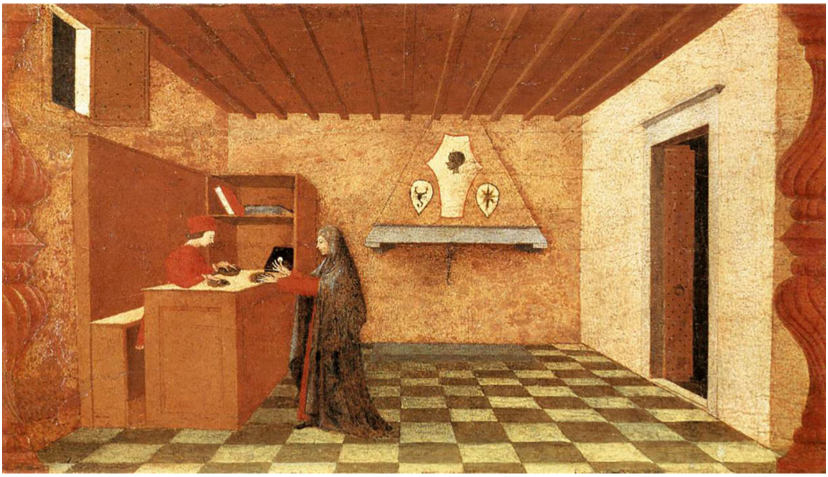
Playing with Sight
Construction of Perspective in Videogames

Stephan Schwingeler

Speaking with Espen Aarseth (2001, 161) every videogame is about space; it is the "raison d'être" of digital games. Every game is about manipulating configurations of space the player mainly perceives in the form of images. This paper explores the history and the unique characteristics of these images. Although current videogames can include all kinds of spatial modes, any method of graphical projection and a vast variety of visual styles, the focus lies on imagery as seen in contemporary 3D-videogames: "And scientific perspective is the kind on which most modern 3D videogames are constructed" (Poole 2004, 205).

Fig. 1: Check-pattern in Wipeout

Fig. 2: Check-pattern in Paolo Uccello's Christian Woman Selling a Consecrated Host to a Jewish Moneylender, 1465-69



The images perceived while playing a videogame like *Wipeout* (Psygnosis 1995) are part of a long tradition of images and, of course, the history of art. The mathematical and geometrical principles of perspective were formulated during the Renaissance. The three-dimensionally constructed images we perceive as spaces are constructed in the same way (fig. 1) a Renaissance artist would have constructed a painting in the middle of the 15th century (fig. 2). Current three-dimensional computer graphics use the same mathematical and geometrical principles as Renaissance painters – namely the principles of perspective.

Renaissance painters had to calculate on their own, whereas the videogame's new images are generated automatically by algorithmic computation; hence their digital nature. In a robust analogy, one could easily say these algorithms behave very much like Renaissance painters who paint a correctly constructed perspective image 60 times a second or even faster. The technique of perspective could be described as a constructional recipe or an algorithm itself. Despite being deeply rooted in art history, these images have developed unique qualities that clearly differentiate them from traditional images. There are major differences and new qualities concerning these new 'space-images' (Günzel 2008) or "navigable spaces" (Manovich 2001, 245).

Images in general have three basic medial modes: first, they can be static as in painting, various graphical techniques or photography. Second, they can be dynamic and moving as in film, traditional animation or pre-rendered CGI and third, images can be interactive simulations (Günzel 2009b, 51/Wiesing 2009). As Peter Weibel (2004, 187) stated these interactive simulation pictures can be described as post-industrial versions of the 'moving image' [*bewegtes Bild*]. Weibel described them as 'living images' [*belebte Bilder*]. Consequently, spectators become users: they are able to navigate images in real-time and perceive the manipulation of the images as being an interactive experience. Videogame images "present artificial navigation" (Günzel 2008, 172).

The paper is structured as follows: In a first step, a short overview is given over the history of linear perspective as formulated in Italy in the 15th century to build the groundwork for the understanding how spatial configurations are shown in pictures. In this context, the term *perspective* is understood as graphical projection: the entirety of means by which an image of a three-dimensional object or space is projected onto a planar, two-dimensional surface. Important contributions to the theory of perspective are shortly reflected in a second step in order to provide a historical framework and to place the current videogame image in the tradition of art history. Linear perspective is characterised as a mathematical *model of sight* and it is emphasized that perspective images have a special relationship to the spaces and objects. In this context, they hint at the discussion about the relationship between *seeing* and *perceiving*.

In a next step it is retraced, that the principles of perspective have been built into devices – namely, photographic cameras and graphics processing units that are able to generate perspective images automatically. In this coherence, linear perspective is identified as a cultural code, a paradigm of depicting space. Because of its independence from the exposure to light and its ability to depict seemingly realistic but conceived spaces, videogame imagery is then marked as being 'hyper-realistic'.

