An Ontological Enquiry into the MagicLeap and Augmented Reality

By

Niels van der Vlugt

University of Twente
February 17, 2017

Thesis for MSc degree in Philosophy of Science Technology and Society

Supervisor: Prof. dr. C. Aydin
Second reader: Dr. M.H. Nagenborg

Acknowledgements

Before you lays the product of a well protracted masters in philosophy of science, technology and society. A time on which I think back with great joy, not only because of the invaluable philosophical knowledge acquired, but also because of the great friends met and the exceedingly unexpected experiences experienced. Yet, no matter how much fun I had in the last years I am also happy to call it quits. As they say: it is time for the next adventure.

As it has taken me some time to dot the last I and cross the last T, I have all the more reason to give my heartfelt thanks to all who have supported, and kept supporting, me throughout my writing of this thesis. First, I would like to thank my supervisor Ciano Aydin and second reader Michael Nagenborg for their input throughout the process and willingness to quickly help me over the last, somewhat hastily taken, hurdles. Second, I would like to thanks my parents and grandparents, who have helped me tremendously, each in the way they personally saw fit. Third, I would like to thank Wouter Versluijs for struggling through my drafts and his much-appreciated feedback. And lastly, I would like to thank all my friends, who mainly helped me in *not* thinking about my thesis.

Rests me to say, I hope you enjoy reading this thesis and next time you wear those MagicLeap glasses stand still for the briefest of moments and ponder on how they influence your worldviews.

Niels van der Vlugt

Enschede, February 17th, 2017

Summary

In this thesis, I have set out the answer the following main question:
'Are the modern ontological frameworks relativist pragmatism and object oriented philosophy still sustainable when taking into account modern reality augmenting head displays and specifically the Magic Leap?'
This question finds its relevance in the fact that academic discourse surrounding ontology and augmented reality has, so far, been very limited. Answering this question will thus allow me to contribute to the ontological understanding we have of augmented reality. In chapter 2 I examine augmented reality from a technological and theoretical point of view and define it as '*An indiscernible virtual addition to physical reality to make it greater'.* After describing Harman's object oriented philosophy and Rorty's relativist pragmatism in chapter 3 and criticizing these frameworks in themselves I use the definition above to show to criticize them from the light of the MagicLeap in chapter 4. I conclude that both frameworks cannot fully account for Augmented reality. Harman falls short because his taxonomy of objects cannot account for virtual additions to the physical and Rorty falls short because he cannot account for individual influence on changing frameworks and vocabularies. I conclude the thesis in chapter 5 by using the results as described above to provide a rudimentary foundation for future work on the ontology of augmented reality; it calls describes an ontological framework that can describe a fluid reality without assuming an essential nature belonging to that reality by focusing on the 'how it is' of objects in that reality instead of on the 'what it is' of objects.

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1. Introduction

In recent years interest in the virtual has grown dramatically. Where virtual reality was a subject merely reserved for the writer of Science Fiction novels and films and its existence could only be thought of as a reality in the distant futures of books like Neuromancer (Gibson, 1984), to a degree virtual reality can now be part of our everyday lives in the form of devices such as the Oculus Rift and HTC Vive. The advent of a prototype for the virtual reality glasses *Oculus Rift* in 2014 can perhaps be thought of as the instigator of a worldwide craze to be the first to produce working and wearable virtual reality goggles. Virtual reality promises the immersion into a new reality that can be explored freely and is only limited by the imagination of the programmer. But no matter the perplexing amount of possibilities virtual reality offers, an even more mindboggling idea has planted itself into the minds of technological developers. *What if the real could be merged with the virtual?* What if the real and virtual could be presented at the same time without being able to distinguish one from the other?

What if we could, so to say, Augment Reality? This idea indeed seems a step from the possible back into the realms of science fiction. But nothing could be further from the truth; at the time of writing at least two separate companies have shown to be able to produce working reality augmenting products. On the one hand there is the goliath Microsoft who presented the HoloLens and on the other the David, small scale start-up company, MagicLeap who are silently working on a product also named MagicLeap. Microsoft's HoloLens has been released in early 2016 and has been extensively reviewed. The HoloLens received widespread praise but also failed to deliver an all-encompassing augmenting reality. MagicLeap on the other hand has been very sparing with its press presentations and has, despite multiple passed deadlines, yet to present a working consumer model. What the company *did* show to the lucky few journalists that got to wear to headset was a product that had overcome the limitations of the HoloLens. Or in other words, the MagicLeap is making promising steps towards presenting the wearer a believable fully immersive augmented reality.

What then does this step from the virtual to the augmented mean? Some intuitive answers can readily be given. First, going from virtual to augmented means stepping from

an individual and closed of experience towards a shared out-in-the-world experience. It furthermore means that a certain sense-of-reality is lost, no longer can the user appeal to the thought 'what I see is ultimately fake', or rather virtual. After all, the augmentations on reality perceived are meant to be indistinguishable from the non-augmented. A third possible implication could be that we must start to rethink any preconceptions we had about what is real. Although there is a plethora of implications that can be raised concerning augmented reality and its connection to the virtual or alternatively the 'real' the three examples given above set the stage for the main topic of interest in this thesis: how does the emergence of augmented reality in the form of wearable headsets change the way what we conceive as reality? Should we rethink existing notions, or do we need new ideas altogether?

However, what 'we' conceive as reality is a highly-debated question, and since the times of Parmenides many a philosopher has pondered over this question. The age of this question has however in no way contributed to reaching a universally accepted solution or answer. In fact, quite the opposite is probably true. Without following the long history of philosophical ontological thought I shall frame my questioning with two competing ontologies: I shall place Richard Rorty's relativist pragmatism opposed to Graham Harman's object oriented philosophy. These two ontologies can be seen as two outliers on an ontological spectrum which ranges from realism to pragmatism and provide approaches to reality that are different in both how they understand reality and in how they frame ontology. As such these two philosophers will give me a broad basis to work from.

Harman on the one hand proposes the new object-orientated realist ontology in which he steers away from two strains of thinking he sees persisting throughout classical realist philosophy. He denies the idea that objects and their relations are merely composed of opposing entities (or, entities and their counterpart) such as mind/body and animate/inanimate, and simultaneously denies that objects can only be described as having a single radix. Instead Harman proposes a polarized view in which objects are seen to exist in two different ways: as autonomous units, or real objects, but also in conjunction with their qualities, accidents, relations and moments, or sensual objects, without being reducible to these.

Rorty on the other hand takes a wholly different stance in his relativist pragmatism and denies access to either a world out there or an inner self all together. Instead he proposes a view in which language is used as a tool to achieve some (societal) task. The human being using this tool is shaped by the form of the tool which in turn is ascertained by societal forces.

With these two opposing philosophies in mind it is not my aim to discredit one in favor of the other or even to reach a consensus and find some form of synthesis theory which would be able to describe reality differently. Rather I shall show that neither theories are sufficient to explain the place of reality augmenting devices such as the Magic Leap in our world. The main research question I shall answer in this thesis is the following: *Are the modern ontological frameworks relativist pragmatism and object oriented philosophy still sustainable when taking into account modern reality augmenting head displays and specifically the Magic Leap?*

Simply put, I shall question whether the theories by Rorty, who, on the one hand, defends that that what is reality is formed by the human being, and Harman, who, on the other, argues that reality is pre-cognitive, are unholdable in the light of reality augmenting technologies like the MagicLeap. However, the answer to this question does not present, or even allude to, an acceptable alternative theory that *is* able to explain the Magic leap as a part of reality. Based on the critiques I give of Harman and Rorty I shall suggest an alternative way to think about ontology in light of the MagicLeap.

As said, with these opposing frameworks, that not only think differently about reality, but have different views on *what* we should think about reality as well, it stands to question what ontology concerns itself with in the first place. Harman on the one hand is concerned with a description of objects in themselves, he questions how we can describe and categorize objects. Rorty on the other is not so much concerned with the nature of objects in themselves but rather with the question if we can say anything about what reality contains, or, what we think of as part of reality. In this thesis, I shall follow the lines of argument provided by Rorty and Harman and will adhere to their respective understanding of ontology. However, in the final chapter I will argue for an understanding that is more in line with Rorty's view on ontology.

With all of the above in mind I shall start this thesis by setting the stage for the theoretical discussion that is to follow in two ways: in chapter 2 I shall give and account of reality augmenting head displays, a technological description of the Magic Leap, its features and capabilities and how augmented reality must be thought of practically speaking. Following this I shall theoretically define augmented reality and set it opposed physical reality in chapter 2.4. Chapter 2 as a whole will will provide both the practical and theoretical understanding of augmented reality needed to answer the main question of this thesis. Following this I shall set out to explain and criticize Rorty's relativist pragmatism and Harman's object oriented philosophy in chapter 3 and show how these two theoretical frameworks are unsustainable in the light of augmented reality in chapter 4. Finally, I shall make a set of suggestions based on my critiques in chapter 5.

2. Setting the stage

The first step towards answering my main question is setting the stage for the theoretical discussion that is to following in later chapters. In this chapter I shall examine augmented reality on both a technological and theoretical level to form a fully informed understanding of the concept.

2.1 Head mounted augmented reality displays

One of the first reality augmenting head mounted displays to break into the consumer market is the HoloLens, presented by Microsoft as the "world's first fully untethered holographic computer." (Microsoft, 2016) In other words, this means that the HoloLens is a head mounted device that allows its user access to an augmented reality without limitations such as screen size (the HoloLens covers the eyes) and cabling. First impressions of the technology are its futuristic look and seemingly simple design. At the surface the HoloLens is no more than an adjustable black band that fits around the head with two sets of glasses attached. The first set squarish and the second reminiscent of sunglasses worn by athletes. Yet behind this simple design hides a complicated network of sensors, lenses, cameras and computers that all work together to emerge the wearer into the promised augmented reality. Since the release of the developer set early 2015 reviews of the glasses are abundant (Hempel, 2015; Fitzsimmons, 2017) each one of them praising the technological feat Microsoft has delivered with the HoloLens.

