and conversational agents [8], [10], [34]. Like the MM, many of these implementations build upon the FFM, and take inspiration from affect theory [53]. In systems where facial expressions are used [17, 26] it is common to select an emotional model based on basic emotions, derived from facial expressions observed in human populations [9], which also is the case of the MM. The distinguishing feature of the MM is that it is specially designed for use with avatars in VGWs, giving them a ‘mental physics’, that can be used to create preferred individual responses for characters depending on immediate circumstances in a game world.

3. THE MIND MODULE USED IN THE PATAPHYSIC INSTITUTE

The Mind Module (MM), further described in [14] is a semi-autonomous agent architecture built to be used in a VGW as a part of avatars. The MM gives avatars personalities based on the Five Factor Model [38], and a set of emotions that are tied to objects in the environment by attaching emotional values to these objects, called sentiments. The strength and nature of an avatar’s current emotion(s) depends on the personality of the avatar and is summarised by a mood. The MM consists of a spreading activation network [6] of affect nodes that are interconnected by weighted relationships. There are four types of affect nodes: personality trait nodes, emotion nodes, mood nodes, and sentiment nodes. The values of the nodes defining the personality traits of characters govern an individual avatar’s state of mind through these weighted relationships, resulting in values characterising for an avatar’s personality. While the architecture of the MM to a large extent relies on theoretical work from the field of psychology it has been an important design goal to make the MM into more than an experiment of different theories of psychology applied to agent structures, that is, to integrate the MM to VGW prototypes, with emphasis on the gaming aspect. Another important aspect of the design has been the believability of the semi-autonomous avatars to their players.

The behaviour of avatars equipped with MMs is two-layered: a mechanics-layer is provided by the MM, which through integration with the architecture of a VGW provides the action potential. The dynamics-layer is the actions performed by players controlling the avatars, actions performed within the provided action potential. Ideally the mechanics-layer of the semi-autonomous agent structure of the MM would facilitate players’ expression of personality, in Moffat’s [41] words “the name we give to those reaction tendencies that are consistent over situations and time”.

The game mechanics of the Pataphysic Institute (PI) are intimately coupled with the processes of the MM in order to accommodate for action potential which could help players to act in ways characterising for their avatars. In PI, reality has been replaced by the inhabitants’ interpretation of reality, and their mental states are manifested physically in the environment. The head of human resources at PI, an NPC, has taken upon himself the task of understanding the new and unknown world by applying personality theories. He forces everyone in PI to take personality tests, and studies what types of abilities these persons get, abilities he calls Mind Magic Spells. Another inhabitant, the NPC Teresa, focuses on the finding that social interactions between people suddenly result in acutely concrete emotional reactions. She calls these Affective Actions (AAs), and tries to understand her changed environment by studying the patterns of these. Players can set their avatars’ node values of personality traits by completing the IPiP-NEO test consisting of 120 rating scale items in order to create a personality for their avatars, or they can chose a ready-made personality template. Players need to defeat physical manifestations of negative mental states. In order to do so, they can cast spells on them, but the spells are available are constrained by the avatars’ personalities, their current moods, and how far the avatars have progressed in learning new abilities. Each avatar has mind energy (mana) and mind resistance (health points). Each spell costs mind energy to use, and attacks reduce mind resistance. The experience of the character defines how large the possible pool of energy and resistance is at a given moment. The regeneration rates of resistance and energy depends on the moods. By performing affective actions on each other, avatars can affect each others’ emotions, which if the emotions are strong, may result in sentiments towards each other. Relationships to other avatars, both formalised social relationships such as ‘friendship’ and relationships of sentiment (effects of past interactions) affect the action potential since the mood of avatars’ changes in geographical proximity of each other depending on the emotional values of particular relationships.

As described by Brathwaite [4], a core mechanic (such as flipping over tiles or selling items to another player) of a game results in a core dynamic when it is played. A core dynamic is a particular pattern of play.
Avatars’ states of mind are reflected in the world in the form of physical manifestations that emerge if an emotion ‘goes out of bounds’. These manifestations are entities which cast different spells on approaching avatars, depending on the emotion that the manifestations represent (such as a Colossus of Confusion or an Interest Integral). Avatars can also partake in authoring entities which act autonomously and become part of the world and the game dynamics in it.