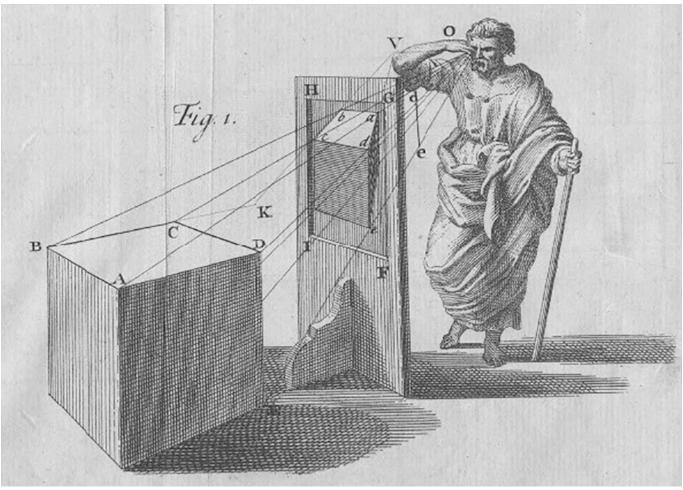
The new qualities of videogame images based on linear perspective are addressed by comparing traditional perspective with the automatic perspective processed by videogames, manipulated by the player. From that argumentation the term 'arbitrary perspective' is deduced, which firstly signifies the player's ability to deliberately control the viewpoint in videogames. The different notions of arbitrariness are then addressed in a last step. It can be stated that the usage of linear perspective for the construction of game space is only one option, considering a canon of different (even non-optical) spatial modes and points of view developed by the videogame as an expressive (and even artistic) medium in its history. Although linear perspective can be defined as a non-conventional construction principle based on natural laws, its application in the context of videogames is conventional and, therefore, arbitrary.

Renaissance Perspective: Translation into Mathematical Space

The invention of linear perspective was the foundation for the development of simulated space we see in most 3D-videogames today. Perspective – as a theory based on mathematical and geometrical principles – begins in the early 15th century in Florence. Art history has a name connected to its invention: "linear perspective was invented by Filippo Brunelleschi" (Kemp 1990, 9) in the year 1413. Brunelleschi was an architect who discovered the basic optical principles that could be used to depict space perceived by individuals with two eyes in three dimensions on two-dimensional, flat planes.

In contrast to non-optical parallel projection, three-dimensional objects are not projected along parallel lines, but along lines emerging from a single point, the centre of projection. Perspective construction correctly represents the light that passes from objects or scenes to a viewer. The assumed *rays of sight* are concentrated and bundled in one point: the viewer's eye, i.e. the centre of an individual's viewpoint. If an imaginary rectangle (e.g. a canvas) is inserted, a flat plane is created. One could define the image as an intersection of this assumed visual pyramid with its tip pointing directly towards the viewer's eye as the centre of projection (fig. 3). This new paradigm of sight, developed in the Renaissance by Leon Battista Alberti (a Renaissance humanist, polymath and perspective theorist), can be understood as an orientation of the whole era towards objective principles of science and as a metaphor for the blossoming role of the subjective individual and a symptom of humanism in the same degree.

Fig. 3: Illustration from Brooke Taylor's New Principles of Linear Perspective, 1719



Alberti coined a metaphor for the perspective image in his treatise *On Painting* from 1435. He compares the image with an 'open window' [*finestra aperta*], the viewer's line of sight is positioned to gaze out this open window and behold depicted space. Clearly this metaphor has influential power until today, relating to overlapping windows of the computer's GUI that open the gaze into virtual worlds (Friedberg 2006).

Brunelleschi's discovery and Alberti's theory fundamentally changed how space is depicted in images. Before knowing the principles of perspective painters kept trying to depict seemingly realistic, three-dimensional space using certain tricks of craftsmanship and their experience. For the first time, Brunelleschi managed to put depictions of space in scientific terms. Linear perspective – fully developed as *costruzione legittima* or 'scientific perspective' – became a "beguilingly simple means for the construction of an effective space in painting" (Kemp 1990, 7). Further it evolved into a "standard technique" to create "a systematic illusion of receding forms behind the flat surface of a panel, canvas, wall or ceiling" (ibid.). Because scientific perspective is based on the optical principles of sight the images have a special relationship to the objects they represent, they are considered 'realistic'. Eventually, due to this invention, the painter's status fundamentally changed: he became an artist. Perspective always corresponds to the individual viewer. Vanishing points are relative to the subject's vision. (This new paradigm of sight can be understood as a metaphor for the role of the individual in Renaissance society and a symptom of the development of humanism in general.)