Although being the first company to make a move into a Technological market is mostly seen as giving a major advantage over possible competitors (Grant, 2003), it also means that those competitors will be able to ride along and take advantage of the so called 'first-mover'. 'Second-movers' (and other latecomers) will have to invest less resources into initial research and development and initial marketing, and, perhaps most important, will have more time to 'fix' mistakes in the first product and build onto existing technologies to overcome glaring limitations.

This interplay between first- and second-movers has unfolded around the HoloLens as well. Despite their praise all reviewers pointed out similar technological limitations of

the device. One of these limitations in particular was present is each review: a limited field-of-view. What this means is that the HoloLens is able to produce a reasonably believable augmentation of reality but can only do so within area. If the wearer would, for example, move their eyes but not the device itself the augmentation would dissolve. In other words, only then when the headset is physically pointed at the to be augmented environment will it work.

Such limitations are overcome by companies that made their move (or still have to) onto the augmented reality market after Microsoft did. Two such companies are TheVoid and MagicLeap. TheVoid (TheVoid, 2017) is a reality augmenting display that fully immerses the wearer in a digital world by speaking to three of the major senses: vision, hearing and touch. The device works by displaying a digital world layered on top of the physical world in which the wearer is present. As such the wearer can interact with the digital world by means of physical representations, e.g. a stick in the physical world can be displayed as a blazing torch in the digital world. Although the technology, opposed to the HoloLens, provides full emersion to the wearer it lacks the ability to show both the physical and digital simultaneously. TheVoid's display is not transparent and is in this sense more akin to virtual reality displays such as the Oculus Rift. Or in other words, the physical props used to enhance the TheVoid's experience are not truly part of its virtual reality. They are merely there to, so to say, 'trick' the wearer into feeling more immersed. The MagicLeap on the other hand promises to bring the best of both of these displays to the table: a fully immersive augmented reality where both the physical and digital are indistinguishable.

2.2 The MagicLeap

As stated above, the MagicLeap promises to be able to produce a fully immersive augmented reality in which the digital is indiscernible from the physical. Rony Abovitz, CEO and founder of MagicLeap, describes this in the following way:

> *"We are building a wonderful, special thing – whose purpose is to gently, and in harmony with you (your physiology, your being), produce a Digital Lightfield™ - a living river of light sculpture, which can transmit to you the feelings of magic and*

> *experience and presence. We call this our Mixed Reality Lightfield™. It comes to life by following the rules of the eye and the brain, by being gentle, and by working* with us*, not against us. By following as closely as possible the rules of nature and biology, we can deliver what is truly* next.*"* (Abovitz, 2016)

Most apparent is that Abovitz does not like to think of the MagicLeap as yet another, or perhaps the next, groundbreaking technology, rather he wishes to see his brainchild as truly magical; a symbiosis of man and machine in which technology respects biology and vice versa. The critical mind might put off Abovitz' vision as fluffy marketing guff, after all the MagicLeap has as of yet not shown any consumer ready product able to live up to the magical promises made by Abovitz. Yet, Abovitz' vision also hints at an important technical aspect of the MagicLeap: the Digital Lightfield. A lightfield is a way of projecting images such that they have multiple points of focus and can be viewed from every angle. What this means can be explained by imagining a room and a television. On the television is displayed some arbitrary three-dimensional object and this same object can also be found in the room. When moving around in front of the television the object will always be projected in the same way, i.e. its point of focus (the television screen) and light fall are static. When we walk around the same object in the room the opposite is true. We can focus behind some arbitrary initial focus point when moving around and light will scatter differently when the object is observed from different angles. In other words the wearer of a MagicLeap will not see static images but rather digital object that behave similar to physical objects. Instead of asking the user to adapt to the technology the MagicLeap works in conjunction with the wearer to present a reality that suits the human condition.

Wired journalist Yang, one of the few outsiders that has been able to test a MagicLeap prototype describes the experience as follows:

> *"An impossible 8-inch robot drone from an alien planet hovers chest-high in front of a row of potted plants. It is steampunk-cute, minutely detailed. I can walk around it and examine it from any angle. I can squat to look at its ornate underside. Bending closer, I bring my face to within inches of it to inspect its tiny pipes and protruding armatures… this alien drone certainly does seem to be*

> *transported to this office in Florida—and its reality is stronger than I thought possible."* (Yang, 2016)

What Yang describes is the Lightfield technology at work. No matter how close or far away the wearer is from the digital object, if she looks at it from the front back or underside it is always there in the same way a physical object would be. According to Yang the object is not pixelated and he is even able to inspect the most minute details on the craft.

However, MagicLeap's strong focus on Lightfield technology also brings to light a glaring problem in their endeavors to achieve fully immersive Augmented reality. That is, MagicLeap's immersion is ultimately founded on the audio-visual, the other senses, while not necessarily ignored, can, by virtue of MagicLeaps design/technical limitations, not directly be stimulated. The first of the senses that the MagicLeap cannot stimulate is touch. Yang describes that when touching the alien drone the simulation reaches out to his hands with appendages of light, reacting to his physical presence. The simulation is not merely a very high definition projection but reacts and plays with the presence of the user. Still, all this is no more than a work-around as the drone cannot be physically felt. That is not to say no solutions to this problem exist: earlier I have described how TheVoid uses physical props to simulate the presence of digital object and more advanced solutions in the forms of suits that give full body haptic feedback (engadget, 2016), i.e. simulating touch by means of applying pressure. These solutions are however only aimed at solving the specific problem of touch while still ignoring other senses such as smell and taste. Furthermore, if we consider the myriad of lesser known senses like proprioception and equilibrioception it becomes almost painfully obvious how very limiting a focus on the audio-visual is when it comes to speaking to all the senses.

In magic leap defense, it must be admitted that it can hardly be expected from such a novel product to solve all these problems at once, yet it is also important to keep in mind that the initial augmented reality by MagicLeap will, in the light of the condition laid out above, be far from perfect. It is furthermore noteworthy that sensory limitation that may initially seem only in the realm of augmented reality are also present in the physical realm. Imagine for example a faraway object, something excessively small,

something we assume to be painful to the touch or dangerous when inhaled; in short, objects that we cannot touch or come close to in the physical realm are more easily digitally represented than objects we are naturally inclined to interact with on a level that transcends the audio-visual. This means that limitations of the MagicLeap are indeed governed by expectations we have of physical reality in the first place. I will come back to this in Chapter 4.

2.3 Envisioning MagicLeaps' augmented reality

From the above an important question arises: what will a fully immersive Augmented reality look like? After all it can hardly be similar to an experience as described by Yang, which in effect is no more than a single (static) lightfield. Clearly, there are no technologies that can simply show us. An additional problem when giving an account of the MagicLeap and Reality augmenting technologies in general is that their physicality gives no hints as to what its users should expect when using them. I can describe the set of lenses, cameras and computers that together form an image, or I can even go as far as describing the image but none of that will describe the experience of augmented reality. In part this is similar indeed to how personal computers are (often literally) black boxes hiding their workings for the user. However, where PCs are commonplace in contemporary society and its users will know what its product is, AR technologies are of such novel nature that this divide between the physicality of AR technologies and their product will persist until they become more commonplace. This isn't necessarily problematic when using the technology, however, in giving a full account of AR technologies I am somewhat limited by this given. Instead I propose to take a step back and examine a triplet of existing, and as such 'inferior', technologies that can give an idea of what to expect from a fully immersing augmented reality. The following three examples are increasingly immersive forms of AR and will hopefully help the reader in doing so:

1. Pokemon GO
2. Fighter jet (and to a degree commercial plane) pilots
3. The television show Black Mirror

Perhaps one of the most well-known applications of AR technology is the popular mobile video game Pokémon GO. Where earlier iterations of Pokémon video games in the

franchise restricted the player to controlling some character 'through' which they would catch Pokémon GO instead allows the player to catch all their favorite pocket monsters themselves out in the real world. The game utilizes the phone's camera and shows a Pokémon as if it were a physical entity. The player can then interact with this entity by catching it with so called pokeballs. Although the game allows to player to feel like she is actually catching real Pokémon it still has some very apparent limitations. First of all, the projection of the Pokémon does not scale with other entities the player happens to frame in their shot. That is, the size of the Pokémon is bound to the screen rather than to the environment it is placed in. Especially when seen up close this limitation breaks immersion of the player. Secondly the player looks at the Pokémon through a screen, meaning that all limitations of the screen itself, as described earlier, are also imposed on the augmentation of reality. In short playing the game Pokémon GO gives us some understanding of what an augmented reality would look like, but in general it is more indicative of the limitations of contemporary technology.

A more advanced form of augmented reality can be found in the head displays of fighter jet pilots (Moynihan, 2016). Where a very basic form of augmented reality has been available in commercial planes in the form of increased vision of runways during heavy weather, modern fighter jet pilots get a helmet that allows them increased field of view, zoom functionalities and the ability to permanently mark targets. The helmet, although clearly far more advanced than the Pokémon GO game, still ails from similar faults when it comes to its augmented reality. The digital additions and deformations of physical reality the helmet makes are part of the screen in the helmet rather than the physical reality itself. Despite similar ailments as Pokémon GO the helmet shows that current reality augmenting technologies are in fact relatively far advanced and that for a hefty price full emersion is in the realm of possibilities.

A third way to imagine AR is brought to us by some CGI Hollywood trickery in the Black Mirror Episode *Men Against Fire (*Verbrugge, 2016*)* which depicts a dystopian future were a form of fully immersive AR technology is available to soldiers in the field. This technology, shown through Point of View perspective, allows soldiers to share an augmented reality that 'helps' them doing their job by digitally dehumanizing the enemies they are supposed to kill; instead of actual human beings, unknowingly the soldiers see

crazed ghouls. As the story develops the viewer learns that the soldiers' augmented reality is all-encompassing and perfectly honed by their superiors to turn them into killing machines. Although the episode aims to give a passivist critique on contemporary military tactics both at home and in the field and merely uses the AR technology as a magnifying glass and plot device, for current purposes it is still a great vehicle to show what a true AR could be capable of doing for its users. However, similarly to Pokémon GO, the problem remains that although for the soldiers the augmented reality is fully immersive, us viewers look at the television screen and only see a two-dimensional representation of this experience, which can only fail to give a true 'feel' of AR. Perhaps the only way to truly imagine experiencing augmented reality is by looking at the pens and paper on our desk and believe them to be digital representations of physical entities.

