

Is Identity Really So Fundamental?

Décio Krause and Jonas R. B. Arenhart

Department of Philosophy
Federal University of Santa Catarina
88040-900 Florianópolis, SC – Brazil
deciokrause@gmail.com
Jonas.becker2@gmail.com

Abstract

We critically examine the claim by Otávio Bueno (Bueno O. 2014. “Why identity is fundamental”. *American Philosophical Quarterly* **51**, 325-332) that identity is a fundamental concept. Bueno advances four related theses in order to ground such a claim: 1) identity is presupposed in every conceptual system; 2) identity is required to characterize an individual; 3) identity cannot be defined; 4) the intelligibility of quantification requires identity. We address each of these points and argue that there are no compelling reasons to hold that identity is fundamental in these cases. So, in the end, identity may not be a fundamental concept after all.

1. Introduction

In Bueno 2014, Otávio Bueno has raised several arguments to the effect that the concept of identity should be, in some sense, fundamental. In particular, Bueno challenges the Received View on quantum particles non-individuality (see below), the interpretation of non-relativistic quantum mechanics according to which the theory deals with non-individual entities; that is, entities with no identity conditions. In this

paper we shall examine Bueno's claims to the fundamentality of identity and we shall argue that they are not enough to impose the general thesis that identity, in a sense to be specified, should hold universally.

There are four related claims whose aims would be to grant the fundamentality character of identity: (1) identity is presupposed in every conceptual system; (2) identity is required to characterize an individual; (3) identity cannot be defined; (4) the intelligibility of quantification requires identity. In the end, as we have already remarked, Bueno discusses the relation of identity and the plausibility of an interpretation of non-relativistic quantum mechanics according to which it makes no sense to attribute identity to its entities. His claim, in a nutshell, was that this interpretation is implausible, given the fundamentality of identity he sought to establish.

Here we shall go through each of the four topics presented to grant the fundamentality of identity and try to bring to light what we believe to be their weaknesses (here, whenever we mention Bueno, it is the (2014) paper that we are referring to). The very idea of what is the concept of identity is not clear in Bueno's paper, and the precise notion of "fundamental" being considered is not presented either. The idea seems to be that identity is fundamental because it has the features presented in the four mentioned uses, so that it cannot be eliminated and no metaphysical system — and no interpretation of quantum mechanics either — can be formulated without the use of a universally applicable relation of identity.

2. Identity may not be so fundamental

Now, we present the arguments advanced for the fundamentality of identity and discuss their merits.

2.1. Identity and conceptual systems

Bueno begins his paper by considering the role of identity in conceptual systems. The application of concepts, Bueno says, requires identity. Bueno begins describing the role of concepts: “[t]he most basic feature of concepts is to demarcate certain things from others, to draw a line between those things that fall under that concept and those that don’t”. In order to achieve this, identity would be fundamental: “[c]oncepts are used to classify objects, to make distinctions among them together as falling under the same concept [...] [and this] demand[s] identity”. The second claim concerns objects falling under the same concept, which also requires identity because to “lump certain things together requires that they fall under the *same* concept”.

As a matter of clarity, we should distinguish the two claims more sharply now. The first claim concerns the identity of objects falling under a concept; the second concerns the identity of the concepts themselves. The first argument seems to be as follows: in order to determine the extension of a concept, we must determine also its complement. Things that fall under a concept cannot be in the complement of the concept: those would be distinct things. So, identity would be required in order to distinguish the items in the extension of a concept and the items belonging to its

complement. To illustrate this point, let us assume that a concept C is given together with objects o_1 and o_2 , so that o_1 falls under C and o_2 does not fall under C . In this case, o_1 is distinct from o_2 . So, identity is required, given that it enables a meaningful application of concepts.