4. DESIGN GOAL CATEGORIES FOR SEMI-AUTONOMOUS AVATARS

Motivations and design goals for developing semi-autonomous agents are unique to particular projects, but can be categorised into three main groups of purpose, relief, expression and impression, as described in the following list.

1. Relief. Aim to relieve users of cognitive or operational load. In navigational systems the aim is to let the AI perform navigational tasks at a micro-level [40]. In virtual environments AI components are often used to continuously choose and execute animations showing body language of the users’ representations, such as gestures, facial expressions, postures, or gaze [55, 26, 12, 20, 21]. This is especially motivated in systems where user interfaces makes it difficult for users to control multi modal expressions with the available input devices.

2. Expression. Aim to increase the believability of the agents to players observing them or interacting with them. In graphical environments where users take on a virtual human form, subtle body-language, which in everyday life is performed unconsciously, can give impressions of lifelikeness of avatars. Personalised reaction tendencies of agents can be helpful for characterisation, aiding in making virtual games and environments more interesting. The action potential of an agent is what it can do at a given moment with it all the circumstances inherent in the context taken into account. Personalised action potential of avatars in role-playing worlds can help players to ‘stay in character’, increasing the sense of presence or immersion in the fictional game world for its inhabitants (by not acting out of character and thus undermining the fiction)[16]. Other powerful ways of providing players with means of expression is to support players’ creation of objects and of individual behaviour patterns, such as own sequences of animations.

3. Impression. Aim to characterise avatars to their players and/or to provide individual representations of particular game worlds. Character-information available only to avatars’ own players shows the action potential of the avatars - what they can do at a given moment and how. The properties of avatars can be used to represent the game world subjectively, helping players to identify with their representations and immerse themselves into story worlds. For example, in Subjective Avatars [36] users receive text descriptions of environments which reflect avatars emotional states.

A well known rule of thumb in game design is to make sure that the players feel in control [23]. Autonomous behaviour of avatars is rare in VGWs while the restraining of action potential of avatars is inherent in all designs. The degree of player-control which would result in enjoyable game play for players, the sweet spot of semi-autonomy, could vary with the specific design of a VGW on a sliding scale of control as illustrated in Figure 1. The use of the MM in PI for avatars operates by design on the right-hand side of the scale of semi-autonomy, that is, the autonomy is used in a fairly low degree, limited to constrictions of action potential guided by personality and current mood. If the degree of autonomy for avatars was to be increased in PI, autonomous reactions of avatars could be triggered at threshold values of various MM properties.

For purposes of developing semi-autonomous agents many of the methods from the area of autonomous agents are useful, but careful consideration is necessary when deciding what behaviours should be controlled by users and which ones that could be automated. Gillies et al. [21] distinguish between primary and secondary behaviour, where primary behaviour consists of the major actions of avatars and secondary behaviour is more peripheral to the action but may be vital to making avatars seem alive. Previous work in the area of semi-autonomous agents which aim to relieve users from load have mostly focussed on developing automation of secondary behaviour.

4.1 Relief

As noted above one of the aims with the development of semi-autonomous avatars is to relieve the cognitive or operational load of players in systems where avatars expresses intentions, attitudes and emotions through body language. Convincing arguments for this approach have been presented by [55, 46, 21]. This is particularly relevant for systems where it can be complicated for players to express different modalities of communication through available input devices. For example, when using a keyboard and a mouse for interacting in a VGW players usually use the mouse pointer to target and to make choices in graphical user interfaces, and the keyboard to give text commands and for chatting with others in the environment. To divert the attention to also give commands or interface choices to express subtle gestures, facial expressions or changes in posture might not be feasible for users. Gillies et al. [21] presents a solution to such a dilemma where body language is derived from emoticons in the chat text, a method that was also used in the VGW Star Wars Galaxies [32] (as described in [11]). Imbert et al. [26, 25], describe how a semi-autonomous agent architecture with a psychological model can convey facial expressions and preferred behaviour. The approaches mentioned
in this section are all, except [46], aimed to convey expression of body language in contexts of conversation (chatting) in virtual environments. This is perhaps not surprising since a lot of useful methods have been developed in the field of natural language processing.