Knowing all this it is still important to keep in mind that the Magic Leap is still a technology very much in a developmental state of infancy. Even such sophisticated imagery as described by Wang is likely a minutely worked out tech demo. Even though the aforementioned interest in reality augmenting technologies by large companies such as Google and Microsoft is of unprecedented scale, expressed in both monetary investments and marketing campaigns, and will undoubtly greatly accelerate development, the development of new and groundbreaking technology is usually a slow process. This assumption is further supported by the fact that technical specifications of the Magic Leap are yet to be released. This means that making the step from the actuality of the Micrsoft Hololens to the great promises of the Magic Leap is, in a way, a leap of faith and conclusions drawn from claims made in this thesis concerning augmented reality as fully immersive and indistinguishable from physical reality cannot be fully supported by current (known) technological capabilities of the Magic Leap. However, this will not discredit any of these conclusions for the following two reasons: firstly, even in a world where no reality augmenting technologies where to exist at all it would still be possible to examine the concept on a theoretical level. Secondly, based on the state of current technological development, think Lightfield and fighter pilot helmets, it is likely safe to assume that true augmented reality will exist in some near future, perhaps not in the form of the Magic Leap, but certainly under some other brand name or moniker. The first of these two arguments certainly has its place in academic discourse however in my opinion the relevance of this thesis follows from the second argument. Where the first argument

only examines a world of what if (true augmented reality existed) the second argument indicates that some actual shift in perception of reality will/must happen, which in turn requires a rethinking of said reality on a fundamental level. In short this means that even though the promises made by the Magic Leap are currently merely that, promises, the analysis to follow in this thesis will be of higher relevance when based upon this ideal scenario.

2.4 Defining augmented reality

In previous chapters I have explained how augmented reality is created by the MagicLeap and, by means of some examples, how a fully immersive augmented reality could be imagined. In these chapters I have also highlighted that both existing and imagined reality augmenting technologies have shortcomings that set them apart from some ideal form of reality augmenting technologies. What I have not done is present a technology, be it an actual technology or an imagined one, that is in fact able to create some ideal augmented reality. This is for the following two reasons: firstly, it is not my aim in this thesis to hint or speculate at possible technological advances concerning reality augmenting technologies. Doing so could certainly help in picturing a feasible ideal reality augmenting technology, however, in what follows I shall take this technology, in the form of some future state of the MagicLeap, as a given. Secondly, and more importantly, so far I have only given an intuitive approach to the ideal form of augmented reality without going into much detail, which makes concretizing a possible technology problematic. This approach was sufficient in achieving the goals of previous chapters, i.e. envisioning augmented reality, however in what follows I shall need a more precise definition of augmented reality.

However as stated in the introduction, academic discourse concerning augmented reality has yet to be initiated. Meaning that a precisely defined and widely agreed definition for augmented reality is still lacking. (this can also be seen in the different monikers different companies use for augmented reality, e.g mixed reality vs augmented reality.) In finding a strict definition for augmented reality it might be beneficial to first study the two ‘components’ of augmented reality: the virtual and the physical part. By studying the building blocks of augmented reality it might be possible to merge their

respective descriptions and end up with a usable definition. For now, I shall focus on the virtual and will go into more detail on the physical part in later sections.

Virtual reality has been described in different ways by different writers. Two examples of such varying definitions can be found in the works of Brey and Søraker. Although these two are far from exhaustive when it comes to the myriad of descriptions and definitions of the virtual, but both have a vastly different approach that shows no strict diffenition of the virtual exists.

Brey described the virtual by means of objects that can be encountered in the virtual world and compares these to objects that can be encountered in the physical world (Brey, 2003). One the one hand there are ordinary entities, which fulfill a function by means of their physicality (e.g. a hammer) and there are institutional entities which fulfill their function by means of a society imposed meaning (e.g. money). Brey notes that ordinary entities can only be simulated in the virtual world while institutional entities can be ontologically reproduced. With this Brey defines virtual reality as an extension of the physical, displacing physical entities to the virtual, thereby trying to fit them into a wholly new environment.

Søraker on the other hand takes an approach that is more aimed at taking the user of virtual reality into account by defining virtual reality as follows: *"Interactive, computer simulated environment experienced from first person view."* (Søraker, 2010, p. 55) With this definition Søraker lays emphasis on the fact that a virtual reality must necessarily be experienced by a user and makes the addition that this must be done in an interactive way.

What becomes clear from the above is that approaches and definitions for a virtual reality are aplenty. Even though the two definitions are not necessarily mutually exclusive the focus of the two writers is highly influential on the form their definitions and views take. Here it is important to note that definitions for the virtual are often put directly opposed to definitions for the physical. That is, the virtual and physical are seen as direct opposites, ontological black and white that can share properties and inhabitants but are always distinct. The intuitive approach taken in chapter 2 to augmented reality however

already shows that the virtual and physical cannot be taken as strictly distinct from each other; when dealing with augmented reality we cannot simply think in black and white terms, even in very limited technologies like Pokemon GO the boundaries between the physical and virtual are blurred. This means that the definitions above can certainly inform on the virtual components of augmented reality they also fail to capture one of the most important aspects of augmented reality: a mixing of virtual and physical. Consequently, instead of trying to define augmented reality by means of defining its parts, I will take a step back and form a definition from the ground up by using both the etymological and historical context of the concept.

The term augmenting finds its origin in the Old French *augmenter,* which translate to increase or enhance. In modern use augmenting is defined more broadly as making (something) greater by adding to it (Oxford dictionary, 2017). In the case of augmented reality this would means that some addition is made to reality to make it greater. This etymological line of enquiry leaves us with two blanks yet to be filled in: what is added and what does it mean to make reality greater? With previous chapters in mind the first of these questions can already be answered: augmented reality is formed by adding virtual reality to physical reality. The second question has a less straightforward answer seeing how greater can be interpreted either as better or as increased in size or contents. Both interpretations pose their own set of follow-up questions respectively ethical or ontological in nature. Although I do not wish to belittle the import of the ethical side of this question, it is outside the scope of this thesis, and, therefore, I shall simply limit myself to the ontological consequences of this definition in what is to follow. This then leaves us with the following definition for augmented reality: a virtual addition to physical reality to make it greater.

Although the etymological definition above is clear-cut it is also wholly decontextualized, meaning that it does not consider the actuality of augmented reality. That is, this definition fails to consider what is required from an Augmented reality when engaged with by human beings. Because I wish to concern myself in this thesis with augmented reality as an actual technological possibility (be it in some near future) and as such a usable product I shall study the way augmented reality was initially envisioned in literature and later in technological development to make clear how this engagement will -

likely- shape itself. This historical path will show how augmented reality has developed from a vision to actuality while keeping in mind a prevailing focus on augmented reality as a possible technology. This will lead to a firm definition for augmented reality that is usable in the light of technologies like MagicLeap.

The first to envision a 'technology' capable of augmenting reality was writer L. Frank Baum. In his 1901 novel, *The Master Key* Baum envisions a so-called character marker, which is a set of spectacles capable of marking those viewed through them with a letter on the forehead. This letter in turn indicates what kind of character the person has, e.g. G for good or W for wise. As such, generally speaking, the augmentation of reality Baum envisions is the addition of a layer of information that tells the wearer of the reality augmenting 'technology' something about the persons she encounters. Baum's information layering can be found in a more modern interpretation in the now scrapped google glass project (McCoogan, 2017). The google glass enabled its user to look at reality and on command display information about the direct surroundings. Additionally, but for current purposes of less importance, the Google glass allowed users to overlay their vision with functionalities that can be found in smart phones as well, e.g. Email, texting and video chatting. Although there seems to be an almost earie* similarity between the character marker and the google glass it is at this point important to pinpoint the major difference between the two is as well.

Where, on the one hand, google glass does no more than project a layer of information which is discernable as clearly separate from the reality over which it is displayed, the character marker, on the other, marks someone's forehead with a letter that seems to be part of reality. This way of augmenting reality is much closer to what MagicLeap envisions. The MagicLeap will be able to add to reality in such a way that what is added will be indiscernible from the original. To increase the feeling of indiscernibility the MagicLeap promises to not only provide the previously described way of adding to reality but also enable its users to interact with the added objects.

Summarizing, a distinction can be made between augmentation of reality by means of discernable information layering or by means of indiscernible adding of 'objects'. Both ways of augmentation fit the etymological definition, after all both ways add to reality to

make it 'greater'. In this thesis, I will however opt to follow the latter of the two ways of augmenting reality seeing how the focus on indiscernibility (character marker and MagicLeap vs. Google glass) makes this interpretation closest to MagicLeap's envisioning of the ideal Augmented reality. I shall define ideal augmented reality as follows:
-An indiscernible virtual addition to physical reality to make it greater.

This new definition for some ideal augmented reality in turn forces us to question the ontological nature of augmented reality. If the virtual and physical become indiscernible how can we identify the resulting product? Clearly, I have defined this product as augmented reality, yet this definition does not tell us what, ontologically speaking, the difference is between augmented reality and physical reality. Or, in other words, ideal augmented reality is equally indiscernible from physical reality as virtual reality from physical reality in augmented reality. This can be aptly exemplified by the way the human eye registers colored light. When the eye, for example, registers yellow there is no way for our brains to determine if what we see is monochromatic yellow light or dichromatic light partly consisting of red light and partly of green light. Only with complicated devices like chromameters can we discover the underlying nature of yellow light. We can think of augmented reality as dichromatic yellow light and physical(/virtual) reality as monochromatic yellow light to see how indiscernible augmented reality problematizes ontological classification of said reality. It could be argued that this problem only stems from the fact that I have partly defined augmented reality from an anthropocentric point of view in which indiscernibility for the observer determines its actuality. This does however not change that the MagicLeap or some other reality augmenting device will most likely achieve this ideal in the near future thereby solidifying the necessity of my definition. Coming back to the problem at hand it is possible to discriminate between augmented reality and physical reality in a different way altogether. Instead of focusing on the nature of either reality we can notice that physical reality is always temporally prior to augmented reality. That is, even though we cannot discern between the two 'in-the-moment' it is possible to say that the augmented always comes after the physical. As a side note it might be worth mentioning that some future is imaginable in which even this temporality falls away. In this future the physical might actually be shaped by what is digitally imagined. Although conceptually interesting such a futuristic idea must be shelved for now as it is outside of the scope of this thesis.

