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Extended Reality and Abstract Objects: A pragmalinguistic approach

Abstract: In this paper I carry out a grammatical clarification of the main concepts and expressions commonly used when dealing with "Augmented Reality". I specifically focus on resolving ontological puzzles concerning the nature of entities produced by new technologies. I offer an analysis of the grammar of the terms "virtual", "reality", "extension" and "augmentation", and I compare Augmented Reality with other problematic domains of language (universals, fiction, mathematics and social phenomena). I conclude that: (i) Augmented Reality is constructed via linguistic procedures; (ii) entities within the realm of Augmented Reality belong to the family of abstract entities; and (iii) Augmented Reality is the ever-evolving culmination of a process that humans started when we created language and have continued to develop through science, engineering, art and other instruments that empower us both to expand reality through the inclusion of new kinds of objects, and to extend our epistemic and existential access to reality.

Keywords: Augmented Reality, extended reality, virtual, abstract, pragmalinguistic.

1. Introduction[1]

The 1980 South African movie *The Gods Must be Crazy* begins with an empty bottle of Coca-Cola being found by members of a *IKung* tribe in the Kalahari Dessert. Most of the film shows the efforts of members of the tribe, living in a pretechnological culture, to give meaning to (and find a use for) the completely alien object. I firmly believe that one of the main tasks of philosophers is to assist their fellow citizens in understanding such "completely new" objects or phenomena that invade our daily lives once in a while. I can find no better example of a puzzling alien phenomenon these days than the family of novelties that go

under the name of "Augmented Reality". This is not least because I believe that whenever we come across the next generation of gadgets, applications or video games for the first time, we feel the very same astonishment and confusion that the members of the San tribe felt. Even the expression itself, which is no new-comer to the realm of words (it seems it was used for the first time in 1992, by a pair of Boeing technicians when they were designing tools to assist in manu-facturing processes), has *prima facie* a suspicious feel to it. To our ears and minds, it sounds almost contradictory: an oxymoron like "round square" or a category mistake such as "blue number". It is also obvious, I hope, that these suspicions arise mainly from what we may call, in a very naïve sense, our "on-tological commitments": can something not belong to reality but belong to an augmentation of it? And what could an augmentation of reality be? Do things in such an augmentation exist or not?

My purpose in this paper is to clarify (or help to clarify) the use of the ex-pression "Augmented Reality" and other related idioms (such as "virtual reality" and "extended reality" – henceforth 'ER'). To do this, I focus on puzzles that nat-urally arise regarding the ontological status of the new kinds of entities we see on the screen or we hear through our headphones. I consider their nature, their relation to other entities, and the similarities and dissimilarities with ordinary, standard objects. In the next section, I provide and examine some examples; but before that, I would just like to make a few brief comments on the method I will follow.

The philosophical realm I am going to move through is what we can call, using neutral terminology, "linguistic philosophy". By this, I mean that I am not going, for example, to examine what happens inside the head of a person who experiences Augmented Reality (I will not embark, for instance, on phe-nomenological research) or to attempt to deduce the conditions of possibility of the existence of Augmented Reality (there will be no transcendental deduc-tion). Instead (and more humbly) I will examine the rules that the uses of the words involved can be seen as conforming to; what we may call the "grammar" of the expressions that are used when talking about Augmented Reality.

More specifically, I will move within a branch of linguistic philosophy which starts from a specific conception of language and grammar that we can call, again in neutral terminology, "pragmatic", and whose roots are usually related to the work of Ludwig Wittgenstein and John Austin. According to that concep-tion, we do not explain meaning by giving semantic definitions or describing syntactic rules (although this is not forbidden as an auxiliary tool), but rather by describing multiple and diverse examples of uses of the expressions in differ-ent situations. One important step in the methodology is comparison between the different examples themselves and also comparison with examples of the

use of other expressions that are more or less akin to those considered, looking for similarities, analogies and differences. The aim is to obtain a holistic, synoptic perspective that allows us to become conscious of all the features of the phenomena, and consequently to understand puzzling uses of the expressions better. This is what I mean in the title of this paper, when I refer to "a pragmalinguistic approach".

2. An initial survey

I will take as my primary reference "The Bible" of Augmented Reality: the 2013 book by Kipper and Rampolla *Augmented Reality: an emerging technologies guide to AR*; although I will also take into account some texts from open access sources, such as Wikipedia. According to Kipper and Rampolla, Augmented Reality is a variation of a virtual environment or "virtual reality" (VR). In applications of VR, users are entirely immersed in a synthetic (computer-generated) environment: they cannot see the real environment around them. In Augmented Reality, in contrast, the computer-generated audio, video, tactile or haptic information is mixed with and overlaid on a real environment. Three characteristics are required for something to count as Augmented Reality:

1   (combination) Augmented Reality combines real and virtual information;
2   (interaction) Augmented Reality is interactive in real time;
3   (3D) Augmented Reality operates and is used in a 3D environment.