In PI, no secondary behaviour were implemented for the avatars, but in a previous prototype where the MM was used, Garden of Earthly Delights (GED), avatars were to be provided with secondary behaviour where avatars had different postures depending on the values of their mood-nodes, aiding characters with expression. In a play-test of a paper-prototype of GED two groups of players with different game-play experiences participated [29]. The players in the first group had many years of VGW-playing experience and the second group had both long-time experience of VGW playing and Live Action Role Playing (LARP). The test indicated that VGW players with LARP experience were more positive to a higher degree of autonomy, particularly to the aspects that would support role-playing, than the first group. This indicates that the ‘sweet spot’ of semi-autonomy would, for the second group, be further to the left as expressed in Figure 1 thank for the first group.

4.2 Expression
Most implementations giving avatars and actors automated body language aim to do this in order to achieve increased believability in Bates’s terms [2], where characters appear more lifelike. There are also projects focussing on body language that do not have the explicit aim to relieve players of micromanaging their characters’ movements, such as Traces [46] where users “dances a sculpture into existence”. A more recent similar artwork is Shadow Agent [45] where a user’s movement is tracked and a shadow of the user first reflects the movement of the user, then gradually starts moving autonomously.

All architectures for both autonomous agents and avatars in contemporary games contain specific limits for the action potential for the agent or for the player. An early use of the term semi-autonomous agent is by Jung et al.[27]: “Agents (avatars) are autonomous (semi-autonomous), i.e., they are able to freely compute their activity (in given bounds).” What bounds particular avatars have on their potential range of actions also expresses the nature of an avatar by what they do (controlled by for example character class or personality traits). Various research projects aim to increase the believability and expressiveness of autonomous agents through automating behaviour and patterns of actions [37, 28, 52, 47, 35, 48, 30, 33]. Imbert [25] presents a framework where semi-autonomous avatars display different reaction tendencies depending on personality traits in a situation where a conversation between two avatars can be initiated.

As mentioned, the action potential of an agent is what it can do at a given moment with it all the circumstances inherent in the context taken into account. The characterising action potential (CAP) defines what a character can do at a given moment that characterise it, both in terms of observable behaviour and in expression of ‘true character’ (as described by McKee [39] – a character’s essential nature, expressed by the choices a character makes.) The observable characteristics include visual appearance, what body language it uses, what sounds it makes, what it says, and most importantly, what it does and how it behaves. CAP is essential for a number of reasons for how players in VGWs can be supported in expressing consistent and interesting characters through their avatars. Interesting characters rich in complexity add to ‘lifelikeness’ of a game world. As Chatman [5] writes, explaining the difference between round and flat characters:

[...the behaviour of the flat character is highly predictable. Round characters, on the contrary, possess a variety of traits, some of them conflicting or even contradictory [...]] We remember them as real people. They seem strangely familiar. Like real-life friends and enemies it is hard to describe what they are exactly like.

In contemporary VGWs NPCs can be said to be flat characters, while avatars, being possessed by players, are real, but might not appear ‘round’ to other players. Semi-autonomous agents can help with this problem. Development holds opportunities to explore ways of aiding players to express their (own or role-played) selves2, to uncover their inherent ‘roundness’ for their own and other players’ enjoyment in VGWs.

Systems which allow avatars to create objects and script behaviours provide players with means of compelling expression. Examples include the VGW A Tale In the Desert [7] where players can construct sculptures that other players can see. In the social virtual world Second Life [31] players are provided with a scripting language and means to create their own animations for their avatars, allowing a multitude of potential means for avatar-expression. The VGW Star Wars Galaxies [32] also provided players with a scripting language which players could use to construct sequences of animations and chat-lines, a feature which is broadly available to players of text based VGWs, MUDs (Multi User Dungeons).

In PI, the expression of avatars’ character consists of what currently available affective actions and mind magic spells players chooses to execute in interactions with other players. Other players can see the current mood state of other avatars which is displayed as a colour above the head of the graphic representation of the avatar (see Figure 3 and further description in Section 4.3). If an avatar experiences a particularly strong emotion a manifestation of it is instantiated in the game world, an autonomous object with avatars can interact with. Furthermore, players can author more complex manifestations (autonomous entities) which become part of the game world and its narrative potential. Figure 2 shows the authoring interface where a player is creating a manifestation of sorrow ‘Grieving Munchy’. When it is manifest it will exclaim ‘Where were you when Mucky died?!’ and cast spell the spell ‘Wet Net of Tears’ on avatars in its proximity, as well as using the affective actions ‘Blame’, ‘Share a memory’ and ‘Deep Lament’. It will also use spells which the player has given custom names, such as decreasing a target’s mental energy with the spell ‘Suspect there is no cat-heaven’.