For now, I see no real way out of this conundrum apart from accepting that augmented reality deserves its own ontological classification similarly to how we discriminate between virtual and physical reality, or, accept that virtual reality, physical reality and augmented reality are all ontologically indiscernible to begin with. In chapter 4 I shall return to this problem. More important for now is that this new definition will allow me to approach augmented reality in a more theoretical manner in the following chapters.

3. Ontologies

In chapter 2 I have described the reality augmenting device MagicLeap and argued for the following definition for augmented reality: *an indiscernible virtual addition to physical reality to make it greater.* This to address the second part of my main question: "*Are the modern ontological frameworks relativist pragmatism and object oriented philosophy still sustainable when considering modern reality augmenting head displays and specifically the Magic Leap?".* In this chapter I will address the first part of the question and elaborate further on the ontologies by Harman and Rorty. Before going into detail on these two specific philosophers I shall give a brief overview of the broader fields their thoughts stem from, which are respectively realism and idealism. Before going into Harman's object oriented philosophy, I shall give a short overview of common sense realism and for Rorty is shall follow is own historical line of enquiry that led to his relativist pragmatism. After laying out the ontological frameworks by these two philosophers I shall briefly criticize them which ten will lead into chapter 4, in which I shall criticize them in light of the magic leap.

3.1 Realism and common sense realism

Realism is a broad school of thought that has similar roots in many different fields. In general realism can be described as the idea that the subject it is concerned with exists and exists independently from human perception and ideology. Two examples of realist thought in different fields are: realism in mathematics, which says that the *"truths of mathematics are objective, which is to say that they are true independently of any human activities, beliefs or capacities."* (Blanchette, 1998) and realism in science, or scientific realism, holds that theories and results in science describe the world truthfully independent of human perception (psillos, 2005). Evidently, both these views on realism hold that human perception is wholly disconnected from the truth about their respective subjects.

Coming back to the subject of the thesis at hand: in ontology, realism can be found most basically in common sense realism. This view holds that that which we perceive with our senses has a one-to-one relation with reality. The mind, or ideas and believes about

reality, have no effect on the nature of said reality. Common sense realism is a point of view that is deceptively easy to believe in, after all if we don't give a second thought to what we see it seems perfectly logical to assume that that what was perceived is real and true. What else could it be? Yet, it is also a point of view that has a remarkably intuitive counterargument. One of the first philosophers to formulate such a counter argument was Alfred Ayer. In his book *foundations of empirical knowledge* Ayer proposes the argument from illusion which says that

> *"…material things may present different appearances to different observers, or to the same observer in different conditions and that the character of these appearances is to some extent causally determined by the state of the conditions of the observer." (Ayer, 1940, p.3)*

In effect this argument is composed of three different argument all culminating towards the conclusions that the veridical and illusionary are in effect indistinguishable.

- The first argument states that an object may appear differently to different observers of that object. This can be defended by for example a coin, which, when seen from different angles, can appear round, elliptical or even flat.

-The second argument states that an object may appear different dependent on the conditions it is observed in. This can be defending by the example of a straight stick appearing crooked when half-submerged in water.

-The final argument states that appearance of an object can differ depending on the state of the observer. This can be defended by imagining to be observing an object while being fatigued. The object will appear to be blurry or out of focus yet its physical state is wholly different.

Ayers admits that in many cases, excepting an actual mirage, the observed object is in fact there but that its appearance, its qualities, may be illusionary. He coins this representation of what is actually there, or the veridical object, sense-datum. With this in mind Ayer wonders if it is possible to distinguish between sense-datum and the veridical object. He thinks this cannot be the case seeing how objects and their qualities are assumed to be constant independent of their observer while at the same time observers only see sense-datum. That is, as Ayer showed with the three arguments above, observers never experience objects as continually the same; their appearance contextually changes.

As such Ayer concludes that what is immediately observed is never the veridical object but always sense-datum.

This conclusion is reminiscent of Kant's noumenon/phenomenon dichotomy which raised the question how it is possible to speak of a 'Ding-an-sich' in the first place. Similarly, how can the veridical object be shown to exist in the first place if all we perceive is sense-datum? Ayer has no direct answer and seems content with simply allowing a material world to exist: *"…philosophers who have recently concerned themselves with the subject of perception… allow that our belief in the existence of material things is well founded." (p.*2)

Still, upholding common sense realism as a sound ontological theory in light of Ayers arguments is a difficult and perhaps even impossible task and as a result common sense realism is often used as a strawman argument. That is not to say that realism in ontology is dead in the water. More intricate theories have been proposed of which Graham Harman's speculative realism is an example.

3.2 Harman's object oriented philosophy

The American philosopher Graham Harman is one of the forerunners of the relatively new philosophical school of thought speculative realism. The term speculative realism was first coined in 2007 and was meant to represent a realist point of view that that looks beyond the critical and linguistic turns (Bryant, Srnicek, Harman, 2011, p.3) Harman's own contribution two speculative realism, which he calls objects oriented philosophy, is placed opposed idealism and, interestingly, opposed philosophers that are often self-proclaimed realists. Harman is of the opinion that most realist thinkers are too lax in their realism. He argues that they more often than not are content with undercutting idealism thereby leaving the now from human influence separated objects sit in an outside world as *"obvious and inarticulate physical lumps"* (Harman, 2009, p.151). More explicitly Harman sees two distinct ways realist philosophers tend to describe objects: radically or conservative. Radical philosophies tend to search for a single *radix* laying at the root of reality. That is, these philosophies reduce everything connected to an object to one single explanation thereby radically denying other possibilities. Conservative philosophies on the

other hand try to conserve the two sides of reality they are trying to explain. This creates a duality that is often unbridgeable.

In some arbitrary radical philosophy, the roundness and redness of an apple, its qualities, would be constituting the apple itself. Anything that cannot be typified as the qualities of the apple cannot be part of the apple. In other words, there is no such thing as an 'apple-essence' disconnected from 'apple-qualities'. Some arbitrary conservative philosophy would argue that both essence and qualities of the apple constitute its reality. To describe the apple as a whole understanding of roundness and redness and of the object apple are needed. Both qualities and essence are in this way separated yet integral to the same object. Another way to think about the difference between radical and conservative philosophies is, in Harman's words: the radical gesture is always to say *'there is nothing more to S than P'... whereas the conservative gesture is to say that 'the world is made of opposed S-terms and P-terms'.* (2009, p.155)

Both radical and conservative realist theories can, in Harman's eyes, not do just to objects because they oversimplify them. They *'objectify'* objects either by reducing them to something describable or to something that stands opposed to something else. Neither side takes objects seriously by taking the object itself as starting point.

The task Harman sets for himself is to find a philosophy that is neither radical or conservative, or as he puts it, a *polarized philosophy*. In such a realist polarized view objects are seen to exist in two different ways: as autonomous units, but also in conjunction with their qualities, accidents, relations and moments without being reducible to these, or *"[Objects are] unified entities with specific qualities that are autonomous from us and from each other."* (2011, p.22) Harman finds the background of this split in types of objects in the phenomenology of Husserl and Heidegger, who he sees as the frontrunners of an object oriented philosophy, and respectively christened the idea of ideal objects and real objects (Harman, 2013). Harman's interpretation of Husserl and Heidegger is best described as an extension or addition to the original theories, so, instead of focusing on how these two different views on objects were first introduced I shall highlight the point where Harman's views begin to deviate to gain the best understanding of his points.

When it comes to real objects Harman first notices that Heidegger's most important insight is that our connection with them is based on how we use them. This opposed to theory or perceptions we have of objects which fail to grasp the usefulness of the object. In other words, objects can be present-at-hand, a state in which they are examined to be theorized about, or, more commonly encountered, ready-to-hand, a state in which they are used, and understood, to achieve something without the further requirement of theorization. Harman however claims that although this insight was crucial, the essence of it was lost even on Heidegger himself: for not only on a level of theory and perception we fail to grasp objects, even through practice we cannot truly know the objects that we use. To ground this claim Harman gives the following two examples: A tribesman dwelling with a (hidden) leopard and a prisoner writing a secret (invisible) message in lemon juice. Harman points out that both the tribesman and prisoner, similarly to some inquisitive, theorizing and perceiving, scientist, fail to grasp the 'hidden' reality of the object they encounter in use, i.e. the hiding leopard is hidden from the sight of the tribesmen and the paper hides the message it contains. The scientist would look at the paper concluding it was an empty sheet and the prisoner would write a message with a similar conviction. In short both in perception and in use objects are distorted into what Harman calls a caricature of what they truly are.

Harman then takes a more radical step and extends this re-interpretation to the non-human realm. For, so he claims, not only humans make caricatures out of objects but so do other objects. A dog, for example, will, as he puts it, never come into contact with the full reality of its bone nor will a planet ever come into contact with the full reality of its moon. This means that when objects are ready-to-hand, as in the case of the writing prisoner or the dog gnawing his bone, not merely useful, but withdrawn from other objects. In other words, objects fail to grasp the full reality of other objects they use. Because both human and non-human objects fail to grasp each other's full reality Harman concludes that it not human consciousness but relationality per-se that distorts the reality of objects.