Our first complaint against this line of reasoning is that it begs the question against those that do not recognize the fundamentality of identity in the sense focused now. In fact, for those that do not want a commitment with identity, the situation may be analysed in an alternative way, by employing a weaker notion of discernibility: given that C distinguishes between o_1 and o_2 , they are discernible. Does discernibility imply distinctness, so that the use of identity is really unavoidable? Well, it depends on our understanding of the relation between identity and indiscernibility (more on this relation in the next topic). We believe that the fact that indiscernibility can be analysed without necessarily implying identity in some systems of logic shows that there is no equivalence between these notions. At the very least, it is logically possible that the relations of discernibility and difference are not the same, with discernibility being a weaker notion. In this case, there is an alternative way to understand the situation described by Bueno without necessarily using identity. So, if this is correct, then identity is not really fundamental for the meaningful application of concepts.

Even though we do not enter into the details of the difference between identity and indiscernibility, there are several systems of logic which we could call upon here to substantiate our claim, and which keep discernibility and difference apart: Schrödinger logics and quasi-set theory (see French and Krause 2006, chaps. 7 and 8), and also

Wittgenstein logics (see a discussion in Wehmeier 2012). Also, even first-order classical logic with identity using so-called non-normal models sometimes interprets the symbol of identity with a relation that is mere indiscernibility (see Mendelson 2010, p.93).

For a second complaint about this argument, we point to one undesirable consequence of the view: it would render an intuitive interpretation of paraconsistency — and along with it, versions of dialetheism — untenable. In fact, consider a contradictory object, like Russell's set R , one of the favourite examples of paraconsistentists (one can take as example any one of the so-called "contradictory" objects available in the literature). Now, R satisfies both the concept defining R and does not satisfy it (the concept is "does not belong to itself"). So, if paraconsistent set theories allowing sets like R are supposed to make sense, then they cannot accept Bueno's account of how concepts are applied. Otherwise, they won't be able to make sense of their contradictory objects: the set R must be in its extension and also not to be in its extension. Alternatively, if one does not want to be committed with extensions in this pathological case, one can keep with R falling under the concept defining R and also does not falling under this concept. On Bueno's account, this would imply either that this application of concepts is meaningless or else that R is distinct from itself.

One way to go out of this situation could be to rule out paraconsistent logics with such an intuitive semantics. This is not a palatable move, we think, and we shall not pursue it here. Another alternative consists in changing the interpretation of how we apply concepts, so that paraconsistent objects can make sense after all. But this would rule

out Bueno's account of concepts (along with its allegedly required use of identity). A third way would be to keep the conclusion that R is really distinct from itself, but this is very difficult to make sense from an intuitive point of view, independently of whether one thinks that identity is either fundamental or not.

Now, going directly to the case that concerns us, that is, the case of quantum mechanics, we shall point out that the use of concepts in this domain is illustrative of how identity is not involved as Bueno suggests. In fact, it is usually held that the properties of quantum objects are not discovered by inspection; for instance, Dalla Chiara and Toraldo di Francia have suggested that quantum objects are *nomological*, given by physical law, and that all objects of a same kind obey exactly the same laws that characterize them, so they could be discerned by none of such qualities (this notion, and its problems, is further discussed in French and Krause 2006, p.221ff). In other words, we have clear classifications of these entities as conceptual systems, even they being indiscernible from one another (without being identical). Identity, in the sense described, is not required here (we remark that Bueno did not say what he understands by identity), for what we need is a criterion for something to be, say, a positron or a Z particle, and we do not require the identity (in the above sense) of these particles themselves. Okay, you may say: identity is required in order of distinguishing positrons from Z particles. But this is a way of speech. As suggested above, all we need is that positrons and Z particles be *discernible*, a weaker notion. In regimenting natural talk for metaphysical purposes, it suffices to use discernibility, and not necessarily identity.

Now, we go to the second of Bueno's claims, that one concerning the identity of concepts: when objects o_1 and o_2 are similar on one specific aspect (described by a concept), this would only happen because they fall under the *same* concept. So identity of concepts would be required for the very application of concepts. For instance, when we say that Plato and Aristotle are philosophers, they must fall under the same concept "being a philosopher". In this sense, there must be identity for concepts too.