Although the "core" of Augmented Reality is the first characteristic (combination), I will place considerable value on the second (interaction). The third feature (3D), which Kipper and Rampolla use to differentiate Augmented Reality from Photoshop and other 2D combinations of real and virtual information, in my opinion is much less important, even incidental; although I will pay some attention to it towards the end of the paper. Kipper and Rampolla also apply the term Augmented Reality to other things (a field of research, an industry, a new medium for creative expression, etc.); but I prefer to see it here mainly as a technology, specifically as a computer technology with a wide range of applications: advertising, task support, navigation, art, domestic and industrial uses, sightseeing, social networking, education, translation, entertainment and games.

As for the functions of Augmented Reality (a key point for the pragmalinguistic approach, in which the meaning of an expression is "how it is used and what for"), those authors distinguish two categories. On the one hand, we have what they call "the augmented perception of reality" ("perceptive Augmented Reality" from now on), which *shows us reality and enhances what we can see*

and do, or *enables objects or relations to be perceived*. Some examples of this category of Augmented Reality are:

– HUD, the heads-up display that gives the pilot of an airplane a digital overlay with an artificial horizon and selected flight information;
– Intelligent Eye, a smartphone app that automatically changes the text visible on the screen through translation into another language;
– and the popular Google Glass headset, a device that continuously feeds the user information on the environment, based on specific personalized preferences.

On the other hand, what they call "the creation of an artificial environment" (or "creative Augmented Reality"), *shows how what is not real allows us to see the imaginary, or allows us to see things that do not exist in the real world and to share that view with others*. Some examples are:

– Construct3D, a mathematical educational tool that allows students to build virtual 3D geometrical figures based on 2D descriptions;
– Magic Mirror, a shopping tool that allows the user to put on virtual glasses and clothes, and see how they look from different perspectives;
– and History Pin, a smartphone app that allows users to "integrate" their image into historic settings.

Kipper and Rampolla provide much information on the methods, support and development of Augmented Reality; but I think it is excessively technical, so I will not reproduce or use it for my analysis here.

I would just like to make one last observation regarding the place of Augmented Reality within the field of contemporary technologies. Although Kipper and Rampolla do not use the expression, Wikipedia includes Augmented Reality as a case of ER; which *refers to all real and virtual combined environments and human–machine interactions generated by computer technology and wearables* (see https://en.wikipedia.org/wiki/Extended_reality). Thus, ER includes Augmented Reality, VR and "augmented virtuality" (VR), that is, the merging of real objects into virtual environments. There is a fuzzy boundary between Augmented Reality and VR (it is not easy to say when the environment is too full of virtual objects to be properly called real) which, precisely because of its vagueness, I will not take into consideration here. What I will focus on is exploring what we mean when we say that something is an extension of reality (ER), when we say that the extension is virtual (VR) and when we say that the extension is an augmentation for the purpose of perceiving properties of real objects (perceptive Augmented Reality) or for the purpose of seeing the imaginary combined with real objects (creative Augmented Reality). This gives us four words to

examine: "real" (as opposed to virtual), "reality", "extension" and "augmentation". So, let us begin.

Real (vs. virtual). The first thing that it is important to note is that, as John Austin famously pointed out, "real" is a highly exceptional word because *it does not have one single, specifiable always-the-same meaning* (Austin 1962, 64). According to Austin, this implies that the word is always used in combination with a (perhaps implicit) noun and usually in a negative form; so normally we do not say that something "is real", but that something "is not a real X", where X denotes a specific kind of things. If I say, for example, that the gun the main character in Woody Allen's *Take the Money and Run* used when trying to escape from jail was not *real*, what I actually want to say is that it was not a *real gun:* it was like a real gun (it had the appearance of an actual gun) but it lacked some fundamental properties of genuine guns (it did not shoot bullets because it was made of soap!). Please note that I do not want to imply that there is also another thing (apart from the carved soap, in the previous case) that is not real or that is real and unreal at the same time; something like "gunness" or "virtual gunness". Perhaps we can say that there is something like an "appearance of a gun", but this is just a property, an aspect of the carved soap. Analogously, when I say that the objects in VR, or the objects added in Augmented Reality, are "not real", what I mean is that they are not real people, or cats, or books; but they are like (they have the appearance of) real people, cats or books. Of course, I can say, for example, that the glasses added to my face in the Magic Mirror app are not real, meaning that they are not made of plastic as they appear to be or that I cannot wear them because they are not solid. We must not forget, however, that we are not looking at an unreal, inexistent thing; what we are looking at, some colored dots on the screen produced by electrical impulses, is as real as my flesh and bones. This, I think, is all that we need to be aware of in order to understand the use of "virtual" when talking of ER. "Virtual" is just one more member of a large family of words that deal with illusions (forgeries, mirages, magic tricks, *trompe l'oeils*, etc.) and I believe there is nothing entirely new in ER compared to the old cases of illusions (aside from the technical media that support the illusion): nothing that obliges us to change the grammar of "virtual" in order to accommodate the new cases.