Sadly, Harman does not further elaborate and leaves it to his reader's imagination how other, less obviously hidden, objects cannot be understood by their users, be it

human or non-human users. It should be asked if Harman would come to the same conclusion when a less obvious example would be used to support his arguments. I can answer this question by using the classic Heideggerian example of the hammer and ask if Harman's conclusion that its relationality with its human user distorts its full reality is still valid. Firstly, we note that we cannot examine the hammer as if present-at-hand. After all, following Heidegger, Harman has already concluded that the examined object can never be *fully* understood. This means that features of the hammer that *can* be understood by means of examination and theorizing such as its materiality (what it is made of) and ergonomics (why it is so good at hitting nails) cannot be part of what Harman understands as the withdrawn real object. Something else must be hidden and withdrawn through relationality. Perhaps this something can be identified as the essence of the object. For as the hammer is reduced to a tool to achieve a task in use its hammerness is necessarily hidden to the user. Harman, however, does not explicitly nor implicitly state that real objects possess some necessary essence. yet, the line of argument I have proposed above points to another answer to the question posed as well. More likely is that Harman means that the completeness of any object is necessarily hidden. What I mean with completeness is the full range of aspects that make the hammer a hammer. This includes for example the materiality of the hammer but its usefulness as well. As Harman points out, it is through examination that we lose sight of the usefulness of an object and through use that we lose sight of the materialistic aspect of the object. Or in other words, through any form of relationality objects get distorted into a single or a limited amount of aspects of the full reality of the object. Coming back to real objects themselves we can say that they are objects as they are physically in the world as a whole including all their physical properties and functionalities. This conclusion however also raises another set of questions. Firstly, what is the extend of this completeness of an object? What are exactly the aspects that entail a real object? Secondly, why does Harman insist that real objects are fully withdrawn from each other and not, as per my conclusion partly? And lastly, is it possible to make the step from human centered to object oriented if so many aspects of the completeness of an object are human imposed? Are there such things as object imposed aspects to objects? For now I shall put these question on hold, and elaborate further in the next section where I critique Harman's philosophy more lengthily.

The second form of objects Harman describes are what he dubs sensual objects. Opposed to real object sensual object are never withdrawn. Instead sensual objects are objects in the way that we experience them. We can view some object with any arbitrary emotion or in any context and still perceive it as that actual object. That is, a sensual object is a unification of all these different modes of experience of that object. When looking at the object we of course do not see this unification but we can still say that all these modes are part of the sensual object.

In Harman's words the difference between real and sensual objects is described as follows: *"Whereas real objects withdraw, sensual objects lie directly before us, frosted over with a swirling, superfluous outer shell."* (2013, p.195) where the outer shell refers to the unification of modes I have described in the previous paragraph. This difference between sensual and real objects raises a question that I have so far not touched upon. This is the question of causation. After all, if real objects are withdrawn from each other how can they interact at all. And opposed to this, how is it that sensual objects fail to interact most of the time. That is, how is it that the multitude of sensual objects we experience at any one time do not melt into a single clump. How is it that they are experienced as multiple objects each with a different mode. Harman answers this as follows: real objects interact by means of vicarious causation and sensual objects are somehow buffered in their causation. To understand what this means it is first necessary to describe how real and sensual objects interact.

Having identified the building blocks of reality a real and sensual objects Harman's next step is to fit them together in what he calls a jigsaw puzzle. This jigsaw puzzle must be able to take into account the nature of real and sensual objects but also fit the pieces in such a way that it is true to what the world is. Harman's first step is to describe how real and sensual object interact with each other. He does this by reiterating Husserl's paradox of intention. He explains that two things happen when we encounter some object. Firstly, we are unified with the object through our intention, however, secondly, we are also clearly distinct from the object in the sense that we do not melt into one. As such through the intentional relationship the distinct object and observer come to inhabit the same shared and newly formed object of intentional space. Harman thus sees the observer, the object and the combined intentional space as three separate objects:

"…my encounter with a pine tree is a unified relation; we can speak of the encounter as a whole… But in another sense, I clearly do not fuse with the tree in a single massive lump; it remains distinct from me in the perception. This gives the strange result that in my intention of the tree, we both inhabit the interior of the total intentional relation." (2013, p.197)

Harman then points out that this symbiosis is in fact asymmetrical. This statement becomes more clear by identifying the three objects as either real or sensual objects. Firstly, the intentional observer, is a real object that actually exist. The observed object is a sensual object. That is not to say that there is no real object 'coinciding' with the sensual object, however the object that the intentional observer is engaged with can only be sensual seeing how the real object is necessarily withdrawn from the real observer. Lastly the intentional space is a real object, for the intention exist independent from anything outside of it. This classification shows the asymmetry between real and sensual objects for real objects can only interact with sensual objects, thereby forming a third real object.

With this classification, we can come back to the question of causality: or, how do real objects interact with other real objects and similarly how do sensual objects interact with other sensual objects? The first part of this question has partly been answered in the previous paragraph. However, what is crucial to note is that although real objects are withdrawn from each other, a connection between the two must still exist. After all, when I pick up a ball, I pick up a real object, not a set of free floating qualia. Thus, my connection with the real object ball occurs by means of the sensual object ball. Similarly, sensual objects can only interact through the intention of a real object. When the ball is engulfed by a thick mist, the real observer sees a shady ball. The sensual object mist carries some of its properties to the sensual object ball. However, this happens only to a degree, the ball is still recognizable as ball and the mist as mist. Thusly, Harman concludes: *"Contiguity between sensual objects is impossible without a real intentional agent, and connection between real ones does not occur except by means of a sensual intermediary."* (2013, p220.)

At this point it should be asked if Harman as inadvertently dug an idealistic grave for his theory. After all, what I have described thus far are real objects with intentionality towards sensual objects. It seems that some sort of consciousness is at work here eerily similar to what we would generally strictly reserve as part of the human realm. If this were the case it would be difficult to defend a realist Harman. Harman however points out that he wants to think of intentionality in a more rudimentary form, namely the contact between real and sensual objects. He calls this contact sincerity. The question to be answered then is if some non-human real object encounters other objects as sensual ones. Naturally Harman answers this question with a yes. His reasoning to support this answer is however less convincing than the short answer would imply. Harman states that because real objects cannot interact directly with each other and because real object never encounter "free floating sensual qualities" the only possible option left is that real objects always come into contact with sensual objects.

Concluding, Harman's philosophies entail the following: Real objects are always withdrawn from each other while sensual objects are always there, in plain sight. Interaction between real objects can only occur by means of a sensual object intermediary and, vice versa, interaction between sensual objects can only occur through the intention of a real object. This ontology goes beyond the human realm and describes the interactions between non-human objects as well: *"The separation of a thing from its quality is no longer a local phenomenon of human experience, but instead is the root of all relations between real objects, including causal relations."* (2013, p. 221*)*

3.3 Critique on Harman

Criticizing Harman's object oriented philosophy can be done on two different levels. Firstly, I shall criticize his philosophy on a theoretical, more general level. In the previous section I have already mentioned some initial critiques on Harman on which I shall now elaborate further. Secondly, in the next chapter, I shall criticize Harman from the point of view of the magic leap. By placing this technology and specifically augmented reality within Harman's framework I shall show how this framework is unsustainable.
Before going more in-depth I want to note that although, as described above, Harman is clear on the types of realist philosophy he does not want to adhere to, it can be hard to

see why he is so focused on realism as the main point of departure in ontological thinking. A strong defense of realism *an sich* would help solidify his claims beforehand, yet at times, when it comes to realism, his writing feels almost dogmatic lacking argumentative substance. When Harman places his philosophies in an ontological framework he writes: *"this article rejects any privilege of human access to the world, and puts the affairs of human consciousness on exactly the same footing as the duel between canaries, microbes, earthquakes, atoms, and tar…".* (Harman, 2013, p. 189) and more specifically focused on objects he defines them as follows: *"By 'objects' I mean unified entities with specific qualities that are autonomous from us and from each other."* (2011, p.22) It could be argued that Harman speaks to us on a more intuitive level relating his philosophies to how we experience the world first hand. However, by forgoing critiques that can be made against commons sense realism such as Ayer's argument from illusion such an appeal to intuition is rather weak.

My first point of critique on Harman's philosophy harkens back to a strawman argument that can be made against realism in general. This argument questions the validity of theories that cannot possibly be verified from a human point of view, and is indeed similar to the counter argument I have raised against Ayer above. When any (ontological) truth about reality is assumed to be independent of human opinion, belief and capacities this reality must necessarily be able to exist without human presence in the first place. Yet because of this anti-anthropocentric foundation verifying such theories is in fact impossible. In other words, does a falling tree make sound when no one is there to listen? Although I do not want to simply dismiss Harman's realism, it is still important to recognize that even he cannot fully escape the necessity of the human being in ontology as a whole. As I have pointed out above, at times Harman's focus on a realist ontology can feel more dogmatic than well argued. Harman clearly has a hard time defending the step from the withdrawing of real objects from human perception to the withdrawing of real objects from each other. Although this step is of vital importance in his theory, Harman whishes us to simply accept that it is not human consciousness that distorts the reality of things but relationality per se by proposing a set of seemingly arbitrary non-human relationships: *"Dogs do not make contact with the full reality of bones, and neither do locusts with cornstalks, viruses with cells, rocks with windows, nor planets with moons."* (p.193) In Harman's defense it should be stated that these examples indeed show how the

full reality of objects withdraws in the relationality described: i.e., a bone gets reduced to a plaything, a rock to something hard and heavy and a virus to something deadly. Still, Harman never answers the question what the extent of the full reality of real objects is.
Even if we accept that the human and non-human are indeed similar on an ontological level we can still question the internal consistency of Harman's theory. My second and main critique of Harman revolves around the complete withdrawing of real objects. This is one of the most important points for Harman seeing how he continually comes back to this 'given' to support further elaborations. Especially his defense of the interaction between real and sensual objects is based on a contraposition that only holds if real objects are in fact fully withdrawn. That is, if real objects are somehow, somewhere, in fact able to interact without sensual objects as intermediary Harman's theory is easily disproved from the ground up. Oddly enough Harman provides this counter himself:

> *"The tribesman who dwells with the godlike leopard, or the prisoner who writes secret messages in lemon juice, are no closer to the dark reality of these objects than the scientist who gazes at them. If perception and theory both objectify entities, reducing them to one-sided caricatures of their thundering depths, the same is true of practical manipulation." (2013, p.193)*

They key here is that Harman states that objects are reduced to *one-sided* caricatures instead of being fully withdrawn from each other. Imagining a hammer striking a nail the difference between one-sidedness and full withdrawal becomes more clear. The hammer, on impact, merely encounters the nail as a hard object that can partly withstand its blow, while other such features such as its ability to fasten, its sharpness and its materiality are withdrawn. Still, the hammer did in fact encounter *a part* of the full reality of the nail. Even though Harman is right in calling this single feature of the nail a caricature of the nail, it is a feature nonetheless. This indicates that Harman is perhaps too hasty in his conclusion that all real objects ae fully withdrawn from each other which in turn invalidates his later lines of reasoning. It could be argued that this critique is no more than a semantical trick that needlessly splits one-sidedness and caricature into two different statements pertaining real objects. Perhaps Harman uses this description as a stylistic tautology to strengthen the image he is trying to sketch. Harman may not think of real objects as a collection of attributes but instead as a necessary whole. If this where

to be the case highlighting a single part of this whole would indeed force the whole to withdraw from perception. Still, even if Harman never intended for real objects to be redefinable into a sum of their parts it is still important to stress that he fails to argue either pro or con such important distinctions. As such my critique stands.