Our view on this issue is, once again, that identity is really not so fundamental. First of all, if concepts are understood extensionally, then their identity will depend on the identity of the objects that fall under them (on an intuitive understanding of extensionality). This won't fit very well with Bueno's claim that identity is fundamental, because in this case the identity of concepts would be *defined* in terms of the identity of the objects falling under them, something that cannot be done for a fundamental concept (see further ahead). On an intensional understanding of concepts, on the other hand, it is notoriously difficult to account for the identity of concepts, and given that no such account was advanced by Bueno, we believe that he unintentionally was thinking in extensional terms.

To advance even further our claim, we hold that the situation described could be analysed in an alternative way. To say that a concept like "being a philosopher" applies to Aristotle and Plato does not require anything like the identity of the concept "being a philosopher". For, changing now to the material mode, going from concepts to their metaphysical representatives, one could for instance be a trope theorist, and deny that

it is the same trope that applies to both individuals, as trope theorists in fact do. We are aware that trope theories are not without problems, but even so they serve to emphasize that one cannot go from the fact that the same linguistic entity (a concept), being applied to distinct names, has an ontological counterpart (a universal?) that is the same in both cases, thus requiring identity. That is, Bueno's conclusion does not follow so straightforwardly.

Of course, one could complain about our change to the material mode. Perhaps in the formal mode, linguistically, there must be a single concept applying to each particular object that falls under it, so that at least this linguistic entity must have an identity. That is, even if a concept refers to various tropes when it is applied, as a concept (*i.e.* a linguistic entity), it is just one. But notice that this only shows one thing: that some abstract linguistic entities, types of concepts, have multiple instantiations on various tokens. To recognize that a token is an instance of a type, no use of identity is required.

2.2. Identity and individuality

As a second point concerning the fundamentality of identity, Bueno argues for the fact that identity is required to define individuals. Individuality being a central issue in metaphysics, this would be an important aspect to be considered (see Lowe 2003 for a general discussion on individuality). According to Bueno, individuality is defined as comprising two minimal conditions: i) individuals are discernible from other things (discernibility condition) and ii) individuals would be re-identifiable through time. Now,

both conditions are said to involve identity: discernibility requires difference, while re-identification requires that an item re-identified must be the same at the two distinct instants of time.

Our first point is that this line of argument is off the mark: one could accept that individuals are characterized by *at least* these two conditions and still hold that identity is not fundamental. In fact, for the conclusion that identity is fundamental to go through, one would still have to add the premise that every object is an individual, or something to that effect. However, if there are objects that are not individuals, then, *they* may not obey the conditions for individuality, so that they may be characterized according to conditions that do not require identity (and identity is not fundamental if that is the case). In fact, assuming that there are non-individuals amounts to such an option: some objects “have identity” (in some sense to be specified), while others do not.

So, to establish his conclusion, Bueno has to grant two things: that those requirements are in fact minimal for individuality, and that there are no items that could be objects without being individuals. The second point seems crucial for us if the thesis that identity is fundamental is to be established. It would be the one granting universal applicability of identity. However, Bueno does not present any argument to that effect, so that it is difficult to see why identity should be fundamental just because it is used to define individuality. Of course, one could still assume that a concept can be of restricted application and still be fundamental; however, if this is the case, once again

we don't have to worry, because we can simply leave individuals as being those things having identity and non-individuals as those things that do not have identity.

The first point, the one concerning the minimal conditions for individuality, involves also great controversies. Both the requirement of discernibility and the re-identification requirement seem to be too much to demand on something to be an individual. We begin by discussing the demand of discernibility.

Traditionally, discernibility is treated as a distinct notion from numerical difference. Discernibility concerns our epistemology, dealing only with what we are able to discern, while difference concerns metaphysics, having to do with the numerical distinctness of items, even if never discovered by us. To make the difference clear, philosophers tend to present a thought experiment according to which we are asked to imagine a possible world in which there is only one object. This object is identical to itself, but not discernible from anything else, so that the concepts of difference and discernibility do not coincide.