Reality. In contrast to the constant use (and abuse) of the word by philosophers, in ordinary language "reality" is a word that we rarely use. Sometimes we talk about some specific domain of reality, the reality of business, or the reality of videogames, but these uses are figurative or they can easily be reduced to the use of the word "real" explained above. On the rare occasions when we use the word without specification, for example when someone says that witches do not exist in reality or that science tries to explain reality, "reality" is just a way of

expressing the most general and universal set of things. In this sense, "reality" means almost the same as "everything" and I suspect it is derived from it. Usually we use "all" or "every" to specify some specific domain that determines the set referred to ("all people", "every bird", etc.). As a special case, when we do not specify the domain, the set we refer to through our use of "everything" is "reality"; and in this sense it follows, almost by definition, that nothing exists outside reality. Everything belongs to (unspecified) reality, because reality is the sum of everything. Of course, what is real and what is not can be discussed, but there is no space for an intermediate realm: there is no limbo of "not belonging to reality but belonging to ER". Once again, we can talk of virtual objects and situations in Augmented Reality, but we must not forget that, just as with fake guns or white rabbits in conjuring tricks, they are part of all-comprising reality.

Extended. So, if reality is the set of everything, how can it be extended? Well, let us take a look at the ways we extend ordinary things. We say that we extend our fingers to make them straight, for example, or that the cook extended the pizza dough over the table with a rolling pin. We also say that the public works will extend the cycle lane by two kilometers or that the match was extended by 5 minutes to compensate for lost playing time. Observing the examples, and leaving aside residual or unrelated uses, we can see that there are two related but different senses here. In what I will call the "increase" sense, one extends something by adding new stuff to a previous entity, sometimes building or manufacturing new things (e. g., the French army extended its armament with nuclear weapons), sometimes just by enlarging the scope of previously existing things (the Spanish government extended the limits of Lugo county). In the "unfold" sense, to extend something means to expand something to a greater length or to cover a greater area without adding new stuff, sometimes just straightening it out it to its full size (as with a finger), sometimes stretching it out (as with the dough). The first sense is clearly more akin to the nature of VR and what I have called "creative Augmented Reality": we extend reality by producing new entities that we add to the set of "everything". Please note, however, that in our common speech there is no shadow of an intermediate realm here: at the very same moment when we produce the new entity (the new visual configuration on the screen, for example), it becomes an element of the only reality there is. As for the second sense, in perceptive Augmented Reality we display some possibilities and aspects of our environment and in this sense I believe I am not twisting English too much if I say that we are "unfolding" them. When we see our environment though Google Glass, we unfold some previously existing but unavailable information, in the same way as we do when we unfold a map and use it to study the orography of a country.

Augmentation. Augmented Reality covers the more ordinary cases of ER, so there ought not to be many new aspects here and fortunately, there are not. In most ordinary uses of the word "augmentation", it can be interchanged with the word "extension". Usually this coincides with extension in the "increase" sense, as in "the UE has augmented its members in recent years"; but sometimes it can refer to the "unfold" sense, as when we say that we see things augmented when using a magnifying glass. Indeed, the magnifying glass can serve as a very good metaphor for what many Augmented Reality applications do: they do not physically augment the scene or the things in it, but they augment our image or in general our perception of them. In this sense, it explains better than the map metaphor how Augmented Reality applications can "extend" our perception of reality; in the same way the magnifying glass allows us to perceive details that were previously beyond our senses, the information provided by an Augmented Reality device allows the user to gain an awareness of aspects that would otherwise remain hidden.

We should not, in any case, take the difference between creative and perceptive Augmented Reality (or between the two senses of extend and augment) too strictly. Some perceptive-Augmented Reality applications, such as Goggle Glass, insert imaginary items into the visual field or change color and other visual properties; while Word Lens and HUD display very useful virtual banners and signals. So extension through unfolding always involves some extension through increasing. In the same way, some examples of creative Augmented Reality would also count as cases of perceptive Augmented Reality: Magic Mirror can be seen as an instrument for exploring the aesthetical properties of glasses or even for perceiving some aspects of my face (something like *how my face is suited to these glasses*); while History Pin allows us to perceive a historical site from a new perspective and discover unexpected aspects by mixing contemporary people and items with it.

This minimal analysis offers us, I believe, a promising route towards the solution of the ontological puzzles. If the main sense of "extended" in ER or "augmented" in Augmented Reality is the "unfolding" sense, if all apparent production of new entities is just an indirect form of exploration of the possibilities of a given situation, then the "limbo" between unextended reality and ER is just a mental illusion. The "new entities" are just complex (sometimes called "high-level") properties of physical, entirely material situations (in Augmented Reality those situations include the computer, the screen and other technological apparatus) that resemble or look like different kinds of properties or entities (they are fakes or simulacra in the sense described above). So, in experiencing Augmented Reality we are simply encountering an *unfolding* of the only reality there is. In cognitive applications, the aim of this unfolding through Augmented Reality is

the apprehension and exploitation of properties of material objects; while in recreational applications, the aim is to produce fake objects for our aesthetic enjoyment and to stimulate our imagination.

So far I hope that we have obtained a clearer picture of Augmented Reality. However, there are two points that I have not taken into account yet that require further analysis in order to avoid confusion. I will address the now.

