Early draft. Please refrain from quoting.

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Three types of representations in video games.

1. Introduction.

The notion of representation inspires many heated discussions among scholars from disciplines as varied as culture studies, aesthetics, philosophy of language, philosophy of mind, cognitive psychology and study of artificial intelligence. On the one hand it is oftentimes criticized for being notoriously vague and polysemious. On the other hand some of the researchers point out that it is crucial for the identity of various fields.[1]

The original Peircean trichotomy differentiates between indices, icons and symbols. All of them can be understood as three-argument relations between the representation itself, the target of the representation and the representation user. The main difference between these three types of representations lies in the mechanism which connects them with their respected targets. In the case of indices the mechanism boils down to the causal relation between the representation and the target. Animal tracks are a typical example of a representation of this type. Needless to say this causal relation can then be recognized and exploited by the representation user.

Iconic representations differ from indices in that the mechanism of representation isn't based on causation. Instead of this it is based on similarity between representation and its target. This similarity can be as straightforward as a 2D projection of a three dimensional object (a similarity of a picture with what is being pictured) or as sophisticated and indirect as a map (which is by no means trivially similar to the terrain it portrays). Pictures, maps and reflections are the best examples of representations of this type.

Symbolic representations relate to their targets via some kind of convention. They can be as simple as a single sign or as complicated as a detailed description. Note that signs used as representation do not have to be a part of any language (they can just as well be a part of a simple code).

Note that although all three types of descriptions denote a different mechanism they are not mutually exclusive. Nothing prevents us from using a convention which builds upon an existing similarity or causal connection (think of onomatopoeias as an example of this).

Small difference to be noted is that symbolic representations differ from their indexical and iconic counterparts in the role they ascribe to the user. In the case of symbolic representations a conscious user with fairly sophisticated cognitive capabilities seems to be necessary as it guarantees a relevant convention to be applied to the representation. In contrast to this the requirements for iconic and indexical relations are much less strict. The reason for it is that the representing relation isn't imposed on the pair of representation and its target by a convention but stems from physical and structural properties of objects. As such it can (in principle) be recognized by much less sophisticated

[1] For example – it has been heralded as the key notion responsible for the cognitive revolution (understood as the abandonment of behavioral tradition).

representation users. This idea is by no means free from controversy, but I will not elaborate on it further as the difference in question does not play a crucial role in my present argumentation.

Although I plan to keep the gist of the original trichotomy more or less intact I wish to point out that the three notions it is composed of will be used in their contemporary sense which is sometimes different from what Peirce (most probably) intended. Historical comparison isn't the aim of this paper so I am not afraid to adopt liberal interpretations as long as they produce interesting distinctions which facilitate game studies. Let me address some of the differences which will be important in the following argumentation. In the case of iconic representations I prefer to abandon the vague notion of similarity and focus on a more precise notion of "structural similarity" known from philosophy of mind and cognitive science. In short – a given object A can be said to be structurally similar to a given object B if there exists a nontrivial homomorphism between A and B.[2] There are two important reasons why I prefer this notion. The first reason is that, as mentioned, this notion is much more precise than simple "similarity". The second reason is that it is much better suited for the explanation of the notion of "simulation" or a "model" which are crucial for the discussion of representations in video games.

As for the symbolic representations – as mentioned above, I assume that their most important characterization is that they are based on a convention – that is, that contrary to the two other types, the relation which bounds them to their targets isn't a natural one. This may surprise some of the readers – aren't games by definition artifacts? If so, how can you talk about "natural" representations? The point is, even if something is an artifact it still has to operate within the boundaries of physical laws. For example – causal connections which tie representations to their targets are natural just as structural similarities between iconic representations and their target.

Last but not least, when it comes to indices I wish to interpret this notion very liberally by assuming that the only thing that is needed for a given object A to be an indexical representation of B is for it to be caused by B.

What is the advantage of using Peircean division in the context of video games? Although it has been dismissed by some scholars (for example Andersenxxx) for being ill suited for interactive and dynamic medium I believe that a more charitable interpretation may in fact be very useful for game studies. There are two reasons for this. First of all, I believe that all three Peircean types of representations can be used to highlight some of the peculiarities of the relation of representation in video games. Second of all, I argue that the biggest gain comes from the possibility of simultaneous use of all three categories in descriptions of various game elements. As we will see different combinations of the aforementioned types account for different ways the term "representation" is being used within the video games discourse. Specifically, I will point out that some of the confusion surrounding this notion comes from the lack of differentiation between its variants.