Bueno claims that the example is not uncontroversial, and that there are already lots of arguments in the literature against possible worlds with only one object. Anyway, he claims, even if the example holds, it is not so easy to separate difference from discernibility: the single object o could have modal properties, like "being discernible from every other object that could have existed", or, if indiscernible objects could have existed, the class of the indiscernibles from object o would have to be distinct from the

class of the indiscernibles from other objects discernible from α . So, identity would be required anyway.

We should point that this is already a change of subject: the fact that an object could have such and such modal properties does not help us in characterizing its individuality. For instance, to say that Socrates could have been a truck driver does not help us in characterizing his 'actual' individuality. Recall that the individuality of an individual, intuitively, is precisely that which makes a thing being what it is, not what it could be. So, modal properties seem to be of little help to the original problem.

Furthermore, Bueno has nothing to say about symmetrical universes comprising indiscernible objects. Those universes, like Max Black's universe comprising only two indiscernible spheres (Black 1952), seem to require that individuality is characterized by something not involving qualities and discernibility, but rather in terms of other features which could grant individuality without discernibility. The case of quantum particles is also a great example. As Bueno himself acknowledges, sometimes quantum particles are interpreted as being individuals. However, their individuality is not understood as grounded on discernibility, but rather through some other individuation principle that would allow for indiscernible individuals, like a primitive thisness, a haecceity, or a substratum.

To make this point even clearer, we could distinguish between two senses of identity: (i) identity as a relation, which says that there is one thing (and whose negation says that there are two things), and (ii) identity as a metaphysical notion, in the sense of a

thisness or a haecceity which every individual is supposed to have and which characterizes each thing as the very thing it is. In the first sense, identity is not required to characterize an individual, it merely expresses the fact that there is just one or that there are more things. In the second sense, identity is required to characterize individuality *according to some accounts of individuality* (again, see Lowe 2003). However, some philosophers prefer to attribute some form of primitive identity to things and not commit themselves with concepts such as haecceity and thisnesses (see Dorato and Morganti 2013).

Now we would like to discuss the idea that numerical identity, given in the sense that whatever collection having a cardinal greater than one necessarily entails that the elements of the collection are different, does not hold either. Indeed, we may say that the very notion of cardinality is common to both individuals and non-individuals. Individuals may have identity given by some form of primitive identity, some kind of haecceity, and may even be discernible from every *other* individual (it all depends on which definition is adopted), while non-individuals do not have identity, which does not imply that they cannot be taken as *many*. Both individuals and non-individuals can be aggregated in collections with a cardinal, but only individuals may be in principle discerned from other individuals of the same kind. In fact, let us recall the origins of modern chemistry. John Dalton explicitly claimed, long time ago, that “[t]herefore we may conclude that *the ultimate particles of all homogeneous bodies are perfectly alike in weight, figure, &c.* In other words, every particle of water is like every other particle of water, every particle of hydrogen is like every other particle of hydrogen, &c.” (Dalton 1808, p.143). From this time on, it was realized the importance of the notion of

number. With Dalton, we have started in writing (in present day notation) things like H_2O , C_2H_4 , etc., emphasizing that it is not the individuality of the components that matters, but their species (and number!). Indeed, in a typical chemical reaction, such as in the combustion of methane, we have $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$, plus energy. In the reaction, four Oxygen atoms move to form a molecule of carbon dioxide and two water molecules. It does not matter *which* of the four atoms move to the carbon dioxide molecule; the result is the same whatever they are. Entities of this kind should not be treated as individuals in the standard sense.