Instrumentality. So far I have concentrated on the first clause in Kipper and Rampolla's definition of Augmented Reality (combination), but the second clause (interaction) poses another issue that I should also take into account. It is not enough to say that what we perceive in Augmented Reality as virtual objects are complex properties of material objects, because not only do we *perceive* the virtual objects, we can also interact with them. In Construct3D and Magic Mirror, we can modify the objects we perceive with our hands. What is more, we can use them to interact with material objects, as in ARMAR: a program that assists mechanics in maintenance and repair tasks. This is not a feature of our common notion of perception. Clearly, perception is useful (even indispensable): perceptual information enables us to take good decisions and organize our behavior; but the instruments or media through which we obtain perceptual information (our senses) are not the same as those we use to act in our environment. How can we deal with this "instrumental" side of Augmented Reality?

Illusion and delusion. Another important point concerns the nature of the illusion produced by the technological device. It is not enough to say that in some cases our senses are "deceived" and we feel we are in the presence of something that does not exist. Unlike mirages and some optical illusions, we are not really *deceived* in Augmented Reality; on the contrary, we participate willingly in the imagination game, and we obtain some degree of pleasure or satisfaction from the experience. Moreover, here, there seems to be something exclusively human: a cat can be deceived by a fake mouse, it can even try to hunt it and perhaps play with it; but only humans have devised practices that essentially involve illusions. I need to clarify this point not only in relation to the distinction between perceptive and creative Augmented Reality, but also with a view to avoiding a skeptic doubt that sometimes appears when the difference between perception and action is lost. In some applications of Augmented Reality, some real objects that we cannot perceive directly are reproduced; this happens, for example, in some medical applications that "show" the fetus inside the pregnant mother or offer X-ray vision of a patient's arm. Is this indirect perception of something hidden, or just an illusion? Well, the computer has no access to the inside of the arm, and the recreation could be completely wrong (the patient could be wearing an orthopedic hand) so perhaps it is better to say that it is an illusion. However, if it is just an illusion, what stops us saying that in all

cases of Augmented Reality (and even in all cases of normal perception) we are just dealing with illusions, perhaps delusions, and that the set of real properties, the "thing in itself", remains inaccessible?

3. Abstract Entities

When one has to deal with a completely new type of entity that defies our taxonomies, as with the bottle of Coke in the Kalahari, a good strategy (perhaps the only one we have at our disposal) is to compare it with more familiar types of entities that resemble it in some particular respect. Anyone who knows something of the history of philosophy will recognize the family resemblances between the discussion in the previous section and the traditional philosophical debate regarding abstract entities: a very old and frequently bitter dispute that has engaged philosophers for millennia. I am not going to immerse myself in that philosophical discussion here (something that I am afraid would produce more white noise than enlightenment); instead, I will compare Augmented Reality with different types of arguably abstract entities. I will recap what common sense or everyday language can tell us about such entities and consider whether this can be applied to cases of Augmented Reality; and if so, how.

3.1 Universals

Traditionally, universals are the archetypal abstract entities. "Redness", "mankind" and "beauty" were terms that gravely concerned Ancient Greek philosophers. Famously, Plato proposed that such references belong to an immaterial realm that is removed from time and space: the world of forms or ideas. In contrast, Aristotle proposed that they do belong to our ordinary spatiotemporal world, though not as things but rather as properties (whether structural or formal) of things. Medieval nominalists considered that such words were *flatus vocis:* not referring to any specific entity, and at most identifiable with sets of objects (the set of objects that are red, for example). Independently of the question of the place of universals within reality (if they have one), we should note that they are mainly related to our experience of material, physical entities. This constitutes, nonetheless, a complex and usually mediated relation, as we do not, in general, spontaneously perceive universals in our environment. We can see directly the color of a tomato in front of us, but to identify it as the same color as that of the carpet in my living room requires training, the use of memory, reflection and sometimes the possession of concepts. But ultimately we only see

them in specific objects and situations, "redness" in a tomato, "beauty" in a seascape and "mankind" in the faces of those around us. Even if we prefer to reserve such words for some immaterial, supranatural beings (something that I do not recommend), it should be clear that: (i) epistemic access to universals is always obtained though particulars: we can only use the word "redness" properly as long as we can see and identify red things; (ii) the utility of universals in our daily language lies in their applicability to our dealings with the physical world: they enable us to organize, exploit and, more importantly, *share* perceptual information in a way that would be impossible without them (for example, to form and answer questions as *Which color is your car?* or *How many colors do I need to make this picture?*).

Many examples of Augmented Reality are analogous to or simply fall within the domain of universals in our natural language. Specially, perceptive Augmented Reality can be seen as an extension of the conceptual system of our natural language, allowing us to identify and make use of universals that are applicable to our environment. The most popular Augmented Reality app, Layar, can be seen as providing universals that are embedded in objects that form part of the scenario. Other applications, such as Magic Mirror or HUD, recognize and outline geometrical shapes, or identify shared properties of objects when assisting with classification tasks.