Erwin Panofsky's essay *Perspective as Symbolic Form* from 1927 has a major influence on theories of perspective. Fact is that perspective images describe the optical principles of human eyesight in a correct manner: they copy human vision. In his seminal essay Panofsky (1991, 29) criticises that the technique of perspective is a mathematical-geometrical bold abstraction from human perception. The illusion of three-dimensional space is created on a two-dimensional surface by using the means of perspective.

Panofsky argues that in reality – within the actual, subjective, visual impression of an individual – spatiality is perceived with two eyes whereas one of the basic principles of perspective is the assumption of monocular sight. (To further conceptualise reality, Panofsky introduces the term 'psychophysiological space' to describe the actual space perceived by an individual.) Further the human eye is a sphere: the correct depiction of subjective vision creates a picture that is sharp in the middle and growing more out of focus tending towards the edges in a circular manner. According to Panofsky, this distortion is tacitly corrected in perspective images. Therefore, every perspective image is an idealised image that is thought of as realistic due to its similarity to the perceived world. In general, it is not a correct representation of the actual perception of a human being but the representation of mathematised spatiality. Perspectival images are not naturalistic depictions of reality but *constructions of a possible space* that seem plausible and convincingly realistic to the spectator.

In this context, it is necessary to hint at the discussion about the relationship between 'seeing' and 'perceiving'. As Klaus Rehkämper (2002) made clear, there is an important difference when he states that we cannot err while *seeing* a picture – but we can while *perceiving* it. The act of seeing deals with the way light takes from an object towards the eye. Visual perception is based on seeing, but strongly permeated by cognitive processes. Rehkämper (2006, 186) points out that in literature on perspective theory this differentiation often is not separated clearly enough which eventually leads to a 'fatal leap' in Panofsky's biased argumentation.

Panofsky's negative bias towards perspective images is, that they do not show the world as *perceived* – that they are abstractions from reality. Rehkämper on the other hand pointed out that this is not the function of perspective images at all. Perspective images do not mimic perception, but they describe the distance light covers from an object to the eye in a correct manner. They, therefore, represent correctly how an individual does *see*. Perspective can reproduce the act of *seeing* and is not conflicting with optical principles. Perspective images correctly depict space as we see it because the underlying construction principle is a mathematical and geometrical model of sight. Rehkämper confronts the underlying critique of perspective theory that images are not 'true' and do not show 'reality' by quoting Albert Flocon and André Barre (1987, 110): "Thus an absolute image does not exist. Only a relative image is possible."

However, of course there is a dichotomy identifiable between 'perceived' and 'represented space'. Gernot Böhme (2004, 129-141), for instance, differentiates between the space of bodily presence and space as a medium of representation. The space of bodily presence can be described as subjective whereas represented space can be called objective. Böhme identifies a second dichotomy – a dichotomy of scientific fields or disciplines associated with the different spaces: He assigns phenomenology to the subjective *space of bodily presence* whereas mathematics is assigned to the objective *represented space*.

Indeed, depiction of space on two-dimensional planes is most closely connected to mathematical, geometrical and optical principles. These principles are the groundwork for scientific perspective as 'legitimate construction' [*costruzione legittima*]. Consequently, perspective itself can be described as a rational instrument, an abstract, mathematical principle producing depictions of space that are rational, abstract and mathematical in their very nature. The invention of perspective as symbolic form is a symptom of an era that is oriented towards rationality, blossoming science and objectivity in general. According to Panofsky (1991, 66), by the means of perspective in the Renaissance, a translation of space was achieved: "The result was a translation of psychophysiological space into mathematical space; in other words, an objectification of the subjective".

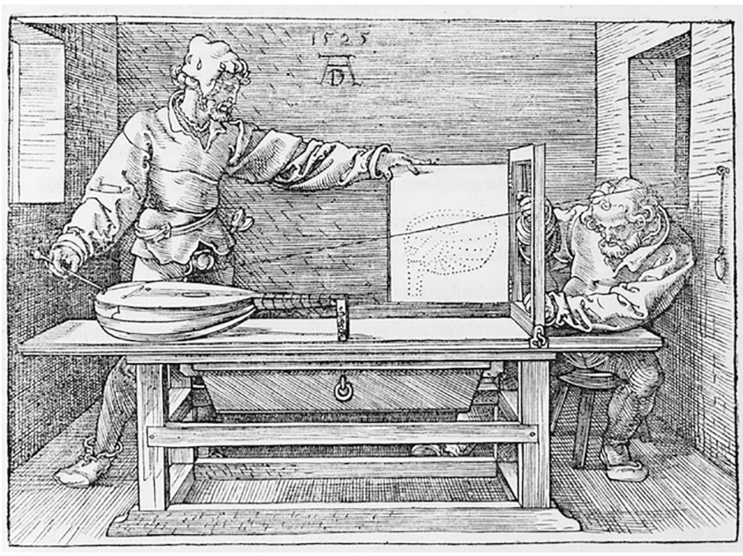
A new idea of humanity is reflected in perspective with its assumed visual pyramid pointing to the individual's eye. On the one hand, perspective *objectifies* space by mathematical abstraction; on the other hand, it is inextricably related to an individual's *subjectiv*e viewpoint. This makes perspective a "two-edged sword" (ibid., 67) oscillating between the subjective space and the mathematised objective represented space.