Another typical example is the case of two electrons of an Helium atom in the fundamental state; according to quantum mechanics, as is well known, we can say that one of them has spin up in a given direction, while the another one has spin down (in the same direction), but *it is impossible to say which is which*. Some philosophers claim that once a collection of objects has a cardinal, they necessarily are individuals, presenting identity (see Dorato and Morganti 2013). However, this is necessarily so only when one follows the accounts of cardinality that are closely related to identity, something we are not required to do; really, quasi-set theory shows that there may exist collections (quasi-sets) of objects having a cardinal greater than one, but being so that the elements are non-individuals (see French and Krause 2006, chap.7 and, for a more developed argumentation against the view that cardinality and identity must be related see Arenhart 2012 and Arenhart and Krause 2014). What really matters for us is that individuality and non-individuality may live together, and that even if some things are individuals and do have identity, from this it does not follow that identity is fundamental.

Now, about the requirement of re-identification, we can say is that it is very unusual to characterize individuality by using such a feature. In fact, it seems to say little to say that what makes Socrates exactly what he is and nothing else somehow depends on re-identification. Furthermore, notice that once again, by the way it is posed by Bueno, the condition has an epistemic connotation, conflating metaphysics and epistemology: individuals can be re-identified, at least in principle. So, if in some situation no one can ever re-identify an individual, that would not make it less an individual. It is a matter of definition.

Also, recall that the kind of identity required to make such identifications possible is still another kind of identity than that we have already discussed: it is identity over time. The demands for identity over time are distinct from the demands on synchronic identity, which is the one required for individuality. As we mentioned, it is not clear which kind of identity is to be fundamental, nor whether all these distinct senses of identity are the same, or even equally fundamental.

2.3. The indefinability of identity

Bueno's next step is to consider the definition of identity or, as he says, its "indefinability". According to Bueno, identity is not definable, not even in languages which are usually thought to have the resources for such a definition. He is right in saying that the notion of numerical identity cannot be defined within the contexts of standard logic. Classical logic (either of first or of higher-order) deals with domains of

objects that are usually thought of as sets (without loss of generality) in a set theory like ZFC. In standard semantics, the alleged identity to be defined in the syntactical counterpart of our logic would be a relation which would be interpreted in the *diagonal* of the domain D (let us suppose for now first-order logic only), namely, the set $\Delta = \{ \langle x, x \rangle : x \in D \}$. As is well known, there is no way of defining or giving suitable first-order postulates for a binary predicate that has Δ as its sole interpretation (the proof is reproduced in French and Krause (2006), p.253-3). Even in higher-order logics, where identity can be defined in the Whitehead-Russell's sense, namely, $x = y := \forall P(Px \leftrightarrow Py)$ (Leibniz Law), where P is a variable of suitable type and x and y are of the same type, truly does not define identity in the required sense, for we can easily present Henkin models comprising things that obey this definition but which are not *the very same object* (again, French and Krause, *op.cit.* present an example at p.257).

However, Bueno is not considering such well-known results when he says that identity cannot be defined. In fact, in higher-order languages restricted to so-called standard models, identity can be defined following the Whitehead-Russell definition above. So, how can Bueno claim that identity is not definable in such languages? The idea is not that these definitions violate some condition on definability or that they do not have the correct models. Bueno makes his point with a remark concerning Leibniz Law (the formula used in the Whitehead-Russell definition) in saying that in formulating the definition, identity is presupposed "given that the variables occurring on the left-hand side of the bi-conditional [our '=' above] need to be the same as those occurring in the right-hand side". In this criticism, Bueno follows McGinn 2000: we must use identity in

order to state the definition of identity and in order to understand the definition. So, identity is not definable, and not being definable, it is fundamental.