3.2 Institutions and Social Phenomena

At first glance, it could seem as if, here, we are in the exact opposite corner from universals. Rights and duties, institutional powers and social status are not to be found in nature but are created by us. If we can talk about them as existent, it is mainly and perhaps exclusively as conventions or as the result of conventions. It is a convention that the oldest legitimately recognized child of the reigning monarch of Spain is the Prince or Princess of Asturias; and it is only as a result of convention that Leonor de Borbón, the daughter of Felipe VI, will enjoy the privilege of being buried in the El Escorial pantheon and is to be addressed as "*Excelentísima Señora*" (Most Excellent). I think that the difference between institutional and non-institutional entities must not be neglected (particularly when it is deliberately erased as a step in the legitimization of a social injustice as "natural"). However, there are some important qualifications concerning what it means to say that "social phenomena are conventional" that we must not neglect. Firstly, "conventional" does not mean "arbitrary"; there are restrictions as to what we can decide by convention (we cannot decide by convention that the Prince or Princess of Asturias has the power to breathe under water) and there is

always a reason to be found in our needs and goals: the purpose of the convention that justifies it (unjustified institutions tend to disappear). Secondly, the convention only exists as long as we follow it; so the convention requires, and in the long run converges with, our commitment to behave in certain ways (as John Searle has famously argued, every social fact hides a "collective intention"). Finally, there is gradation in the "conventionality" of social phenomena: from almost biological and directly intentional (for example, the preferential feeding of babies) to completely artificial and only indirectly intentional (for example, the raising of the interest rate by the IMF), and there are always genetic and constitutive dependence relations between them.

Many examples of Augmented Reality are related to the world of the social. The app Recognizr offers the user data about a person, including web and social network data, and allows the user to contact and communicate with that person. Furthermore, in many games and social networks, such as Second Life or Facebook, we assist and participate in the creation of a network of institutional status, power and duties as complex as any in the "real world" (and connected to it: virtual currency has been recognized by the European Central Bank since 2012).

3.3 Mathematics

The case of mathematical and other theoretical entities is intermediate between the "perceptual" basis of universals and the "intentional" basis of the social. Of course, there is also gradation here (whose importance will be revealed later). When I say that there were five pebbles in the sack, now I have added two more, and so there are seven, it looks as if I am giving a factual report. In contrast, when I say that zero factorials equals 1 or, even more clearly, that the degree of the zero polynomial equals $-\infty$ (or -1), it looks as if I am just describing a convention. In the middle of such gradation, we find many uses of mathematical expressions where it is impossible to distinguish the conventional from the factual. When a textbook on geometry presents a graph and some proof involving a square and a compass is provided, we cannot determine where the representation finishes and the stipulation begins. That there is a conventional element is clear: we use many concepts that we do not see at all (Π, $\sum$ or Δ); and, if we are strict, what is printed on the page can only be taken as a reference to the mathematical expression by convention (there are no "perfect circles" or "genuine triangles" in reality). It is nonetheless also obvious to readers of the textbook who follow the demonstration that they are learning something about the printed figures; something that can be applied to other physical objects. The same "hybrid" nature is experienced in Augmented Reality. As I

said, Construct3D allows virtual objects that fit a specific geometrical concept to be "created"; while some recent apps allow us to see and manipulate the 3D shadows of hypercubes and other 4D objects.

It is worth stopping for a moment at this point, which I believe to be critical, and taking a closer look at where we are. Let us take definitions as an example, for the purpose of getting a closer look. It is traditional to distinguish two types of definitions: a *descriptive* (sometimes called "real") definition gives the characteristic features of a previously existing thing (for example, if I define water as H_2O); while a *stipulative* definition (sometimes called "conventional") gives the criteria for applying a new word or a new use of an old word (for example, Goodman's definition of "grue" as "a property of an object that makes it appear green if observed before some future time t, and blue if observed afterwards"). There certainly is a contrast between them, as I have said, and it is important when demarcating discourse domains (for example, social from scientific discourse); but, as I have also been stressing, the difference is only one of degree and frequently both aspects are combined in the same definition. If the general formula for a descriptive definition is something like: "X is a Y if and only if it has properties P" (please do not take this too seriously; I give it just for the sake of the argument, as a general approximation and not as a theory); and the general formula for a stipulative definition is: "From now on, let every and only the Xes that have the properties P be Ys", then the hybrid definition that works in mathematics has the form: "From now on, let X, that has the properties P, be taken as a Y that has the properties Q".

If we pay attention to the way we use our definitions, we will see that not only in mathematics, but in all fields, the original format is the hybrid; and that both purely stipulative and purely descriptive definitions are degenerate cases of the hybrid. First, as I say above, any stipulative definition must fulfill some adequacy requirements. "To have the height of Chesterton's killer" fails to define anything, because Chesterton died a natural death; and it has been noted that even a definition of a logical constant, such as Prior's tonk operator, must fail. Meanwhile, every descriptive definition includes some conventional element, because some decisions are taken as to which cases we leave aside, which are considered prototypical, when it is better to distinguish two different kinds or to merge different cases into one kind, etc. Second (and this is an important point I will come back to later), no definition, description or declaration works in isolation, but only under the framework of a multitude of linguistic elements and movements; and very frequently it is in these other pieces of language that the element apparently absent from the literal definition hides ("imaginary numbers" or "i" may appear to be stipulatively defined, but when we look at the role they play when calculating the interest on a loan or the

strength of a building, their factual nature immediately becomes apparent). If this were not enough, we must furthermore not forget the "what it is for" of the definition; a word came about to fulfill a function, to fill a gap in our language, which gives the word its *raison d'être*. So no definition is completely stipulative (there is a matter of fact as to whether it succeeds in filling the gap or not) and none is completely descriptive (its correctness is judged in accordance with pragmatic considerations).