In summary, both these critiques boil down to the fact that Harman chooses to focus on the relationality between objects rather than the objects themselves. In doing so Harman makes the important and striking points that 1) relationality is not something necessarily human centered and that 2) in relation with other objects the true reality of objects withdraws. However, by forgoing a more indebt description of objects, be it sensual or real ones, in themselves Harman leaves a lot of his work up the imagination and willingness to accept of his readers.

3.4 Rorty's relativist pragmatism

Richard Rorty was an American philosopher that advocated relativist pragmatism. In relativist pragmatism description, and language in general are used as tools rather than as something conveying truth. This distinction becomes more clear when placing pragmatism opposite representationalism. Where a representationalist would argue that although we experience the world through some intermediary; by means of interpretation, it is still possible to attach a truth value to this interpretation. That is, some descriptions of reality are more adequate than others. The pragmatist on the other hand would argue that such descriptions must not be seen as truthful or false but, rather, are evaluated as tools. In this view a description or belief is useful in a specific situation without necessarily wanting to make claims about what the situation is in itself. Rorty's especially places emphasis on the notion of truth: in *'The contingency of language'* (1986) he describes how some two hundred years ago the notion began to take hold that truth was made rather than found. This idea was a result of both the French Revolution which showed that social relations and institutions could be replaced in a relatively short amount of time and of romantic poets who came to think of their works as self-expression rather than imitation. In contemporary times this idea concerning truth has evoked a split in philosophy. One the one hand there are those philosophers adhering to the idea of science as an objective truth-finding activity, and on the other, those that think of science as yet another human

activity. An activity that, alongside art and politics, finds descriptions that achieve a certain goal but do not necessarily represent the world in itself. The first step towards the existence of the ideas of the second kind of philosopher was made by the German idealists such as Kant and Hegel. They renounced the natural science as truth finding and instead thought of the world as if constructed by the mind. Rorty however finds this first step unsatisfactory, for even though it denounced the idea of an actual world out there it still held fast to the idea that the shaping mind was something to be discovered rather than made. Instead what is needed is a philosophy that does away with the idea that anything has an intrinsic nature that can be discovered. According to Rorty, the notion of a world out there to be discovered is wrongfully seen synonymous with the idea that the truth is out there. For, so he argues, saying that the world I out there means to say that there exists a world independent of human thought, saying that truth is out there simply means we point out there are sentences which contain truth. These sentences are however part of language which is in turn merely human creation. As such, truth out-there cannot be seen as coinciding with a world out-there. In other words, descriptions of the world can be either true or false but the world itself cannot. This false conviction mainly follows from the habit to split up language and the world in sentences and facts. When, for example, we utter the sentence "this apple is red" and the apple which we describe is indeed red it seems natural to believe that this small factual part of the world, or the red apple, contains truth and consequently made our believes true. However, Rorty then shows that when we look at vocabularies as a whole we soon discover that this conclusion is not as straightforward as it initially might seem to be. When imagining two opposing vocabularies that aim to describe something similar, say Newtonian and Aristotelian physics, it is hard to imagine that the world 'choses' which of these vocabularies is true. Instead one of the vocabularies is more useful when describing a certain part of the world (in this case Newtonian physics describe the world more easily than Aristotelean). Rorty thus concludes that criteria (based on an objective world or subjective user) and choice play no role in which language is used, instead language gradually changes over time. This taken together with the points that both the world and the self have no discoverable intrinsic nature Rorty amasses the following: *"…Changing languages and social practices may produce human beings of a sort that had never before existed".* (1986, p.7)

Expanding upon the above Rorty continues by reiterating Davidson's arguments concerning the fact that language cannot be seen as a medium. When language *is* seen as a medium it means it stands between some object-subject dichotomy. On one side, there is some essential I that has desires and on the other side there is some external world about which we hold believes. Desires can be criticized when they do not cohere with the essential nature of the human being holding them and believes can be criticized when they do not correspond with reality. The role of language then is to either express those believes or represent reality. However, by doing away with this view on language, and thus doing away with the believe that there is some intrinsic self and world out there, so Rorty and Davidson argue, we can also do away with such eternal strives as waged between for example realism and idealism in which it is merely debated if language provides an adequate, or truthful, description of, in this case, the nature of reality. Instead, by looking at language as a tool we can do away with questions concerning the adequacy of certain descriptions and ask if *"…our use of these words get in the way of our use of those other words?"* (1986, p.12) This question shows how different vocabularies can and will make place for new ones over time.

To make more clear why language must be seen as a tool instead of as a descriptive medium Rorty describes Davidson's thought experiment "a passing theory". In this thought experiment some human being hears and sees the sounds and utterances made by some other human being. Both must guess and theorize about what kind of behavior will follow or predate certain utterances and continually adapt their (passing) theories based on newly introduced sounds or patterns of behavior. Ultimately, when communication succeeds it is because both parties can successfully predict each other's actions based on the utterances made. In other words, the language used by these two human beings is not something that needs a world world out there or an intrinsic part of the self, or refers to some truth value, but instead is something that is used as a tool to achieve a task. Language succeeds when two human being's passing theory converges, not when it refers to some truth. Note as well that Davidson's passing theory does not require a pre-given vocabulary or even the notion of language an-sich. It merely requires the will to communicate.

The conclusion to the view on the nature of language as proposed by Rorty naturally leads into the question what this means for both the nature of the human being that makes this language and the world, or reality, in which it lives. As stated above, Rorty sees the human being as the creator of language and the language it uses as coshaper of the human being. Seeing how no language is 'enforced' by some individual but rather by a collective, it is society at large that shapes the human being into what it is. The second, ontological, part of the question is in an area that Rorty wishes to avoid altogether. Because nothing can be said about (true) nature of reality in the first place, for Rorty questions regarding opposing frameworks such as realism and idealism are nonsensical and trivial:

> *"…if we can come to see both the coherence and correspondence theories of noncompeting trivialities, then we may finally move beyond realism and idealism and to the point at which, in Wittgenstein's words, we are capable of stopping doing philosophy when we want to."* (Rorty, 1972, p.665):

In conclusion, Rorty defends a view that denounces questions concerning the true nature of the world and the human being and instead focusses on language as a tool to be used, and replaced when the need arises for a more fitting tool. Language as a product of human society shapes the human beings in that society. Such shaping isn't necessarily a conscious act or choice but rather gradually takes place over time when the need for a more fitting language/tool arises:

> *"…we will not imagine that there are enduring constraints on what can count as knowledge, since we will see justification" as a social phenomenon rather than a transaction between "the knowing subject" and "reality." If we have a Wittgensteinian notion of language as tool rather than mirror, we will not look for necessary conditions of the possibility of linguistic representation.* (Rorty, 1979, p. 9)

On a final note, I would like to add that Rorty uses his pragmatist philosophy to make suggestion towards the rethinking of vocabularies in varying fields that range from politics and ethics to simple everyday interaction. Based on the notions of language as an

adapting tool and the redundancy of truth such suggestions often times boil down to a call for respect and tolerance among users of competing tools and the need to shift our attention to alternate more adequate frameworks instead of the insistent reinterpretation and reiteration of truth claiming frameworks. Although from a personal perspective I find such suggestions strikingly on point I shall refrain from going into more detail seeing how the focus of this thesis is on ontology. With this in mind, the overview I have sketched above will suffice.

3.5 Critique on Rorty

Similar to the critiques I have made on Harman's Object oriented philosophy shall I split my critiques on Rorty in two parts. In this first part I shall give a general critique and in the following chapter I shall use this to judge the sustainability of Rorty's philosophy from in the light of the MagicLeap. My critique on Rorty's relativist pragmatism is twofold. The first of these is not only a critique on Rorty, but serves to defend my use of Rorty as an ontological writer as well. After all, Rorty fervently condemns any such questions that inquire into the nature of a reality in itself. This raises the question if Rorty can be criticized from an ontological point of view if he places his philosophies outside of conventional philosophy. Firstly, even though Rorty claims that his pragmatism does away with truth claims concerning the world and the human being in themselves it is important to note that Rorty does not reject the existence of said world or human being. As shown above Rorty even claims when a language is used as a moldable tool, the wielder of that tool is just as moldable. This means that by rejecting ontological truth claims and describing the language and the human beings that uses it as changing according to social movement Rorty inadvertently creates a paradox. On the one hand there is the word which defies description and on the other the claim that that is what the world does. A similar argument can be brought forth focusing solely on Rorty's vehicle of choice: language. Giladi, following Peirce, argues for the indispensability of metaphysics (Galidi, 2009). In this view language is inherently imbedded with metaphysical concepts and as such handling language means you concern yourself with metaphysics. Rorty would only be able to achieve a philosophy of non-ontology by accepting some kind of pre-metaphysical language. Or a language that is outside of the human realm; some perfect conceptual language. Of course, this is exactly the way Rorty would not want to think

about language. In short, Rorty cannot escape the ontological consequences of the claims he makes. Rorty counters this by stating that his philosophy does not want to suggest that it is right. It does not try to make any truth claims what so ever and that: *"…our purposes would be served best by ceasing to see truth as a deep matter, as a topic of philosophical onterest, or 'true; as a term which repays 'analysis'"* (1986, p8). In other words, Rorty is of the opinion that because he showed that there is no intrinsic nature to be examined in the first place, asking after this nature is a void quest. However, yet again, in his denial of the value of ontological enquiry lies the affirmation that ontology is a topic of interest. Simply closing one's eyes in the face of peril will not make the problem go away.