However, this is not a problem of questioning identity. The two exes in the Leibniz Law are instances of the same abstract object (a variable). Of course in elaborating our conceptual schemes, we need to discern things such as the letters a and b . We reason in an almost constructive way, starting from standard things we are accustomed with, and step by step we go to more and more sophisticated conceptual schemes until we arrive, say, at a strong theory such as the ZFC system. Then, as suggested by Kunen, we enter this system and revise our steps, perhaps understanding what we have done before. As an example, in order to elaborate arithmetics, we need to have the notion of 'two' (in order to be aware that we have two different symbols in our language), but only after having developed arithmetics itself we can (supposedly) get an understanding about what 'two' is intended to mean. As Kunen says, "formal logic must be developed *twice*" (Kunen 2009, p.191). This is so also with other systems of logic and mathematics. For instance, paraconsistent logics and paraconsistent set theories make use of the basic idea that a proposition and its negation can both be true (Béziau 2003; Arenhart and Krause 2014a). But in formulating such a logic, we assume that nothing is an axiom and not an axiom at once. That is, in the metalevel, we assume something that resembles classical logic (or at least a constructive logic). But even assuming the validity of things like the Principle of Contradiction, we arrive at systems that violate it. Furthermore, the definition of identity given by Leibniz Law can be said to be formulated in a part of our framework where identity makes sense, although it does not hold for some objects of our intended domain. This happens in

particular in quasi-set theory, where in its 'classical' part, the objects obey classical logic.

Kunen's claim holds also here. We may start by using a very rough intuitive notion of identity and difference of course, and by using them we may arrive at strong systems in which these very notions can be questioned and even eliminated for the objects the theories are supposed to apply. The fact that we use identity in elaborating our conceptual schemes does not force upon us the identity of the objects we are dealing with, and this is the point to be emphasized. This, we think, answers Bueno's related claims concerning propositional logic. In fact, in the language of classical propositional logic, the occurrences of A in $A \vee \neg A$ are occurrences of the same variable, but we could simply say that they are two occurrences of the variable A without mentioning identity at all, just by emphasizing the number (as we made before, by distinguishing the various tokens of a type). Anyway, this use of identity is in another level than that one which questions its applicability to a certain realm. Indeed, this notion does not matter for the possible consideration of a metaphysics involving objects like the quantum non-individuals. As a further remark, let us mention that there is a theory of *multisets* (Blizard 1988); roughly speaking, a multiset is a collection of objects where a certain element may appear more than once, and the number of occurrences of the elements are relevant for the cardinal of the collection. For instance, while $\{1,1,2,3,3,3\}$ has cardinal 3 in a standard set theory like ZF, in multiset theory it has cardinal 6. A quasi-set is not a multiset. In a multiset, it is *the same* element that is counted more than once, while in a quasi-set, due to the fact that some of the elements may lack identity, we cannot say that, but only that a certain *kind* of entity

may appear more than once. Anyway, the cardinal number of the collection makes sense, even without identity conditions.

2.4. Quantification and identity

The next claim by Bueno concerns identity and quantifiers. According to him, in order for quantifiers to make sense, we must have identity as applied to all elements. Intuitively speaking, “for all” means “for each”, thus, if we say that for all even numbers some property holds, then it holds for 0, for 2, for 4, and so on. In this sense, we need to identify all elements of the domain, hence, they must ‘have identity’. But this is just an interpretation. For instance, in order to understand the rule of universal generalization, namely, that from Fa it follows $\forall xFx$, being a is arbitrary in Fa (that is, a ‘parameter’, not a proper name of an individual object), we must know in advance that “each *distinct* object in the domain is in the range of the universal quantifier”. Furthermore, we must know that there is no object in the domain distinct from a that is ‘not- F ’. Identity is involved in such claims, and so, the intelligibility of quantifiers, it seems, requires identity.

However, things are not so drastic as they seem. In the first place, one could apply a proof-theoretic kind of semantics in which the meaning of the quantifiers are fixed by the syntactical rules we use for such logical constants, such as the standard ones in first-order or in higher-order logics, and nothing about the domain is said from this purely formal point of view. According to this approach, the way quantifiers work is determined by the axioms we use, and not by the intended interpretation we have for

them on a Tarski-style semantics. So, universal quantifier gets its meaning independently of identity.