For the purposes of this paper, then, the optical principles of perspective and the images constructed upon these are designated as 'objective'; whereas the spectator's or player's realm is designated as 'subjective'. Considering videogames in particular, different planes can be divided in *rule-based space* and *mediated space* on the objective side and fictional-, play- and social space on the subjective side (Nitsche 2008, 15-17). Following Alexander Galloway (2006) the objective side is called the 'machine's moment' whereas the subjective side is the 'operator's moment'.

Automation of Sight: Photographical and Geometrical Traditions

The translation of space into mathematical space – the invention of perspective and the formulation of its mathematical, geometrical and optical principles – is the fundament for the development of automatically generated perspective images; images we see in 3D-videogames today. Consequently, the creation of perspective images was handed over from illustrators and painters to devices.

Fig. 4: Woodcut from Albrecht Dürer's Four Books on Measurement, 1525



Historically such devices range from early auxiliary means such as diffusing screens, to the *camera obscura*, and photographic cameras (fig. 4). The mathematised space Panofsky described consequently became the digitized space of current videogame imagery automatically created by algorithms. This process can be described as 'rationalization of sight' (Ivins 1975), 'rationalization of mimesis' (Büttner 1998) or as a last step for the time being 'automation of sight' (Manovich 1993, 132-146). Lev Manovich – basing himself on the preliminary work of William M. Ivins – pointed out, that the process of automation has two dominant historical development directions:

> Modern designers, scientists or engineers, of course, do not simply use perspective as it was formulated by Alberti in the fifteenth century; they use more sophisticated techniques. According to Ivins, the rationalization of perspectival sight proceeded in two directions. On the one hand, perspective became the foundation for the development of the techniques of descriptive and perspective geometry which became the standard visual language of modern engineers and architects. [...] On the other hand, the photographic technologies automated the creation of perspectival images. Both were accomplishments of the nineteenth century; in fact, both were developed more or less simultaneously. Indeed, as Ivins points out. Niépce and Talbot, the founders of photography, were con-temporaries of Monge and Poncelet, decisive figures in the development of descriptive and perspective geometry. (Ibid., 117)

Both development traditions are based on perspective principles with one major difference: The photographic direction is dependent on exposure to light (Friedberg 2006, 72) whereas the geometrical direction is not. Joseph Nicéphore Niépce was the creator of the first known photographic image that shows a gaze out of his study's window around 1820. He called his invention 'heliography' (meaning 'writing with the sun'). This fact even has not changed with the digitalization of photography. Photography is still dependent on the exposure to light. This has the consequence that photographic images can only show objects that physically reflect light – objects that exist in the *space of bodily presence*.

Videogames and Realism: Hyper-Realistic Power Culture

The field of computer graphics – and therefore videogame imagery – is associated with the geometrical tradition of perspective images. This result in computer graphical images that are independent from the exposure to light and consequently can depict spatial configurations and objects that are conceived and fictional but plausible and seemingly realistic at the same time: "In this sense, a videogame camera shares a relationship much closer to painting than the photographic arts'" (Thomas/Haussmann 2005, 2).

Although the construction of videogame imagery is closer to painting than to photography, we can observe that the spaces and objects represented in most modern 3D-games are oriented towards remediating photographic and cinematic techniques considering their aesthetics and concept of realism. Videogames tend to mimic analogue photographic aesthetics by integrating simulation of virtual cameras, lens flare effects, in-motion blurring, depth of field etc.

Lev Manovich (2001, 92) discussed how linear perspective was adapted by the photographic/cinematic image and how this is adapted again by human-computer interfaces as a cultural code; a paradigm of sight, originally developed in the Renaissance: "As a result, linear perspective became the default mode of vision in computer culture. […] In short, what was cinema is now the human-computer interface." Building on that observation, David Thomas and Gary Haussmann (2005, 1) pointed out that the use of linear perspective in a sense of cinematic perspective is a "form of visual cliché" in modern videogames. This convention renders something as realistic because players are used to it from other media: "Videogame fans and critics still praise, 'realistic graphics' without a hint of irony or a whiff of history" (ibid., 3).