This same hybrid nature appears in our speech acts. Following John Searle's taxonomy, we usually use universal words descriptively as defined in *assertives*; statements of the type: "John's house is white", which we use to report a matter of fact. In the domains constituted by stipulative definitions, such as the social, the typical speech act is a *declaration*, of the type: "I declare John and Mary to be married", which we use to confer new institutional status and in this way "change reality" in accordance with the proposition of the declaration. In the mathematical domain, as in general when we use hybrid defined words, the typical speech act is what Searle calls a *representative declaration*, such as when the soccer referee decrees "It is a penalty" or the judge gives the ruling "The accused is guilty". These contain a factual claim ("the defender touched the ball with their hand" or "the accused committed the crime") but they also change reality, producing new situations and events (the forthcoming penalty kick or the jail time to be served). Once again, if we observe what is happening carefully, not only mathematical statements but all our common speech acts have this hybrid nature. And it is always difficult to find a "pure assertive" because there are always factual considerations underlying the declaration.

3.4 Fiction

Other regular residents of the "House of Abstraction" are the characters, places and objects described in works of fiction: literature, cinema, painting and other arts. An initial contrast is that, unlike universals and the majority of mathematical entities, fictional creations are mostly particulars (I say "mostly" because a novelist can invent new types of things, as in science fiction, for example); this makes the use of "abstract" a bit different here. If in the case of universals we say that they are abstract mainly as opposed to "concrete" (and then we may disagree as to whether they are part of reality or not), in the case of fictional creations we call them abstract in contrast to "material", "really existent" or even "self-existing". In this aspect, the domain of fiction is a neighbor of institutional space; when we say that money is an abstraction, we are just saying that there is nothing in nature that is in itself money, and that euros, dollars and rupees exist

only as long as we have the will for them to continue. This feature is perhaps a consequence of another: fictional creations are the best examples of mere stipulation; they are introduced freely by the author with almost no adequacy conditions (except maybe for some sophisticated and vague aesthetic criteria).

As I have said, however, there are no purely stipulative definitions when we consider the whole language game and not just the move performed by a declaration. In the case of fiction, we must once again bear in mind the "what it is used for" of the creation. Fictional declarations play an essential role in the game of imagination that the artistic or literary work triggers. Understanding the "definition" of Don Quixote or Shangri-La is not the end but the beginning of the literary practice. We have to use our minds to conceive the person behind the description and the deeds; trying to grasp a physical appearance, a personality, a pattern of behavior, a circumstance and even an ego. In short, we have to take the fictional character as *real*.

This trait of fiction, which traditionally is sometimes called the "fictional pact" and other times, in homage to Aristotle, the "mimetic pact", is just one facet of a profound and distinctive feature of humans. Moreover, we cannot understand human forms of life, and especially the importance of the symbolic in them, if we neglect this crucial point. That oh-so-human feature is our capacity for consciously treating things as different from what they are. This is, in a certain sense, natural and even innate to humans: a small child treats a teddy bear as a living thing; but it is also expanded and radically positioned at the center or our existence by education and other socialization processes. A different version of the fictional pact, not related to leisure and in which the factual consequences have an important value, is at work in the background when we take "as real" the process of baptizing a child. Yet another version, weak but indispensable, is at work whenever we call an irregular three-dimensional object a triangle or we say that the door and the window are the same color when in fact there are many slight differences between them. If I am not wrong, the literary fictional pact is just a modality of the pact that we tacitly sign up to whenever we participate in linguistic or symbolic practices: the compromise of treating conventions unconventionally, of taking definitions as not mere stipulation and adopting the same attitude towards them as we have to matters of fact. Without the fictional pact, creative Augmented Reality could not have been developed, because we could not make use of or even recognized "virtual" objects. Video games (VR or Augmented Reality) are, in this sense, a continuation of Greek drama, the performances of medieval minstrels and Hollywood movies.

As I hope I have demonstrated, "abstract" applies to a heterogeneous family of concepts; and abstraction works in such very different ways that it would be useless to try to provide a general definition. However, we can find a common

trait; one that is not exclusive but is central in the cases of abstract notions and expressions: they are words whose grammar raises pertinent questions concerning the identification of references (they are categorematic), but we cannot identify the references with anything that we perceive directly with our senses. When we introduce the gradualistic and holistic features of our language, we can clearly recognize that abstract expressions are also related to experience; but in a complex way that involves not only straightforward perception but also the execution and acknowledgment of actions, intentions, dispositions and complex relations. Considering these two features of abstraction, holism and graduality (or hybridism), we can easily deal with the two perplexities I described at the end of section 2 above. On the one hand, in natural language there is a wide notion of "perception" that includes the use of memory, imagination, training and other skills and abilities, as well as the use of tools and instruments (indeed, I have been using it unproblematically in this paper every time I have talked of "seeing" or "perceiving" an aspect of a concept or a relation between words). Moreover, this notion fits perfectly with the sense of the extended perception of reality that Augmented Reality permits. On the other hand, there is no genuine "delusion" in AR and there is no genuine question about the veracity of Augmented Reality in general. In creative Augmented Reality, we play with illusions as we do in other linguistic games that exploit fictional pacts; the best examples of our symbolic capacity at work. In perceptive Augmented Reality, the veracity does not depend on being or not being a "real" thing that is represented by a device interface (or on what that thing is); it depends on the global success of the activity that is executed using Augmented Reality (for example, the surgical operation assisted by Augmented Reality).

