FILOSOFIJA. SOCIOLOGIJA. 2017. T. 28. Nr. 3, p. 165–171,

On Identity and Simultaneity

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While we often talk about different types of identity, logical, ontological, or Leibniz's Identity of Indiscernibles, we often tend to overlook that any question regarding "What is identical?" or "How is it identical?" depends upon "When is it identical?" or "Where is it identical?" Therefore, identity cannot be understood without spacio-temporal reference. Also, as any object can be described as an event or to make it stricter – any object is an event, thus anything considered to be simultaneous also must be considered as identical in time. However, while simultaneous objects (events) are considered to be identical in time, not all identical objects (events) are considered to be simultaneous. Following this consideration, four possible types of spacio-temporal identity are analysed. Any object (event) can be identical: A) In Time and Space; B) In Time but not in Space; Γ) In Space but not in Time; Δ) Neither in Space nor in Time. Therefore, all objects (events) that are considered as being identical fall into one of these four spatio-temporal types. This is true whether we have properties, features, qualities or any other factors which let us consider objects (events) as identical. As we can see, only cases A and B apply to the notion of simultaneity, where objects (events) are considered to be identical in time. We also know that simultaneity is relative and depends upon a system of reference. Therefore, we may expect that the same applies to identity thus forming an idea of relativity of identity in those types that depend on time.

Keywords: identity, space, time, simultaneity, relativity, chirality

In this paper I am going to analyse the interconnection of the notion of identity and simultaneity. I am going to argue that any notion of simultaneity depends upon a notion of identity and that any notion of identity is spatio-temporal. However, before doing this a thorough analysis of the concept of identity is needed. This analysis will be carried out always with reference to space and time. While the notion of identity is not an object itself, most of the references to it will instead refer to the identity of objects.

Any object with which we are familiar exists in space and time and there is no object which we would naturally experience and which would not exist in space and time. Therefore, any type of identity of objects, their properties or thoughts about them is already spatio-temporal. Even if I have in mind Post's transcendental identity (Post 1963), thoughts about it are ordered in spatio-temporal connections, order and continuity. The importance of spatio-temporal order in a problem of identity is emphasized by many philosophers and scientists. Quine puts it this way: "In ostension, spatial spread is not wholly separable from temporal spread" (Quine 1950: 4) and "The concept of identity, then is seen to perform a central function in the specifying of spatio-temporally broad objects by ostension" (Quine 1950: 4–5). If

all objects are spatio-temporal, then all objects are events in space and time. Any event is what happens at certain positions and periods in space and time. Each object has its lifeline which always intersects with lifelines of other objects. Such an intersection is usually called an event. Therefore, any object is an event itself and it is moving in relation to other objects in space and time which can also be said of its lifeline's intersection with lifelines of other objects. As such events each of the objects has its own lifeline or, as French and Krause call it, trans-temporal identity (French–Krause, 2006) which is not the most successful term as it misses the spatial part of it. I would not be arguing about the necessity of the conditions for the acceptance of the importance of lifelines of an object – for more detailed discussion on this topic see Hirsch's "The Concept of Identity" (Hirsch 1982). Not all the conditions are necessary as an object might undergo various transformations of states in its lifeline. Meanwhile, I just note that an object as an event without lifeline cannot be identified.

Often many different analyses of identity tend to mix problems of identity of one object and problems of identity of two or more objects. This often leads to confusion and pseudo-problems as well. Following Frege's Puzzle we will analyse relations between objects but in regards to their spatio-temporal continuity and their lifelines. Therefore, here we will make a distinction between 1) one object as identical to itself, $X = X$; 2) two or more objects as identical, $X = Y$. The first type of identity is often called self-identity. As we will see, strict identity (A-type identity) cannot be applied here at all. This distinction is important as it separates between an object with the same lifeline and objects with different lifelines. I will call this distinction 1st and 2nd types of identities. It is also important to distinguish between moments in time and process through time according to Quine (Quine 1950) which also refers to a position in space and different changing positions in space. At the same time according to Wiggins, who supports the Aristotelian idea that existence is not a predicate, both the strong and weak principles of the Identity of Indiscernibles based on predicates only do "not give us any effective sufficient condition of identity" (Wiggins 1967: 34). Therefore, lifelines of objects expressed through spatio-temporal continuity play an important part in solving problems of identity. The importance of space and time is well described by Armstrong in his "immanent" conception of universals (Armstrong 1989), according to which universals are in space and time. Black's critique of the principle also involves space as one of the major factors constructing his argument. Worth noting is that John O'Leary-Hawthorne shows in his article (O'Leary-Hawthorne 1995) that Black's arguments (Black 1952) do not defeat the bundle theory which can be used to solve the Identity of Indiscernibles problem. In fact, Black's argument repeats Leibniz–Clark and later Kant's debate while his "Isn't it logically possible that the universe should have contained nothing but two exactly similar spheres?" (Black 1952: 156) already presupposes two objects and not one. Therefore, despite considering them to be imaginable or having real existence, we already have two objects with two separate lifelines in space and time and thus we have a $X = Y$ case here. While Black's argument is here mainly dealing with identical predicates, it is also clear that such an argument is *prima facie* false. It is also worth noting that space is used as a major instrument for the analysis of his argument. I shall come back to this issue in the analysis of chirality as well as similarity vs sameness. After all is said, we can see that space and time play crucial roles in any critique of any identity. I will not go into debates with many different philosophical positions regarding problems of identity. In my opinion, spatio-temporal analysis shall reveal solutions to some of them. Therefore, let us analyse four possible types of identity according to lifelines of objects in space and time (Table).