Before I begin a systematic and detailed description of application of the titular trichotomy to video games let me consider one more preliminary concern. Although I leave all three Peircean categories intact, I do not believe that they cover all the spectrum of possible interpretations of the notion of representation as used in video games. On the contrary – it seems very much plausible to me that some additional types of representations could be added to the classification in the future. It might also be possible for some accounts to eliminate one of the categories by reducing it to one of the other (or a combination of them). A good example of such reductionist strategy is the causal theory of reference which can be easily used in order to interpret symbolic representations as a special case of

[2] I cannot discuss the notion of nontriviality which is used here in more detail. The main intuition behind it is that a non-trivial similarity is a triviality which does not obtain between a given object and everything else.

indexical representations. I don't have the space to discuss this possibility here, especially that it does not seem very relevant for my purposes. Even if such a reduction is possible it still does not change the fact that differentiating between symbolic and indexical representations provides a good explanations of some of the peculiarities of the notion of representation in video games.

2. The trichotomy

2.1 Symbols

Let's start our analysis with symbolic representations as it will be the easiest to show how important they are for the study of video games. The most striking example of symbolic representations doing all the representational work in games can be found in early games which had to resort to paratexts (online and offline manuals, box covers or even magazine articles) to establish the representational link their creators intended. Think of the famous case of dragons from the Atari VCS classic "Adventure" which were oftentimes taken to be ducks by the players who did not have the access to the game manual. The reason early games used these representational techniques is fairly obvious but it can be precisely pinpointed by the three-part distinction I am advocating – early computers and consoles did not have the technical capabilities to use iconic representations. A classic example of this can be found in Rogue (and its various clones) as the game literally tries to use symbols as game graphics but becomes virtually unplayable without explanation of the convention (for example there might be no way of differentiating between friends and foes). Contemporary games rarely back away from iconic representations to the point where paratexts become crucial for understanding the representational level. The closest to it are the niche strategy games which use fairly nondescriptive tokens with very simple graphics. It is also important to add that some of the conventions used in games differ greatly from linguistic conventions we are all familiar with. Color coding used in RPG games can be a good example of this as many games of this genre use red, blue and green bottles for health, "mana" and antidote potions respectively. This type of popular convention should be treated as a special case of symbolic representation as there is no real structural or causal connection between these colors and any real life artifacts.[3]

At this point it is important to introduce a distinction which has its implications in the case of other types of representations but is, without the doubt, the most prevalent in the case of symbolic representations. Whenever we talk about representations we could always ask if the relation we are describing concerns diegetic or non-diegetic parts of the game. It is not hard to see that in the case of symbolic representations it oftentimes makes a huge difference. Consider the most obvious diegetic aspect of games – their interface. Most game interfaces are still at least partially textual. Consider a very typical example of a part of an interface – the display of the ammunition count. In this typical case a two part symbol – a number and a word indicating that the number refers to ammunition, which can be read by the player via linguistic convention refers to an in-game property. Note that the ability to read the linguistic convention is a necessary condition the representation user has to fulfill. Without this prior knowledge the representation user can be completely oblivious to the representation relation. It is quite easy to overlook this fact because linguistic conventions are so ubiquitous in our environment that we oftentimes don't treat them as conventions. But even if someone who couldn't read the representation description noticed that the number changes in correlation with the shooting she would still need a relevant convention to interpret the number. Symbolic representations can be embedded into interfaces in two significantly different ways. First of all they can enhance the existing representational layer of the game – it is especially evident when the interface consists of labels for

[3] Needless to say they are also more than likely explained by relevant paratexts (manuals, in-game tutorials and game guides)

game objects. A good example of this is *Championship Manager* which presents the simulation of a match as dots with name tags. This shows why video games can be treated as even better an example of symbolic representation relevance than board games as most game tokens preserve at least a bit of resemblance to their targets. Note that representations used this way are in fact similar to online paratexts (for example turorials or online help which can be switched on and off).[4]

The second way symbolic representations can be embedded in game interfaces is the case of our ammunition counter. In these cases the representation does not target a manipulable game object (and thus cannot be understood as a simple extension of gaming paratexts). The ammunition from our example can be perceived by the user only through the symbolic reference. The label points at a game mechanic which the user can interact with but which she cannot perceive in any other way. It is hidden and remains visible only through the interface. Examples of symbolic representations functioning this way are numerous – health meters, money, experience points etc.