4. Augmenting Reality

The set of results we have considered so far are, I believe, sufficient to allow me to summarize an initial conclusion of this grammatical study: we understand Augmented Reality better if we take the new entities produced by the technological devices involved as abstract entities. They bear some family resemblances to universal notions in our natural language and mathematical entities, and also to fictional and institutional entities. We can say that Augmented Reality "extends" (or augments) reality because it "makes it bigger", producing new entities that serve to "unfold" the properties of pre-existing entities and situations.

This cannot be the end of the story though. Although the examples I have given so far may be enough to allow us to perceive the analogies (and disanalogies) − that is certainly my hope − the reader may feel a bit disoriented by the

comparisons. The term "abstract", in all the different usages I consider in the previous section, is always applied to phenomena, properties or entities that are not the direct objects of our perception; either because they are not concrete, or simple, or immediate, or because they just do not exist. But in Augmented Reality, as the first clause of Kipper and Rampolla's definition states, the new entities appear in front of us mixed with standard entities, and they look as concrete and physical as those standard entities. So, how is it that I can classify them together with those invisible things: numbers, marriages, unicorns and so on?

To answer this question we have to take a step forward in the analysis. My method so far has been to compare the new things with older, more familiar ones. This has a hidden advantage: sometimes it enables us not only to understand the new things better, but also to gain a new perspective (the one which arises from the comparison) on the old types of things; to see and understand them better. I will now try to convince you not only that traditional abstract entities belong tout court to the realm of everyday things, but also that Augmented Reality offers us the best proof that they belong there. I will begin by giving a description of the genealogy of the "mistake"; I mean, of course, the mistake of believing that abstract entities are not physical. First, I will consider two common errors that I believe the idea that abstract entities have an ontological realm of their own may stem from.

The "popular" mistake: not taking into account that the production of abstract entities is a linguistic process. We must not forget that a symbol is what it is through its reference to another thing that we do not have in front of our eyes when we are using it (it is intentional in Brentano's sense). Because of this, when we are using a symbol, we have the impression that it is hiding something from us; that it has a life of its own, as Wittgenstein famously pointed out. Usually we can find entities in our environment that more or less correspond to the things the "intention" of the symbol is directed towards. In the case of the expressions examined in the previous section, however, we have great, sometimes insurmountable difficulties finding those entities. So we may finally make the mistake of yielding to the temptation of postulating those other mysterious, invisible entities, abstract objects, and the ontological mess begins. But all the perplexities disappear if we realize from the beginning that the "intentionality" of symbols is just a consequence of their being meaningful, and that the "life" or the "soul" of the symbol is simply the meaning we assign to it.

The "philosophical" mistake. Once we have recognized the symbolic nature of abstract entities (that they are just meanings or parts of meanings), we have to take into account the pragmatic nature of meaning. If one is moving within the syntactic-semantic framework, if one insists on finding the sense and refer-

ence of the expression, then we make a mistake similar to the popular but even more severe, because now we have the endorsement of the theory which "obliges" us to produce the things that constitute the reference of all words, and accordingly "implies" that abstract entities exists. This produces a new set of problems and debates, such as the nominalist-conceptualist polemic or the indispensability of mathematics argument, that have occupied philosophers for centuries without a consensus being reached.

In order to avoid falling into these two errors, and in general to avoid postulating mysterious ontological domains, I next consider two features of the pragmatic conception of language that are extremely helpful.

(i) Meaning is not an entity that accompanies the symbol or that is hidden inside its material appearance; meaning lies in our use of the symbol. Once we attend to the practices, actions and attitudes (as in the fictional pact) that surround the symbol (and which belong to the everyday world), we see that the functions, goals and ends (those we fulfill and those we fail to fulfill) are the things that "give" objectivity and even factuality to the symbol, and that "insert" it into reality. The meaning becomes factual because it is a fact, or not, that in a given situation it is used rightly (or not), and that the expected consequences are obtained (or not) in that situation. We do not need any "object" to ensure the objectivity of the meaning, because it is the situation that chiefly determines which other possible situations are obtained when we use this or that other expression in this way or another.

(ii) Meaning is not something fixed or well delimited (it does not have the dimensions of an object in the non-philosophical sense of the word) because it is: (a) continuously changing (we adapt and sometimes modify usage according to the peculiarities of the situation); and (b) holistic (the actions and practices related to uses of the different symbols interpenetrate one another). The notion of "number", for example, is not "closed" by a definition; rather it is something that is constantly rebuilt through the interaction of a plethora of interwoven practices. There is not any "common property" shared by the many things we call "numbers" (so neither is there a "universal entity" in the traditional sense), or by the many things we call a "natural number", or by the many things we call "twenty"; but rather there is a tangle of changing praxis, belonging not only to mathematics but also to other theoretical domains (physics, economics, etc.) and to practical activities (law, art, etc.).