The second point of critique in wish to raise against Rorty's relativist pragmatism is that it seems to denounce the importance of the individual. Rorty uses vast movements in society to describe the disparity between world and language, yet what happens when we look at ourselves as autonomous beings? Following Rorty it seems that any input by the individual is always overshadowed by the consensus of the group.

> *"A plurality of metaphors thrives and in doing so upsets the settled, the canonical, the convergent consensus, keeping the conversation going. Rorty contends that it is the bruising competition among rival frameworks, including his own, that will result in a shakeout of the best framework fit for the times, around which will form a solidarity (albeit, contingently) of similarly-minded individuals."* (Grippe, 2017)

Even though the individual may have some initial input into the system what is left is always a group of temporary likeminded people. This would imply that outside of the times of competing frameworks, in times of consensus, there is no room for competition of frameworks. Do we simply drown in a muddle of societal change over which we have no control? For now I wish to leave this argument at an intuitive level, but in the next chapter I shall show how the MagicLeap forces us to rethink these notions.

4. Sustainability of ontological frameworks

In this chapter I shall combine the definition posed for augmented reality: '*An indiscernible virtual addition to physical reality to make it greater'* and the results concerning the ontological frameworks by Harman and Rorty as described in chapter 3 to answer the main question of this thesis: "*Are the modern ontological frameworks relativist pragmatism and object oriented philosophy still sustainable when considering modern reality augmenting head displays and specifically the Magic Leap?".*

However, before getting into the thick of things there is one more issue in need to address which concerns the ontological status of virtual objects. Explicating this status further will ground the discussion to follow in this and the next chapter. So far I have indicated that the physical and the virtual are indiscernible in a perfect augmented reality and have rather quickly done away with any attempts to describe or classify augmented reality by seeing it as a sum of it parts. I have done so because in my definition for augmented reality I wanted to make specifically clear that the physical and virtual must necessarily be seen as indiscernible. However, in doing so I have also problematized the value of the question why augmented reality introduces an ontological problem in existing frameworks in the first place. After all, if they are indiscernible why do we have a problem in the first place? Indiscernible does however not imply (ontological) evenness. In other words, by taking a step back and describing the difference between virtual and physical objects I shall show that augmented reality indeed gives rise to ontological issues.

Intuitively speaking a physical object is something we encounter and can interact with in the real out-there world. A more eloquent way of putting this is described in the spatial location account (Markosian, 2000) which states that:

> *"Objects from all of the different ontological categories – physical objects; non-physical objects like souls, if there are any; propositions; universals; etc. – have this much in common: they all exist in time. But not all of them exist in space. The ones that exist in time and space, i.e., the ones that have spatial locations, are the ones that count as physical objects."* (2000, p.1)

Markosian thus distinguishes between objects that exist in time and objects that exist in space and only the ones that exist in space can be classified ontologically as physical objects. However, as I have stated in chapter 2, exactly because the physical and virtual are indiscernible in augmented reality we can only temporally distinguish between the two as both the physical and virtual appear to exist in space. This rather straightforward description of physical objects cannot immediately explain the difference between the physical and the virtually added.

However, I can add to this definition by examining what we expect of physical objects that exist in space. First, we expect not just existence in space but rather a *continued* persistence. Physical objects do not simply disappear or change form at 'will'. Second, physical objects are experienced collectively, they are experienced by everyone at the same place and time. Thirdly, physical objects have a predictable physicality, they can be molded and touched, but at the same time resist this interaction, i.e. a copper plate can be pressed into a coin, but a copper plate cannot be pressed into an apple. Clearly, for each of the conditions above some fringe cases can be brought up that disprove our right to have such expectations of physical objects, a cup of boiling water will evaporate until 'nothing' is left, some optical illusion may appear differently to observers standing in different angles and a statue of ice will eventually melt into water. However, even though these fringe cases do not directly support our initial expectations of the physical they also do not decohere with them. All the examples above can (with some effort) be systematically predicted, for example mathematically, and as such still adhere to the expectations we have of them. In short, physical objects have a predictable presence in space.

Added virtual objects on the other hand do not simply abide to these expectations. They can be molded at will (within limitations set by programmers), they can be done away with by turning of the head mounted display and are not a shared experience. That is not to say that these limitations cannot be overcome in some future augmented reality experience, but it shows that, at least for now, we cannot have the same expectations of virtual additions that we have of physical objects. As such it can be concluded that exactly because they are indiscernible from the physical yet cannot be expected to

behave/exist in the same way virtual additions in augmented reality must be seen as ontologically distinct.

The point could be raised that it would simply suffice to classify virtual additions in augmented reality as virtual objects. Yet, this would do them no just. After all, virtual objects persist in virtual space, we can interact with them through a physical computer screen or physical virtual reality device but their presence always remain purely virtual. Even institutional entities such as digitized money are merely representations of something physical, e.g. work, gold, shells, and can, as such, be seen as extensions of the physical or as expressions of the physical, but never as occupying the physical realm. Virtual additions in augmented reality on the other hand share their space of existence with the physical, they are indiscernible yet ontologically distinct from each other. As such I can conclude that virtual additions are as distinct from pure virtual objects as they are from pure physical objects.

4.1 Sustainability of OOP considering the MagicLeap

To start of, I shall look at Harman's theory from the light of the magic leap and augmented reality. In doing so I shall take object oriented philosophy at face value, for now forgoing the criticisms I have made in chapter 3. What this means is that Harman must be able to account for augmented reality as is.

My first point of critique is a rather straightforward one and states that per definition augmented reality is a business solely reserved for the human being. Per definition augmented reality cannot exist outside of human perception. After all, augmented reality only exists as a product of the interplay MagicLeap's Lightfield technology and the human wearer. Harman's object oriented philosophy takes objects as a starting point thereby denying that human beings are the sole proprietors of reality. However, we can see that augmented reality is always in the human realm and cannot exist in the non human realm. To exemplify this, imagine a rock, or any non-human object for that matter, 'wearing' the MagicLeap, interaction between the augmented and the rock cannot exist. What is more, the MagicLeap is a technology that caters *only* towards its human wearer; it is designed in such a way that, within the limitations as

postulated in chapter 2, indiscernibility is established with the human senses and mind in mind. Perhaps the conclusions drawn above stem from the fact that I have looked solely at the MagicLeap and augmented reality as a product of the MagicLeap. It is imaginable that some, non MagicLeap produced, augmented reality exists that is not human centered. In other words, in such an augmented reality non-human objects would be able to interact in some way or another with the indiscernible addition to the physical. The straightforward argument based on a human centered technology I have made above will not work in this case. So instead I shall look at the classification of objects and their interplay Harman describes in his object oriented philosophy.

First, it must be questioned if I can simply handle the same definition for augmented reality as I have up till now, after all this definition is formed with the MagicLeap and modern reality augmenting head displays in mind. Perhaps indiscernibility would be of less concern in such a non-human centered augmented reality seeing how this is mostly a product of human perception in the first place. What we can however hold on to is the digital addition to the physical to make it greater.

With this in mind we must thus try to classify objects in augmented reality as either real objects or as sensual objects. When we do not concern ourselves with indiscernibility we can say that for the initially existing physical objects nothing changes. Real objects are still withdrawn and sensual objects still are in plain sight. However, when we shift focus to the digital additions to the physical Harman's philosophy can be problematized: first, if the digital addition is classified as a sensual object it means some real object must be withdrawn behind. After all, in Harman's philosophy there are no such things as free floating qualities that stand disconnected from something real. But that is in fact what real objects would encounter. The digital addition has no real part which is withdrawn from interaction, and as such no other real objects can interact with it using the digital sensual object as intermediary. Second, if we look at the digital addition as a real object we run into a different problem altogether. Per Harman real objects are necessarily fully withdrawn. However, for these digital additions the exact opposite is the case. After all they are constructs (made by some reality augmenting device) that can be examined and altered at will by the mere push of some (presumably) buttons. That is, there is no completeness that constitutes the object as a real object.

Concluding, augmented reality cannot be categorized as either having a real or sensual part, indicating that Harman's taxonomy is either incomplete or wrong.

If we now take one step back and try to fit human centered indiscernibility back into the picture, we are left with an even more complicated question. For if we imagine that Harman's taxonomy can be saved by the simple addition of digital objects, next to sensual and real ones, we create a knot in which the asymmetric relationality between real and sensual objects becomes un-unravelable. After all we are left with a reality in which a real observer interacts with both actual sensual objects (the physical objects) and digital objects that only seem to be sensual objects (the indiscernible digital additions) but in actuality cannot be categorized as such. Based on the above, I think it fair to conclude that Harman's objects oriented philosophy cannot be sustained in the light of the MagicLeap, or even augmented reality in itself.

In Harman's defense let me consider the following: digital additions are but the sensual crust of their coded real object counterpart. What we encounter through the MagicLeap as augmented reality are always sensual objects, sometimes with a real in-the-world object counterpart and sometimes with a stored-on-a-disk real object counterpart. At first glance this seems to be a fair solution and would allow Harman to include augmented reality in his object oriented philosophy. Looking at augmented reality in this way will also allow it to persist apart from the human mind. Yet, the same problem arises that I have described earlier: code is malleable, it is never withdrawn. Because the code is literally accessible it cannot be classified as a real object. In the end, we are still stuck with the conclusion that digital additions must be seen as merely free floating qualities. Qualities that are similar in appearance to sensual objects, but in nature must be classified differently.

Concluding I want to reiterate the following two observations: first, augmented reality I is a reality that is by definition only accessible by the human being. Second, even if we allow for an augmented reality accessible by non-human beings digital additions to physical reality cannot be classified as either sensual or real objects. As such in answer to my main question I can conclude that MagicLeap and its augmented reality cannot be accounted for in Harman's object oriented philosophy. To be able to account for

augmented reality Harman needs an extended taxonomy of objects including their mutual relationships.