2The expression self is used in the meaning described by Turkle [54].
The avatar state the particular avatar is important since it impacts other players’ interactions with co-operate. An avatar’s role in co-operation with others is normally defined which roles players take in groups where players particularly good at doing in the VGW. These skills nor-

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the properties of avatars give players an impression of their particular avatar’s nature and action potential. Normally in VGWs the foundation of the action potential of avatars is chosen by players in the very beginning of the game, at the character-creation stage, where players choose gender, visual appearance, class and skills for their avatars. It is these choices which will determine what the player can do in terms of game play and what the avatar may become particularly good at doing in the VGW. These skills normally define which roles players take in groups where players co-operate. An avatar’s role in co-operation with others is important since it impacts other players’ interactions with the particular avatar.

The avatar state includes properties specific to the game (‘stats’) such as current and maximum health and hit points (or equivalent) and values (such as strength or dexterity) which determine how efficient avatars are in performing particular tasks. Avatar skills define what types of actions avatars can perform and how efficiently they are performed (such as what items can be used in combat and types of items that can be crafted, and the quality of the items). Avatar possessions often enhance or modify avatar-properties and -skills. Avatars’ relationships include networks and individuals that avatars communicate and cooperate with or have conflicted relations to, normally presented as guilds, list of friends and lists of ignored avatars.

In PI, the impressions of the avatars’ states displayed to players include the values of the personality traits, and current moods, emotions and sentiments given by the MM. Relationships are the avatars sentiments, the emotional ties to other entities in the game which have emerged in previous interaction. Figure 3 shows the avatar Owindea’s display of Mind Module values overlaid on the virtual world environment. In the column to the top right shows Owindea’s mood, displaying the value of the inner and outer mood nodes as well as the mood co-ordinate system. The white dot in the mood co-ordinate system shows which mood space Owindea currently is in; she is gloomy and angry. The dots in the mood co-ordinate system are clickable spells which affect mental energy and resistance in her targets. The availability of these spells varies with the mood. When characters are in positive mood spaces they can cast restorative spells, and when in negative moods harmful spells become available. In the column to the lower right effects of recent actions are displayed. The avatar Neurotica has performed the affective actions ‘Cheer up’ and ‘Calm down’ on Owindea. These are only successful when a target, such as Owindea in this moment, are gloomy or angry. Another player can see the colour of the auras of surrounding avatars to get an idea of their moods since the colour corresponds with the mood coordinate system. Because Owindea’s aura is orange Neurotica could see that Owindea might be in need of some cheering up and calming down. Also formalised relationships such as friendship, and the number of friends an avatar can have (constrained by personality trait values) and membership in permanent groupings which affect the current mental state of avatars is a source of impression in PI. The combination of circumstances determining the action potential is the base for the perhaps most important source of impression, the action potential, that is, the selection of affective actions and mind magic spells, the skills in PI, which are possible to perform at a given moment.

Action potential ties into Schubert et al.’s [50] work about presence in virtual environments, where they propose that representation of users (avatars) is understood by what actions are possible to perform in the environment. The users construct, by assessing their action potential, meshed sets of patterns of action. This is comparable to strategies of action in VGWs which rely on the nature of the action potential of avatars. The meshed sets of patterns of actions are constructed by the users, constituting the mental models the users have of their action potential. The mental construction of action potential is in VGWs crucial since this governs how players act in particular VGWs. This is one of the reasons for that in play-test of the game mechanics (as described in [15]) a strong focus was set on evaluating whether play-
ers could construct mental models, or ‘reverse-engineer’, the game mechanics derived from the MM. Players managed to successfully solve problems they faced in the test-scenarios using their own mental models of how a ‘mind’ works together with the provided game mechanics. The participants in the test played ‘as themselves’, that is, they did not act in roles of authored characters. The participants were of the opinion that the personalities of their avatars, derived from the IPIP-Neo assessment of traits, were loyal to their own self-images regarding personality.

The properties of avatars are, in some games and game worlds, used to present the player with a representation of the world which is altered according to the current state of the avatar. Mateas’ implementation using subjective avatars [36] in a text-based story world is an early example of this. The emotional state of the avatars and story context are used to provide subjective descriptions of sensory information. The purpose of the descriptions is to “help a user gain a deeper understanding of the role they are playing in the story world”. Mind Music [13] was an experimental application using the MM which explored how adaptive music can be used to increase believability and immersion in games. Players were provided with a personalised musical soundtrack reflecting the affective processes of their avatars.