For an alternative, consider the rule that goes from Fa to $\forall xFx$, with the proviso that a is arbitrary (*i.e.* a parameter). The only sense Bueno sees in this is that for each object of the domain, it has F . However, even in classical semantics, one can have an alternative interpretation that goes without mentioning *each* object of the domain: it is related to the approach to generalized quantifiers. In a nutshell, call $|F|$ the class of objects of the domain that have F , and let D be the domain of the interpretation. The interpretation for $\forall xFx$ can now be stated simply as saying that D is a subset of $|F|$. For instance, we may say that $|F|$ is the class of all (just two) Oxygen atoms in a molecule of O_2 without need of identifying them.

In the same vein, the interpretation for $\exists xFx$ means that $|F|$ is not empty. For instance, we may say that in an Helium atom in the fundamental state, we may say that there exists *one* electron with spin UP in a given direction, without need of identify it (really, this is impossible according to standard quantum mechanics). In neither mentioned case it is required the identity of the objects being quantified. Furthermore, this interpretation has the advantage of being generalizable and also of taking seriously the idea that a quantifier is a higher-level predicate.

The interpretation sketched in the last paragraph has another advantage: it can be employed to provide an interpretation for quantifiers in metalanguages without identity, like quasi-set theory. Given that this can be done, it seems for us that the

claim that identity is required to make sense of quantifiers does not go through (for further discussions on this problem, see Arenhart 2014).

In such interpretations we also have an answer to another claim made by Bueno: that to make sense of universal generalization (from Fa to infer $\forall xFx$), we must make sure that there is no object in the domain of interpretation that is *distinct from a* and that it is a 'not-F'. According to our proposal, all that needs to be assured in order to grant that the rule works, besides the interpretation above, is that we make sure that there is nothing *discernible from a* that is a not-F. In fact, everything indiscernible from a will automatically be an F, otherwise they would be not indiscernible from a . So, all we need to take into account is discernibility, a relation we have already claimed to be strictly weaker than identity. So, to make sense of quantifiers, we need much less than the whole identity.

This argument also works to solve the problem posed by Bueno of the collapse of existential and universal quantifiers. According to Bueno, if we do not take into account that a is arbitrary in the inference from Fa to $\forall xFx$, and that a is not arbitrary in the inference from Fa to $\exists xFx$, both quantifiers end up collapsing. Identity is needed for that distinction, because a is said to be arbitrary in Fa , recall, when we are able to determine that no object distinct from a is not an F. However, with the interpretation sketched above, and taking into account only discernibility, and not identity, we are able to show that quantifiers do not collapse.

3. Identity and quantum mechanics

Bueno still makes a further point in connection with his claim that quantifiers do not make sense without identity. He relates such an issue with the consequent failure of an interpretation of quantum mechanics in which not every object has identity. According to Bueno, if his arguments are correct, the interpretation should not work.

However, if our above arguments are correct, then the relation of identity is not so precious that it cannot go out at least in some domains of interpretation. Bueno advances against such an attempt another charge: that we cannot make sense of cardinality of collections without identity. So, in the interpretations of quantum mechanics according to which objects do not have identity, we would not be able, according to Bueno, to keep a cardinal for collections of such entities (see French and Krause 2006, chap. 4 for further discussions on the non-individuals in quantum mechanics).

One of the procedures used to establish a cardinal in quantum contexts, one, that is, that allegedly does not require identity, is criticized by Bueno. According to such an approach, first presented by Domenech and Holik 2007, we may count the electrons in a Helium atom by putting it in a cloud chamber and using radiation to ionize it. We observe the track of an ion and the track of an electron. By repeating the procedure, we discover that only two electrons can be extracted by such a procedure. The whole point is that by employing this approach we do not need to take into account the identity of the extracted electrons. All that matters is that we have two electrons.

Against these, Bueno states that in order to grant that we have two electrons, we must make sure that the extracted electrons are not the *same*, that each time we apply radiation we are extracting a new electron, that is, one that is not the same as the previous one. Otherwise, we cannot make sure we are not counting the same thing twice.