4.2 Sustainability of pragmatism considering the Magicleap

At first glance it might seem difficult to use Rorty, a writer who is so strongly outspoken against metaphysical debate, in an ontological account of the MagicLeap and augmented reality. In the previous chapter I have however already shown that even Rorty cannot fully distantiate himself from metaphysics. As such is it fair to question Rorty from the light of the MagicLeap, a device that will introduce a wholly new form of reality. However simultaneously, a direct ontological enquiry into Rorty's relativist pragmatism is difficult seeing how he very carefully avoids making any truth claims concerning his own framework: "*The difficulty faced… is to avoid hinting that this suggestion gets something right, that my sort of philosophy corresponds to the way things really are*" (1986, pp.7-8) as such I will opt in the following to not question right or wrongness of Rorty's relativist pragmatism an-sich but instead will place the MagicLeap in light of its consequences.

In chapter 3 I have already formed the start of an intuitive argument against Rorty's relativist pragmatism from the point of view of the individual. To reiterate, in Rorty's view language and the human being using and producing that language exist in a relationship in which language is used as a tool and the human being coheres with the shape of that tool. Seeing how Rorty mainly concerns himself with large societal movements often instigated by a select few (Grippe, 2017) it is easy to lose track of the role of the common individual in that society. It is not my aim to accuse Rorty of collectivism or elitism in any way, yet Rorty's focus forces me to point out the following: the MagicLeap allows the individual user to form her own reality by means of the technology. No longer is she in need of overarching societal powers to form a vocabulary that serves as the tool to serve her goals. Instead we are faced with a society in which each individual can form her own vocabulary/tools and thereby shape herself and her reality. A shaping that is wholly based on individual choice opposed to Rorty's view of gradual change through collective need.

I must however concede to Rorty that truth claims concerning reality are arbitrary when we consider the MagicLeap and augmented reality. Perhaps we can call augmented reality the embodiment of Rorty's relativist pragmatism when it comes to showing that we express ourselves to achieve goals rather than to make truth claims. After all, by making indiscernible digital additions to physical reality we wholly do away with the idea that said reality can be truthfully understood. Instead we thinker with it, force it into a desired shape and leave it up to the senses to make sense of it all. In this process, we leave in the dust any desire to understand what we started off with. By molding our realities though the MagicLeap we allow ourselves to stop questioning what we started with and instead focus on how the product will best serve our needs. Perhaps to some this admission sounds out of place in a thesis that has thus far tried to say something meaningful concerning augmented reality, but I do not think that admitting that a focus on the tool-like nature of our language will allow for strides forward necessarily decoheres with a quest to understand the nature of what we form. Again, not even Rorty can fully distantiate himself from metaphysics as it an inherent part of the language we use.

To answer my main question, I can conclude the following: the consequences of Rorty's relativist pragmatism can be partially sustained in light of the MagicLeap. On the one hand, Rorty shows how a shift away from a truth debate concerning the nature of reality allows for a focus on change towards better suited vocabularies. On the other hand, Rorty falls short in only allowing this change to happen through grand societal movements while the MagicLeap shows that individual shaping will garner greater precedence than ever.

5. Reflection on results

The conclusions I have drawn in the previous chapter all point towards the general conclusion that both Rorty and Harman cannot fully account for the MagicLeap and augmented reality. In having shown this I have however not presented a framework or ontological point of view that can fully account for augmented reality. Such a framework should be able to account for physical reality, digital additions to that reality and the indiscernibility of those two combined. Perhaps it is too much to ask of any one framework to account for all these factors and form some theory akin the grand unification theory in physics. Especially when considering that the frameworks I have discussed each have problems in their own rights it perhaps seems farfetched to hope for some such theory to exist. Still some initial steps can always be made and in this chapter I shall provide a foundation for possible future research into the ontology of augmented reality.

Both Harman and Rorty provide us with valuable insights into the nature of augmented reality, their vastly different points of departure and methodology help in constructing a view on augmented reality that together with the definition I have given for it in chapter 2: '*An indiscernible virtual addition to physical reality to make it greater*' may be able to provide a basis for future discourse on augmented reality. First, even though Harman's philosophy is lacking in providing a full taxonomy of possible objects it does provide an invaluable insight into the nature of augmented reality: where an intuitive approach, as I have taken in chapter 2, to the indiscernibility of augmented reality and pre-augmented physical reality may lead to the conclusion that, excepting temporal differences, no sensible conclusions can be drawn about the difference between the two, taking into account Harman's philosophy will instead allow us to differentiate. Although Harman does not help us with a theoretical account of the digital addition he does show that it is fundamentally different from both sensual and real objects. Augmented reality is a reality created by and for humans and is fundamentally different from anything pre-augmented. Second, Rorty shows that the possibilities in augmented reality affirm his conclusions that language must be used as a tool to continuously search for more fitting frameworks. The MagicLeap will be able to provide the possibility for individuals to form their own vocabularies and as such shape their reality and themselves.

In short, what is needed is an ontology that can continuously account for an ever-changing reality. A reality that is not bound to some unchanging essential nature of either itself or the human beings inhabiting it but allows for adaptivity. At the same time said reality contains both physical and virtual components that are indistinguishable to the human senses and ontologically distinct. An intuitive way to think of such a framework is by calling it a description of a fluid reality. This fluid reality is adaptive and flows around the forces we exert on it (by means of the MagicLeap) yet still consist of some fluid substance. That is to say, even though this fluid reality is continuously in a different state it still consists of something that we can study and describe. To be sure, this something does not necessarily refer to an essential nature of said reality. After all we can freely interchange one fluid with the next (i.e. change one form of augmented reality for the next) and still speak of an indistinguishable virtual addition to physical reality to make it greater.

To put this into context, coming back to the nature of physical, virtual and virtual additions I have described in chapter 4, we can see that the ontological foundation I propose is not so much concerned with the nature of physical or virtual objects but instead mainly focuses on virtual additions and their role in our perception of reality. That is to say, the framework I propose does not wish to make a truth claim about the nature of virtual additions or the nature of physical objects that indiscernible stand beside them but instead claims that what they are to us, how they are placed in reality, how we perceive them as part of our reality is ever changing by means of the MagicLeap. What is more, because the physical and virtual will (to a degree) become indiscernible we should let go of the notion that ontologically categorizing objects is a way to explain our reality. Any attempt at such categorization will always lead to an account, as I have made in chapter 4, that describes the physical versus the virtually added and then concludes that they are ontologically distinct, yet, our experience of them tells us otherwise. No longer should we fall back to pre-conceived nations of physical, such as persistence and physicality, and attach a truth-claim to this on which we base our worldview. Instead we should base our view on the world on what it means to us, what it contains. In short, we should not focus on what it is, but on how it is. And this how is malleable and at our fingertips through augmented reality.

On a final side note it is worth mentioning that Abovitz' dreamlike ponderings on the possibilities of the MagicLeap: "*By following as closely as possible the rules of nature and biology, we can deliver what is truly* next" (Abovitz, 2016), still presumes some naturalistic essential qualities in the human being. For him this essentiality is however required to produce a working technology. Still this indicates that for now even essentiality is an allowable point of view of 'the how' if it is used in a tool-like fashion.

Concluding, with the stipulated above as the foundation for some future ontology of augmented reality we can see that said ontology will, although in part informed by the conclusion that the ontological 'what' of digital additions is different from the 'what' of physical objects, will focus on the how of our reality. In this fluid reality, we can, within the bounds of the technologically possible, freely shape the contents of said reality and base and shape our worldview in line with those ever changing contents.

6. Conclusions

In this thesis, I have set out the answer the following main question:
Are the modern ontological frameworks relativist pragmatism and object oriented philosophy still sustainable when taking into account modern reality augmenting head displays and specifically the Magic Leap?
This question finds its relevance in the fact that academic discourse surrounding ontology and augmented reality is limited to say the least. I have set out to answer the question by first giving a definition for augmented reality after which I have described and criticized Harman's object oriented philosophy and Rorty's relativist pragmatism. After which I have combined these results to answer my main question. Finally, I have formed some very rudimentary foundations based on this answer to inform future ontological frameworks that regards augmented reality.

Based on an analysis of the virtual, examples of rudimentary and envisioned reality augmenting technologies, and an analysis of the MagicLeap I have defined Augmented reality as:
An indiscernible virtual addition to physical reality to make it greater
Meaning that the virtual and physical cannot be told apart in a perfect augmented reality.

I have shown that Harman can be criticized by questioning his rather dogmatic approach to realism and by showing that real objects cannot always be seen as fully withdrawn. In light of the MagicLeap I have argued that Harman's taxonomy of objects which described sensual and real objects is at the least incomplete. This because digital additions in augmented reality cannot be classified as either sensual or real objects.

I have shown that Rorty can be criticized on his fundamental stance against metaphysical debate concerning the true nature/essence of reality. I have also argued that Rorty's insistence on change through overarching societal movements or the whims of a select view cannot be defended when taking into account he MagicLeap's ability to provide its user with the tools to continuously change and adapt their reality towards their personal needs.

With these answers to my main question I have argued for an ontological framework that will be able to describe augmented reality. This framework should allow for an ever-changing fluid reality, as constituted through reality augmenting devices such as the MagicLeap, that has no essence but can still be questioned and examined from case to case by virtue of it containing, albeit indiscernible, physical and virtual parts. This framework is however less concerned with the question of what objects are in reality and more of how they are in reality.

The ontological backgrounds I have described and criticized are clearly limited and doubtfully representative of the whole field of ontology. That is to say, other ontological frameworks might exist that will be able to account for the MagicLeap and augmented reality as such eradicating the need for the rudimentary foundation I have described in chapter 5. However, even though the philosophies by Harman and Rorty can be seen as extremes, or outliers, in respectively the fields of realism and pragmatism, it is fair to say that the main line of argument I have presented will hold equally well in more moderate versions of realism and pragmatism. As such, a different candidate would have to be found in a wholly different branch of ontology.

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