It can be observed that videogame imagery and its representation of space is often characterised as being *realistic*. Espen Aarseth (2001, 169) was of the opinion that "[c]omputer games, finally, are allegories of space: they pretend to portray space in ever more realistic ways, but rely on their deviation from reality in order to make the illusion playable". This (eventually industry driven) tendency to be "ever more realistic" was accurately characterised as a "hyper-realistic power culture" by Gerrit Gohlke (2003, 105). In this coherence computer generated imagery in general has been described as 'hyper-realistic': images depicting spaces and objects that have no reference in the *space of bodily presence* and therefore do not exist but seem plausible and convincing. Still, an avatar has no reflection in the mirror.

Linear Perspective in Videogames: Playing with the Viewpoint

Because of their independence from the exposure to light and their digital nature, videogame images can be navigated in real-time offering an interactive experience to the player. Consequently, spectators become users. In videogames users begin to manipulate the images, they choose the viewpoint, move the visual pyramid. As stated by Günzel, videogame images present 'artificial navigation': "Videogames are actions. […] One plays a game. And the software runs" (Galloway 2006, 2).

About the new qualities of the videogame image and the artistic relevance of gaming technologies (Schwingeler/Lohoff 2009) – Mathias Fuchs (2003) claims: “Computer games are more innovative in so far as the view-point of the viewer must not necessarily be predetermined by the medium.” The player herself chooses the viewpoint. Depending on the chosen viewpoint, the image is generated almost in real-time based on the principles of perspective computed by algorithms: e.g., the player’s hand moves the mouse in the *space of bodily presence*. Because of and dependent on this movement, a new image is created in *represented space*.

Klaus Rehkämper (2002, 4) coined the term ‘p-shape’ [*P-Gestalt*]. A p-shape is the objective depiction of an object or space based on the principles of perspective. In Panofsky’s sense, this would be the objectivization of the subjective. Dependent on different viewpoints, pyramids of sights and vanishing points an object or space can have infinite p-forms in theory because one perspective image shows exactly *one* p-shape of its denotatum. Videogames as computer programs are able to render these p-shapes depending on the player’s input in theoretically unlimited different ways.

Fig. 5 and 6: Changing the viewpoint arbitrarily in God of War

This phenomenon is known as ‘free look’. It can be described as a simulation of the alteration of the player character’s viewpoint, like staring at the ceiling (fig. 5) and to the ground (fig. 6) in *God of War* (SIE Santa Monica Studio 2018) nowadays. If the character is not getting killed, these images are persistent. These image phenomena are technically generated by perspective algorithms but produced by the player’s *will* to change the viewpoint. The image is always connected to the player as a subject. The videogame image generated by first person shooter-games (FPS) for example can be characterised as follows: “In the simulation image the line of sight is centralized and fixed, and what is steered by the interface is the virtual space around it. The simulation picture of the first person shooter type thus visualizes intentionality and, furthermore, uses it as the major basis for interaction” (Günzel 2007, 6).

The player literally begins manipulating the image deliberately by choice: She is able to gaze at a represented sun or at a virtual wall and persist in this viewpoint of her own free will: “The computerization of perspectival construction made possible the automatic generation of a perspectival image of a geometrical model as seen from an arbitrary point of view – a picture of a virtual world recorded by a virtual camera" (Manovich 1993, 131).

Clearly, linear perspective used in videogames has added new qualities to the principles of perspective, made possible by the digital nature of the medium and the 'automation of sight.' The ambivalent relationship between subjectivity and objectivity concerning Renaissance perspective and perspective as used in videogames can be described as follows: As we have seen, the Renaissance perspective's purpose was to turn the *space of bodily presence* into *represented space*. Historically the main concept of representation was *mimesis* – the depiction of the world. By making human vision calculable the Renaissance perspective objectified the subjective, space was transferred into mathematical space – pictures seen by spectators. A picture is exactly one static intersection of the assumed visual pyramid.

Perspective as used in videogames turns the *space of bodily presence* into *represented space* as well. It is still a principle to project three-dimensionality onto planar surfaces. This process occurs automatically and almost in real-time. Its main concept of representation is simulation – the imitation of a world. By making human vision computable, this kind of perspective objectifies the subjective even more. The binary nature of code is more abstract than figures and formulas are. Spectators become users. The visual pyramid is movable by the user. While interacting with the images she can change her viewpoint dynamically. Therefore, an infinite amount of perspective images can in theory be generated. Metaphorically speaking, one could say the perspective image evolved from a window into a door (Weibel 2004, 190).

Paradoxically, perspective videogame imagery simulates subjective perception to a higher degree than perspective images in general: movement, interaction, simulation of physical laws and the phenomenon of hodological space (Günzel 2006/Schwingeler 2008, 144) can contribute to intensive subjective experiences while playing videogames. In videogames, then, perspective's *construction* is more objective in comparison to the Renaissance perspective, but its *reception* is more subjective. Steffen P. Walz (2009, 241) summarises:

> So according to Manovich, geometric, i.e. algorithmic vision, is subject to automation. Perspective in videogames is simulated and fully mathematized. […] Schwingeler suggests a name for this hyper-subjective view of the player in games: arbitrary perspective. […] Manovich and Schwingeler, for their part, show that in comparison to Renaissance perspective, the construction of perspective in videogames engenders infinite possible points of view. This finding can, in turn, be related back to Salen and Zimmerman, […] who commented that 'space, it seems, is in the eye of the beholder.'