Notice that this goes straight against the idea that one can interpret quantum mechanics as comprised of entities without identity but with a definite cardinal. So, to grant the intelligibility of the project we must grant that this criticism is not well placed. And, indeed, we believe it is not correct.

First of all, we grant that the experiment *can* be described as extracting two different electrons. We hold, however, that it need not be so. We can, for instance, absorb each electron that is extracted from the atom, so that there is no doubt that an electron is not being counted twice. Furthermore, we may produce alternative counting procedures, such as weighting, in which, given that we know the kind of particles we have in a state, and given that we know the mass of each such an element (remember that they are nomological, after all), we can determine how many objects there are. This procedure involves no extraction, and no claim of the identities of the elements need be made. So, in the end, cardinality may very clearly be seen as independent from identity (for further discussion, see Arenhart and Krause 2014).

4. Conclusion

We conclude that the claim that identity is fundamental, according to Bueno, does not go through. Almost every claim made to establish this thesis can be either shown not to achieve its goal or else to be amenable to be paraphrased in terms of discernibility. So, in the end, it seems that the most we need is a discernibility relation, which is in fact closer to our everyday necessities.

Furthermore, as we have mentioned in the beginning of the paper, it is not clear for us what Bueno meant by “identity” and by “fundamental”. We hope to have shown that, whatever the senses these words may have, in the context that they are used by Bueno, the idea that identity is fundamental does not get established by his arguments. We would even go further in claiming that identity is, for practical purposes, unnecessary, but this is a matter for another work.

References

Arenhart, J. R. B., 2012. “Many entities, no identity”. *Synthese* **187**, pp.801-812.

Arenhart, J. R. B., 2014. “Semantic analysis of non-reflexive logics”. *Logic Journal of the IGPL*, **22**(4), pp.565-584.

Arenhart, J. R. B. and Krause, D., 2014. “Why Non-Individuality? A discussion on individuality, indentity, and cardinality in the quantum context”. *Erkenntnis* **79**, pp.1-18.

Arenhart, J. R. B. and Krause, D., 2014a. "Oppositions and quantum mechanics: superposition and identity". In *New dimensions of the Square of Opposition*. Eds. Jean-Yves Béziau and Katarzyna Gan-Krzywoszynska, In print in Munich:Philosophia Verlag GmbH: pp.337-56.

Béziau, J. –Y., 2003. "New light on the square of oppositions and its nameless corners". *Logical Investigations* 10, pp.218-232.

Black, M., 1952. "The identity of indiscernibles". *Mind* **61**, pp.153-164.

Blizard, W. D, 1988. "Multiset theory". *Notre Dame Journal of Formal Logic* **30**, no. 1, pp.36-66.

Bueno, O., 2014. "Why identity is fundamental". *American Philosophical Quarterly*, **51**, pp.325-332.

Dalton, J., 1808. *A new system of chemical philosophy*. London: Printed by S. Russell.

Domenech, G., Holik, F., 2007. "A Discussion of particle number and quantum indistinguishability". *Foundations of Physics*, **37**, pp.855-878.

Dorato, M. and Morganti, M., 2013. "Grades of Individuality. A pluralistic view of identity in quantum mechanics and in the sciences". *Philosophical Studies*, **163**(3), pp.591-610.

French, S., and Krause, D., 2006. *Identity in Physics. A historical, philosophical and formal analysis*. Oxford: Oxford University Press.

Kunen, K., 2009. *The Foundations of Mathematics*. London: College Publications.

Lowe, E. J., 2003. "Individuation". In: Loux, M. J., Zimmerman, D. W., (eds.) *The Oxford Handbook of Metaphysics*. Oxford: Oxford Un. Press, pp.75-95.

McGinn, C., 2000. *Logical Properties*. Oxford: Oxford Un. Press.

Mendelson, E., 2010. *Introduction to mathematical logic*. 5th ed. Chapman & Hall/ CRC.

Wehmeier, K. F., 2012. "How to live without identity – and why". *Australasian Journal of Philosophy*, **90**(4) pp.761-777.