Note that there is nothing wrong with the old "reifying" discourse concerning abstract entities; just as long as we do not forget that it is only "a way of speaking". Such idioms also belong to language and they play their roles. Taking Othello and Desdemona "as real" helps us to immerse ourselves in and fully engage with Shakespeare's story; and the rigor of mathematical thought depends

on taking numbers "as real" entities with intrinsic properties that can be characterized by a description. The mistake occurs when we take what is a linguistic convention as a matter of fact.

When we understand abstraction from within this pragmalinguistic framework (in general terms, as a linguistic recourse and not as some means of access to other ontological realms), then it is natural to take Augmented Reality as a process of abstraction. With Augmented Reality, technology has enhanced our ability to take advantage of situations, sometimes extending them (in the sense of increasing them) with new objects produced by us. In this way, Augmented Reality extends (in the sense of unfolding) properties and potentialities that otherwise we would not be able to grasp or exploit. We can take things a step further though. From within the pragmalinguistic approach, there are good reasons to claim that Augmented Reality is not only an example of abstraction, but the best example of it; and the one that best allows us to avoid the "reification" temptation. Indeed, as we have seen, that mistake stems from the fact that in many cases of abstraction we cannot perceive the alleged entities with our senses (for example, when reading a novel we do not see the characters with our eyes); but in Augmented Reality we can see, hear and even sometimes touch the entities.

Let us return to Kipper and Rampolla's definition, which is revealing in relation to this point. To begin with, Augmented Reality is a technology. Perhaps in the old conception this is a reason to consider it as non-linguistic; but in the new conception, where all components of language are taken as tools, being a technology is not an impediment but fulfills this necessary condition for being a symbol. Moreover, as a technology, it is more difficult for us to forget that it is something that does not come "out of nowhere", but in fact something that we make with our minds, and also with our hands.

I have said that the third clause in the definition is, in my opinion, less important; but the fact that the objects of Augmented Reality have the visual properties of physical 3D objects does prevent us for taking them as Platonic entities. In Augmented Reality, abstract entities are there in front of us (although in some cases we know that they are just simulacra of the things they appear to be, as we saw in section 2 above).

If we still feel the "Platonic temptation", we must take a look at the second clause of the definition. Something that was difficult to understand in terms of the old explanation was the "communication" between abstract and regular entities; something that looks impossible if they belong to different ontological realms (a problem that can be tracked through history, from Plato-Aristotle's Third Man to Wittgenstein-Kripke's On Following a Rule). But in Augmented Reality we handle abstract entities and, even more revealingly, through handling

them we manipulate other things in our environment. This point confirms and clarifies a previous one: the factual element in abstraction comes from the things we can do with the abstract. Indeed, the best proof we have that abstract entities are just a kind of physical entities is that we can interact with them and that by interacting with them we also interact with other physical entities they are casually connected with. Even when we only use Augmented Reality to grasp aspects of our environment, as in Layar, we can do so because Augmented Reality entities are casually connected with the environment (changes in certain properties and relations cause changes in the icons and simulations). But we can also use Augmented Reality to produce variations in our environment; so there is causal connection in the opposite direction too. It is important here to pay attention not only to the changes in our environment, but also to the ways Augmented Reality affects our lives. It is very interesting and revealing that Kipper and Rampolla are deeply concerned with the social, ethical and legal issues raised by Augmented Reality. These include not only the ways in which Augmented Reality affects (or will affect in the future) our ways of life, in terms of some important aspects as public safety, health, education and personal relations, but also specific legal issues such as those concerning the right to privacy or when aggressive publicity is to be considered a criminal offence. This demonstrates not only the insertion of Augmented Reality within our overall system of linguistic practices, but also that in Augmented Reality, as in other abstract domains, nothing is completely virtual, fictive or ineffectual.

If that still is not enough, if any shadow of a doubt remains concerning the exact sense in which we are faced with something "real" in Augmented Reality (in the ordinary sense of the word, remember, including the cases in which we are just dealing with a "real falsification"), then we have the first clause in the definition to rely on: technological Augmented Reality entities and standard entities are mixed together within the same situation. That "virtual" and "real" elements overlap proves that we are not in two different contexts "at the same time", but in just one single context formed by different kinds of things including technological images and sounds.

At this point I am in a position to invert my initial thesis. I have tried to give good reasons to support the claim that Augmented Reality entities belong to the family of abstract entities; and when looking for similarities and differences, I have discovered that Augmented Reality is the best and clearest example of abstraction. It may be argued that although they appear later in our history, it is better to take Augmented Reality as the model, the archetype for our notion of abstraction. The point we are just now beginning to reach, thanks to new technologies, is the culmination of a process we started when we created language, and we have developed through science, engineering, art and other instruments

that empower us both to expand reality with new kinds of objects and situations, and to extend our epistemic and existential access to reality. Therefore, I believe that it is better not to say that Augmented Reality is a case of abstraction, but quite the reverse: abstract entities (both the new and the old) belong to Augmented Reality.

References

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