Graphically simple economic simulations with text rich interfaces which target mostly hidden mechanics can be in fact understood as games comprised almost entirely of interfaces built from symbolic representations. Last but not least – pure, non-graphical interactive fiction games can be described as games which present the player with nothing but interface built from symbolic representations (passages of text). Interestingly enough, classic Infocom interactive fiction games enhanced their representational capabilities by way of many paratexts (in form of manuals and additional materials, so called "feelies").[5]

2.2 Icons

As already mentioned in section 1 iconic representations are to be understood as nontrivial homomorphisms between game elements and the structure of their targets. It is best to understand this type of representations by invoking an example most readers will probably be familiar with - the relation between a building plan and the building itself. Note that the building plan isn't trivially similar to the building interior – reading the plan demands for certain cognitive capabilities of the user. That is why the building plan differs from the bird's eye photograph. Nonetheless, the structural similarity between the plan and the building interior isn't just a matter of convention. It could, in principle, be discovered by the user because the representation relation isn't just projected by the users via social contract (as it is done in the case of symbolic representations). There are two features of iconic representations which make them unique. First of all, unlike symbolic representations they can be manipulated by their user in order to discover new facts about their targets. For example – a building plan user can easily discover the position and layout of a room she has never been to. Second of all, an iconic representation can be used as an representation of any given object which happen to be structurally similar to it. If, for whatever reason the plan I am using ends up being similar to the building I am exploring only due to a sheer coincidence, then it still can be understood as a pretty decent representation of the building. It is the similarity that counts (and not history, causal relations, etc.).

It is not hard to see why both of these features make iconic representations a good fit for the video games discourse. Iconic representations are obviously connected with the notion of "realism" as they provide a relatively natural way of expressing the idea of progress of realism that permeates the video game discourse. Representations can be more or less similar to their targets just as various aspects of games can be perceived as more or less realistic. Additionally iconic representations understood as homomorphisms allow for talking about realism of many different aspects of games which are

[4] Pressing ALT in Diablo 2 can be a good example of this.
[5] It should be added that some of them contained also iconic representations (e.g. photographs).

impossible to describe in terms of the simple similarity relation. Instead of talking about a picture or resemblance of a target we can easily express the idea that a given game element is a model or a simulation[6] of its target. It is precisely because models can be understood as object which are structural homomorphs of objects they model and simulations could be defined as dynamic models of ongoing processes. This characteristics of iconic representations purchase us a lot of explanatory power as we can now show why parts of video games can be used in significantly more sophisticated way than mere resemblances. The best way to understand this difference is to realize that (at least in this context) game objects should be treated as virtual counterparts to physical models and simulations. And there are plenty of those – toys, installations, mechanized train sets, we know them pretty well. A toy gun remains a much more sophisticated model of the real gun than even the best picture of it and so is the case with virtual iconic representation of a gun. Once created a toy starts to live its own life, so to speak. It can be manipulated and used with other toys. It can be changed too much and loose the connection with its initial target (stop being structurally similar to real gun) or reveal something its user didn't know about guns.[7] As evidenced by the examples I proposed up to this point there is nothing specific that separates virtual models used in video games from physical models. There are, nonetheless two specific features of virtual iconic representations that separate them from toys. First of all, as virtual objects aren't bound by actual physical laws they can be easily used in counterfactual situations which are very far from reality. Second of all, computers allow us to model and simulate much more complicated systems then toys ever allowed for. For example it would be rather hard to imagine what a physical toy simulating the economy of an entire city looks like but there is nothing that prevents us from creating a game simulating a city. Similarly even though sophisticated dollhouses existed for centuries, they were never able to autonomously simulate the interrelations between their inhabitants the way *The Sims* do.

As iconic representations get their representational power from the similarity of structure, and not from the intentions of their creator, causal relations or linguistic descriptions they may end up being used in ways which are surprising even to their designers. If someone learns to break law because she realized how to do it in a virtual race, she will be exploiting a homomorphism between the virtual and physical street in an unexpected way. In consequence, every game using graphics contains many potential iconic representations waiting to be recognized, utilized or even exploited.

There are no doubts that the idea of iconic representations raise many questions. Fortunately for us most of them are so general that there is no point addressing them in this paper as the answers to them belong to philosophy and cognitive science and not to game studies. There exists, nonetheless one specific problem we should at least try our hand at as it seems to be very typical for video games (although it can affect different media as well). Consider a virtual object which depicts some fantastical creature, for example a dragon. It seems a bit weird to say that it models a dragon, as dragons do not exist. We could of course say that it models a "fictional dragon" but what would it actually mean? Is there a single fictional object we all refer to when we talk about dragons? And if there isn't – what exactly is our virtual model structurally similar to? One way to solve this problem is to declare that virtual models constitute a category of their own. They are not fictional, they are virtual (Aarseth). But this seems to me to be a category mistake. Some of the virtual models depict existing objects and some of them don't. *Watch_Dogs'* virtual Chicago calls for a different ontological description then *Grand Theft Auto's* Los Santos. It is exactly the same with physical models – they can be said to be representations of real (a toy Ferrari Testarossa) or fictional (a figure of Superman) objects.