Choosing from Arbitrary Perspectives in Videogames

The arbitrariness of perspective in videogames is not limited to changing the viewpoint and moving the visual pyramid. By doing so, perspective itself – the principle of construction – is not altered of course. Deliberately choosing an arbitrary viewpoint has always been a component of linear perspective: Historically the illustrator or painter chose a viewpoint first and then begins to construct the picture. The major difference between traditional, static images and interactive simulation pictures is of course that changing the viewpoint has immediate effects on the visual phenomenon perceived. This immediacy of the computer's reaction provokes the feel of interactivity.

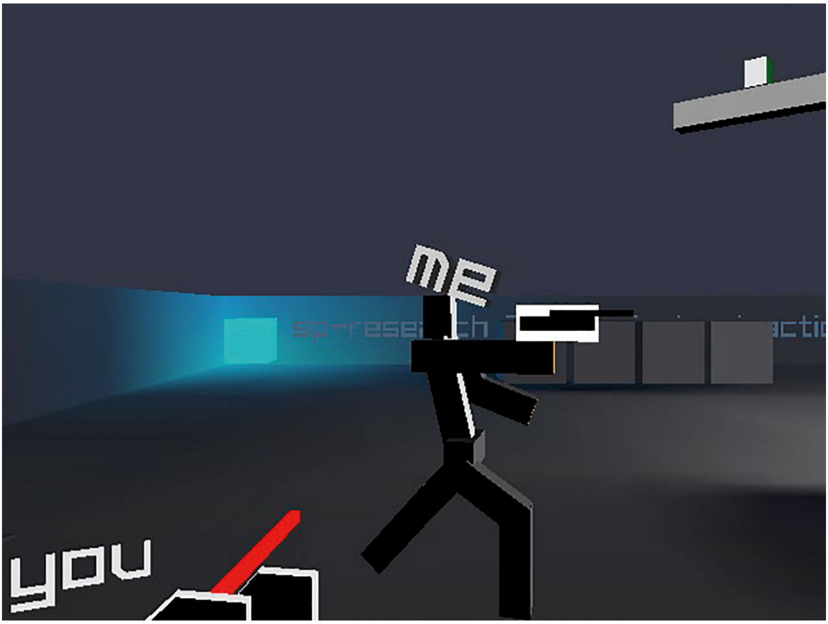
Overall linear perspective may be the defining principle of videogame imagery, but it is still only one mode of depicting spatial configurations in videogames. This again brings the videogame closer to painting than to photography. Videogame spaces historically developed from being two-dimensional parallel-projections towards being true linear-perspective constructions. The spatial categories range from being text based, only 'described spaces', to contained spaces on a single screen, to fully developed interactive three-dimensional environments (Wolf 2001). Videogame imagery's independence from the exposure to light means that videogames can use all kinds of spatial modes and methods of projection besides linear perspective (Schwingeler 2008).

From Poole's (2004, 136) perspective as a game designer, the spatial mode is a major framework for gameplay and can be chosen arbitrarily: "Two-dimensional videogames live on, for example, in software for the Gameboy. The choice of spatial mode, of course, which includes the choice even of whether or how far to be representational at all (*Doom* versus *Tetris*), is bound up intimately with the question of what kind of game the designers want to make." Interestingly it can be observed that videogames that rely on two-dimensional mechanics and gameplay (x- and y-axis) have made use of linear perspective but stay in two dimensions regarding their gameplay. In their latest releases, the *Street Fighter-* and *Mortal Kombat*-series show characters, environments and objects in three-dimensional graphics, for example. Nevertheless, the use of three dimensions is purely cosmetic in *Street Fighter V* (Capcom 2016) and the ninth *Mortal Kombat* (NetherRealm Studios 2011).

The possibility to change the point of view is a standardised convention in digital games as well. In avatar-based games, it is possible to switch from a third-person- to a first-person-perspective. Here the use of the term 'perspective' is borrowed from literary theory describing the narrative mode of a text and the point of view. This does not refer to visual perspective in the first place, but can very suitably be transferred to videogame images, in order to describe what is seen on the screen.

Artist Julian Oliver (2005) even developed a game making use of an experimental second-person-perspective: The player controls the avatar labelled as me and is seen through the assumed eyes of an enemy controlled by the computer (labelled as 'you'). The *2nd Person Shooter* inverts the ego as the assumed subjective viewpoints of the player character and the enemies in a three-dimensional space: the player-controlled avatar is seen through the 'eyes' of the computer-controlled enemy as if it was an enemy. – The concepts of *me* and *you* are interchanged (fig. 7).