Implementations where avatars’ states are reflected by how the world is presented to individual players is more common in commercial games than in research prototypes. The most common is to add a temporary property to an avatar of the type drunk, drugged or insane. For example, in the VGW World of Warcraft [3] using items of the type alcohol can cause avatars to become ‘drunk’. The representation of the game (as of Patch 2.3) simulates real life drunkenness. When avatars are drunk the graphics are blurred, and camera movements create effects of swaying. If avatars run or ride they lose their course. The chat text players type in is also modified, the letter ‘s’ will become ‘sh’, and occasionally a ‘...hic!’ is added, expressing the drunken state to other avatars. The action/adventure game Grand Theft Auto IV [49] is another game featuring impeded navigational control when avatars are drunk. There are numerous games where the world representation is changed, but most of them use them as on-off switches that trigger changes in graphics, audio and avatar-control possibilities – either avatars are temporarily drunk, insane or drugged or they are not.

5. DISCUSSION

As mentioned in Section 4.3, in games where players get subjective representations of the world, particular to individual avatars, the functions triggering them are most often limited to certain events. There needs to be a bottle of mead to track, a magic mushroom or an equivalent event that can trigger the changes of the representation of the environment.

In games there are seldom continuous player states which can inform a system of world representation of how to modify the representations according to affective states of avatars. Existing commercial VGWs lack semi-autonomous agents with models that may be used continuously for individualised relief, expression and impression. Existing semi-autonomous agent architectures lack environments extensive in content and game mechanics where avatars can interact with entities they can interpret according to their possible psychological models and react to accordingly. It is no trivial task to take an existing game world with vast amounts of content and give each class of object, even individual objects, declarations that agents can interpret. Even if this was done, the results may not be interesting or meaningful if they are not tied into the game play. Items, actions and events and their values need to tie into the core mechanics of the game in order to be meaningful for players.

An exception to the rule is the psychological horror game Eternal Darkness [43] where continuous ‘sanity effects’ changes the world representation.

For example, in WoW [3] avatars can learn recipes to make...
truly utilise the potential of psychological models as part of semi-autonomous avatars in VGWs it is necessary tie them intimately to the game mechanics which may result in interesting game dynamics. Characters may be given means for expression, but they also need to have something to express.

Recent advancements, where tracking devices of players’ movements and biological processes have become accessible and affordable, suggest that future development of semi-autonomous avatars hold promising potential. Gillies described [21] how tracking of users’ positions and movements while they interact using a personal computer can be used to derive users’ potentially desired proximity to conversational partners, but argues that full-body tracking might not be practical, given the demands on technical equipment (motion capture systems or CAVE systems) and processing power. Currently available devices such as the Nintendo Wii Balance Board, the Sony PlayStation EyeToy and Microsoft’s Project Natal (under development) suggest that it has become more feasible to build implementations using input from various tracking devices of players’ physical movements in order to animate avatars, relieving and aiding players when expressing themselves via body-language in VGWs.

In game research electroencephalography (EEG) reading devices are often used to assess players’ reactions and attitudes to game prototypes as described by Nacke [42], but can also be used as feedback from players via specialized controllers such as SmartBrain Technologies’ SMART systems for PlayStation and XBox or Emotive’s EPOC headset. Other types of useful devices measure the heart rate, galvanism and temperature in fingers, and other significant processes of the body. Interpretation layers using bio-data may be useful not only for animating characters, relieving players of cognitive load, but also for use in game design where the bio-data may affect the internal state of avatars, further determining their action potential. However, in the context of games it is vital to not commit the intentional fallacy of equalling the player with the avatar by using a direct mapping of players’ motions to their avatars (unless this is the desired effect). In many contexts an interpretation layer of a semi-autonomous avatar in tune with the game is necessary. As Gillies et al. puts it [21]: “The effect of the tough action hero body would be ruined if it had the body language of the bookish suburban student controlling it.”

6. CONCLUSIONS AND SUMMARY
An approach to semi-autonomous avatars in VGWs was proposed where the distinguishing factors are the design goals of the applications they are used in: relief of cognitive and operational load of the user, believable expression of the avatars to others in the same environment, and impression to the players themselves characterising the own avatar and individualising the representations of particular game worlds in order to aid the sense of presence and immersion. Characters may be given means for expression, but they also need to have something to express.

7. REFERENCES