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[6] The way I understand the difference between models and simulations in this paper is that simulations are simply dynamic models of a given process.

[7] I believe that this is the main reason why some scholars [Aarseth] wish to separate simulations from fiction.

We could try to solve this problem by saying that for every fictional object there exists a canonical description (or a depiction) and that every subsequent model of this object has to be somehow structurally similar to the original. The problem with this solution is that not only is it completely arbitrary but also completely useless in cases where a fictional object has been introduced as a model. Additionally, as I mentioned above the medium of video games only adds to the confusion because of the role technological progress plays in its history. Is Lara Croft's model from 2013's version of *Tomb Raider* a better model of Lara than the original model from 1996? Which of these two is more structurally similar to their target? But what is the target – which depiction is supposed to be canonical. Is it the illustration from the box? Or maybe one of the models who historically played Lara at public events and in commercials? Fortunately, as we will see in section 3 Peirce'an distinction gives us the tools to solve this problem. But before that we have yet to discuss the third (and last) type of representations.

2.3. Indices

Contrary to symbols and icons the application of Peirce'an indices to video games seems rather counterintuitive. As mentioned in section 1 indices should be understood in a following manner – an object A is an indexical representation of an object B if it is caused by B. The thing that ties representations to their targets is thus a physical cause and effect relation that obtains between representations and their targets. It shouldn't be understood as a recurring, stable event though. In fact it can happen only once – the moment assets for the game were being created.[8] Initially it may seem to be surprising but it is actually pretty well suited for the explanation of the common notion of "being a digital representation of…". Consider some of the more recent techniques of game assets creation – photogrammetry used in *Vanishing of Ethan Carter* (among others) and laser-scanning used in *Forza Motorsport* series. The first technique requires the developer to make a huge amount of photographs of a given real life object and then enables the artist to create an accurate 3d model of said object. The second technique produces a similar effect (an accurate 3d representation of an existing racing track) but the measurements are made on the spot (instead of being calculated from the photographs). The point is that what both techniques do is that they establish a causal link between a physical object and a virtual object in the game. In fact, every texture which has been created from a photograph can be said to be a digital representation of the object it was scanned from. The fact that a causal link of this kind creates a representational relation between the game and the original source shouldn't be understood as some kind of metaphysical discovery but as a simple consequence of the way we describe things. When I say that a texture on a building in the game I am playing is a photograph of a real building I am pointing at the representation relation by the sheer fact that I used the word "of". We may be misled by all the intermediating technology but there really is nothing fundamentally different between the mark an object left on the matrix of a camera and the mark it left on snow or sand. It might be easier to get once we switch visual for audio stimuli. Let's say that someone fires a gun. The sound of the gun is a typical example of Peirce'an indexical representation of a gun. Will it lose its representational status if I record this sound and use it in a video game? The obvious criticism is that in the first example the sound could be easily used as a sign of the gun – something that stops being the case once the sound is recorded and played back. But this would be mixing up ontology with epistemology. The fact that the player cannot discover that a given part of a game is causally connected to a target does not mean that it isn't connected. These are two separate things. That causal connection causes a representational link even if it cannot be later used as a natural sign. This can be easily seen in the way the users react to it, once the causal connection is revealed. Causal connection has a special status which is incomparable to any other relation. There is a huge number of other ways

[8] It is still a stable connection in a sense that the causal link supports counterfactuals.

that our recording of the gunshot relates to real objects. It was recorded by a particular team, in a particular building, with a particular microphone. It happened before and after many different real phenomena. But we wouldn't say that the gunshot is a digital representation of the building that it was recorded in or a microphone. Contrary to this, once a causal connection is revealed, the users will oftentimes refer to virtual objects as of representations of real objects even if the game fiction flatly denies it. *Vanishing of Ethan Carter* which we mentioned above uses a painstaking representation of Polish landscapes and buildings but the in-game fiction describes it as "Red Creek Valley". But it does not discourage the users from discussing the relation between in-game objects with real life Polish counterparts in terms of representation.[9] This may lead to confusion. What do these objects really refer to? Would it be different if "Red Creek Valley" existed (but still not as a source of pictures)? One of the main advantages of using Peircean trichotomy in the context of video games is that it allows us to precisely describe cases similar to this. The objects in question are indexical and iconic representations of a part of Poland but symbolic representations of a fictional part of USA. Confusion ends once we realize that the notion of representation we used was to coarse grained. It is in fact a combination of three more specialized types of representation.