Fig. 7: The intermingled egos in Julian Oliver's 2nd Person Shooter



Often a change of projection mode is integrated in the game's mechanics: players can switch to topographical representation of game space when looking at a map for example. Arbitrariness of the projection mode even became a key element of gameplay in *Super Paper Mario* (Intelligent Systems 2007) which is a game with a true arbitrary perspective, in the sense that not only the viewpoint or point of view is changed by the player, but the whole graphical construction principle of the game world. At a certain point in the game, the player gains the "ancient secrets of dimensional flipping" from the NPC Bentovius– an ability to switch the spatial mode from a parallel projected 2D view (non-optical) to a three-dimensional, linear-perspective view (optical) which literarily adds another dimension (z-axis) to the gameplay. Interestingly, *Mario* himself stays in his two-dimensional, flat form, resembling being made out of a piece of paper (fig. 8). The use of perspective here is truly arbitrary, because the player can switch the whole construction principle of the game world: from a parallel projected 2D view (non-optical) to a three-dimensional, linear perspective view (optical).

Fig. 8: Flipping dimensions in Super Paper Mario

Rehkämper (2002, 106) defined linear perspective as a non-conventional construction principle of visual representation because it is based upon natural, optical laws. Linear perspective is a scientific model that correctly shows how the rays of light behave in correspondence to the human eye. A perspective image exactly mimics this correspondence. As shown in videogames linear perspective behaves differently than in a static image because linear perspective is automated and can be played with: the player can move the viewpoint and manipulate the visual pyramid, which adds a feel of subjectivity. In theory, while playing the game, the player chooses between an infinite quantity of viewpoints. Whereas linear perspective is a non-conventional principle, its use in the context of videogames is very much a convention closely connected to a certain concept of realism – namely the simulation of cinematic aesthetics.

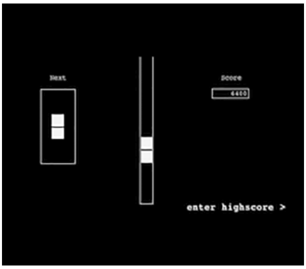
Like in painting the objective, mathematical laws of linear perspective can be deliberately broken or neglected in videogame imagery because it is independent from these natural laws hence its digital characteristics. This means videogames are independent from the paradigm of linear perspective as well: "Because the videogame camera is not an optical camera, it can be programmed to represent a potentially infinite number of perspectives beyond the classic, representational linear perspective" (Thomas/Haussmann 2005, 1).

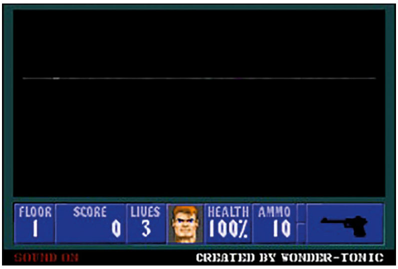
Historically different spatial modes have been developed for the representation of space in videogames. Non-optical perspectives – like wraparound screens that describe the form of a torus when unwrapped for example – belong to the digital games' repertoire of spatial modes whereas linear perspective is only one possible construction principle of videogame imagery. All the spatial modes, that have become design conventions today, are still used and even become intermingled. As Aarseth (2001, 154) pointed out: "Computer games are essentially concerned with spatial representation and negotiation, and therefore a classification of computer games can be based on how they represent – or, perhaps, *implement* – space." The principle of perspective in digital games turns out to be an arbitrary one.

That means there is no method of projection and no kind of perspective that is better in a sense that it is capable to depict representations that are closer to reality. The different kinds of spatial modes (or the intermingling of spatial modes) do not have to be *representational* or *realistic* at all. All kinds of experiments are possible, like (future) cubist games or games based on M.C. Escher's impossible drawings – such as *Echochrome* (SCE Japan Studio 2008) – like Steven Poole (2004, 369) suggested. Interestingly art history shows that – after perspective has been fully mastered by artists as a technique and means of expression – modern painting begins to experiment with and reflect its laws and principles; experiments range from impressionism, to cubism and radically neglecting perspective in abstract painting (Hofmann 2003/Gombrich 2006). In this context, Julian Oliver's *2nd Person Shooter* and *Super Paper Mario* could be described as modern games in the art historical sense of the word.

In this connection one might ask, what lies beyond three-dimensional graphics? – The 'games' *Tetris 1D* (Dawn of Play 2010) and *Wolfenstein 1-D* (Wonder-Tonic 2011) humorously comment on and reflect about the three-dimensional paradigm by demaking the original games in one dimension only: *Tetris 1D*'s 'gameplay' is restricted to the y-axis; blocks keep falling, the player's only possible action is to make them fall faster (fig. 9). The original FPS *Wolfenstein 3D* (id Software 1992) has been converted to a one-pixel line with its 'gameplay' unfolding strictly on the x-axis (fig. 10).