This solution invites two additional questions. First of all, we might ask, what other combinations of three types of representations are permissible and what are the cases these combinations depict? Second of all, if symbolic representations of fictional objects exist, what about the other types? Can there be iconic or indexical representations of fictions?

3. Varietes of representation

As evidenced in the last example we discussed, all of the three types of Peircean representations don't necessarily have to go together. It is not hard to find other similar cases. For example – many objects and places displayed in *Grand Theft Auto V* have been modeled on parts of Los Angeles and they remain very similar to these places. But the game insists on referring to the fictional city of Los Santos. Thus, even they are indexical and iconic representations of Los Angeles they remain symbolic representations of Los Santos.

There are more possibilities to explore. For example – can a game object be a symbolic and iconic representation of a real object without being at the same time its indexical representation (that is without being causally connected with the object)? At the first glance it might seem to be unlikely but examples of this kind can be found. Consider a fighting game which uses the character of Bruce Lee but models its 3D representation of him on a living actor who happens to be very similar to the famous martial artist.

Needless to say it also possible to imagine a scenario where an object directly refers to a real life counterpart (and thus can be seen as a symbolic representation) and uses digitized assets created out of its target (thus being an indexical representation) but fails to display nontrivial structural similarity to the target in question. This is what would have happened if the model was so badly produced that it was actually similar to an entirely different object.

But what about the cases where only one of the requirements is fulfilled – are there representations of one kind only? As we will see below, each category can be exemplified although the games which fit them are fairly atypical. This stresses the importance of combinatorial character of the notion of representation.

[9] See https://steamcommunity.com/app/258520/discussions/0/618453594755304831/ as an example of this.

As pointed out in section 2.1 purely text based interactive fiction (which do not use additional physical materials) could be considered to use symbolic representations only. Some of the contemporary Twine games are very similar in this respect. As for the games which use only the second type of representation (iconic) the closest to this idea seem to be the ones which use only procedural graphics without the aid of any symbolic indication. *Proteus* can be a good example of this. The game uses almost no linguistic descriptions and contains no textures and creates its models semi-randomly. But even all the graphics and sound are created procedurally and do not relate to any real objects they still resemble natural landscapes (meadows, forests, mountains and houses). The structural similarity cannot be escaped but it seems to be the only representational mechanism the game contains.

Interestingly enough, a game containing only indexical representations seems to be rather difficult to find. Fortunately it is not very hard to describe as there seem to be no reasons why a game of this type could not be created in the future. Consider a game which secretly uses a combination of user's files and a random seed to generate levels. Because of the random addition the levels are not structurally similar to the files. They cannot also be called symbolic representations of these files as there is no symbolic indication of this fact. But the files are nonetheless causally connected to levels so they can still be described as representations of users' files.

But what about the idea of a representation of fictional objects we encountered earlier and promised to solve. How can game objects represent non-existing entity? How can they be better or worse at it? The explanation I propose to invoke makes use of the combinatorial nature of our trichotomy. To understand it we have to firstly note a rather obvious fact: let's say that A and B are two iconic representations of an object X. It means that they are both structurally similar to X. Now, the obvious fact I mentioned is that in this case it is more than likely that A and B are structurally similar to each other.[10] Let us now assume that we discover that X didn't in fact exist. Will the structural similarity of A and B vanish? Why would it? Would we say that in this case one of the objects becomes a representation of the other? But how do we chose which one is the representation and which one is the target? Should we toss a coin? The easiest solution for this problem is to proceed as if nothing has happened – we simply postulate that these are representations of some single (unattainable) object. The best way to suggest it is to use a single proper name, that is supplement our iconic representations with a symbolic one. I suggest that this is what happens whenever we consider a representation of a fictional character. Representations of fictional characters are simply sets of game objects which are structurally similar to each other and a proper name which gives them unity. On this account neither representation of Lara Croft is the proper one, or the most accurate. They can only be more or less structurally similar to humans and this is what we take into account whenever we evaluate the quality of the new representation of Lara.

The main aim of the paper was to show how Peircean trichotomy could be used as a robust classificatory device for differentiating between forms of representation which can be found in video games. As I pointed out the categories function both ways – as singular and as combinatorial types. Nevertheless, there are still some questions which demand further study and attention. First of all, it would be beneficial to see if there exists a hierarchy of the representation types in actual processes of identification. Are all three types of representations equal or perhaps is one of them being used by players as a deciding factor? Second of all it would be very important to see if the division I described is detailed enough or should we look for additional types of representations (some of them could end up being characteristic only for video games).

[10] There is no guarantee of this as the relations of structural similarity is not transitive.