Fig. 9 and 10: Demakes of Tetris *and* Wolfenstein 3D *in one dimension*





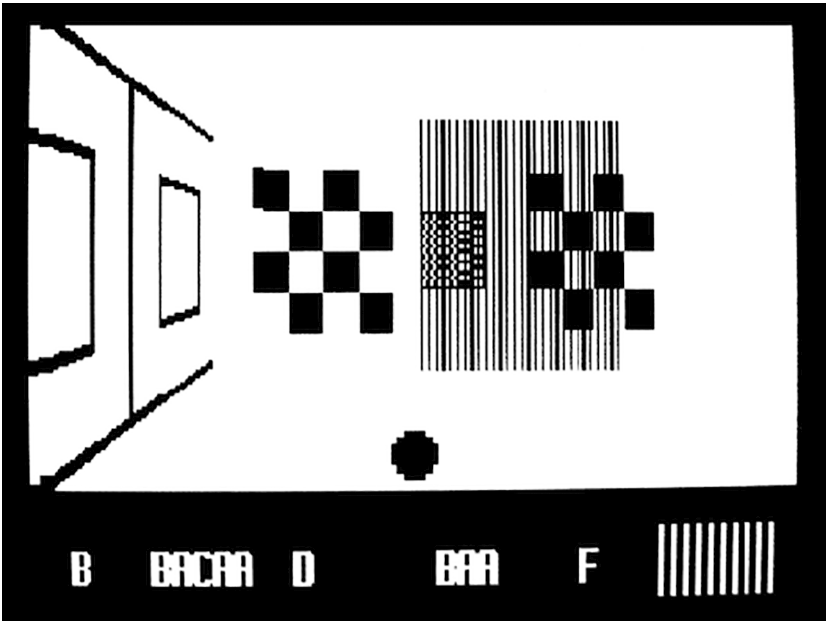
The spatial mode determines the underlying principle of action (Günzel 2009b, 54). *Wolfenstein 3D* is a different game than *Tetris* (Pajitnov 1984) with different gameplay. *Wolfenstein 3D* is based on a certain representation achieved by the means of perspective whereas Tetris is a non-representational game with no simulation of a camera at all. It is important to emphasize that the first-person-shooter, as a genre, is linked to linear perspective's representational abilities as its visual style. Gameplay cannot unfold if the player does not see the game space depicted in a representational manner.

In this regard, the works of media-artists JODI show that a purely abstract FPS can be programmed, but not played in a meaningful way anymore (Günzel 2009a, 339). In JODI's (1999) artistic modification of *Wolfenstein 3D* – called *SOD* – the player does not recognise the graphics as a representational game space and is unable to act upon that basis (fig. 11). The original game has been stripped and abstracted to its very core, being a pure 'perspective engine':

> The starting idea was to find very basic forms like just a line or a square, just black and white, and attach these forms to the behaviour of the code so that we could have a better view on how such a game is driven, what are the dynamics of the game. So it's bringing those games back to the abstract dynamics of it and we were also trying to find out a little bit, how they do create the so-called 3-D space. That's the whole trick of these games, that they are perspective engines. All the time they create tunnels and illusions of a 3-D space and that's part of the 'kick' you have as the user, that you think you explore and you enter and you move into. In fact the only thing which is happening is a perspective which just is drawn all the time – so it's just about graphical tricks. (Hunger 2007, 154)

Its immersive power is exposed as being an interplay of graphical tricks. – *SOD* is a piece of interactive art, a paradox artefact: a FPS reduced to absurdity, a game that should be played with, but cannot be played with according to its intention.

Fig. 11: JODI's SOD



Overall, there is no hierarchy between a representational and a non-representational game. In opposition to a "hyper-realistic power culture" (Gohlke 2003, 105) of games developing "ever more realistic" (Aarseth 2001, 169) representations, Aarseth's (et al 2003) multi-dimensional typology of games provides an unbiased analytical tool to describe perspectives and space in videogames: Players either have an omnipresent or vagrant view; movement through space is either topological and discrete or geometrical and continuous; the environment is either static or dynamic.

The imagery of digital games is evolving and tends to reach further into space. Recent development considering the Nintendo 3DS' autostereoscopic capabilities and the rise of VR with Oculus Rift and similar products might be the next logical steps to add another tradition of visual representation to the videogame's canon of spatial modes and conventions. This does not mean – of course – that 'transplane images' (Schröter 2014) are closer to reality than other images. They only have different traditions and principles of construction: "For they are still images, when all is said and done, no more, but also no less" (Grau 2003, 323).

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