Table. **Types of identity**

Identity	1 ($x = x$)	2 ($x = y$)
Identity A in time and space	one object identical to itself at the same position and moment in space and time	two or more objects identical to each other at the same position and moment in space and time
Identity B in time but not in space	one object exists in two places at the same time	two or more objects coexist in time
Identity Γ in space but not in time	the same object at the same position in space over the period of time	two objects at the same position in space at different moments of time
Identity Δ neither in space nor in time	one and the same object at different positions in space and at different moments of time	two or more different objects at different positions and moments in space and time

A) IDENTITY IN TIME AND SPACE

This type of identity is strict. Following our distinction of identity of objects with the same and different lifelines we have:

– A1) one object identical to itself at the same position and moment in space and time; and

– A2) two or more objects identical to each other at the same position and moment in space and time.

John Locke notices in his Essay that ideas of identity and differentiation evolve from a comparison of objects at different moments and positions in space and time (Locke 2000). Therefore, identity A1 is impossible because we cannot compare an object to its other positions and moments in space and time and such identity statements would be tautology. We can say "this house is this house" ($x = x$) but we can say nothing about its sameness. We do not know if "the house is the same as it used to be a while ago". Therefore, the lack of comparison makes this form of identity impossible.

A2-type identity is that of Identity of Indiscernibles. Two objects are identical if and only if all of their properties including their positions in time and space are identical. However, we can define this principle only negatively (see also Leibniz (Leibniz 1989) and Locke (Locke 2000)) because it is impossible to identify two objects if they are one, and vice versa when two objects are one, then it is impossible to tell that they are two. Therefore, McTaggart's Dissimilarity of the Diverse is a more correct illustration of this principle. In other words, there should exist at least one property that lets us distinguish between two objects. French and Krause put it this way: "we might point to some property which cannot be shared, such as location in space-time. Clearly – or so it would seem – our two umbrellas cannot occupy the same space at the same time. But why not? Because – it might be answered – they are impenetrable" (French, Krause 2006: 2).

In his "Physics" Aristotle (Aristotle 2001) gives an example of a road that leads from Athens to Thebes. Wiggins emphasizes the question as to whether this is the same road that leads from Thebes to Athens as one way it goes down the hill and the other up the hill. This "problem" is not really a problem at all. It is the same as asking whether it is the same jacket when looked at from the inside and the outside; it raises a far more important problem of identity and chirality which applies to Black's argument and which I shall briefly discuss in the following identity type analysis.

B) IDENTITY IN TIME BUT NOT IN SPACE

This type of identity is partial identity:

– B1) when one object exists in two places at the same time; and

– B2) when two or more objects coexist in time or, in other words, their existence is simultaneous in different places. Those two objects also either might have identical certain properties or they might have different ones.

Strictly speaking B2 type of identity is possible only within the same framework of a reference system which was shown by Einstein. Therefore, I will not go further into its analysis. Relativity of simultaneity is well explained in Einstein's "Relativity" (Einstein 2004).

B1 type of identity was first predicted by Bose and Einstein and it is well known in quantum mechanics provided we recognize a particle as individual. As we know also from the recent scientists research of Max Plank Institute and CIT (California Institute of Technology in Pasadena), electrons in atoms of Nitrogen molecule have simultaneous emissions if the molecule is ionized with weak X-rays (Rolles et al. 2005). This experiment in fact confirms earlier experiments in quantum mechanics about the behaviour of particles as waves which leads to an interpretation of them being simultaneously at two different places. Moreover, today's experiments of Monroe, Meekhof, King, Wineland, Haroche (Monroe, Meekhof et al. 1996), the last two being awarded a Noble prize in 2012, show us that not only small particles such as electrons but also "giants" of quantum world such as atoms can appear simultaneously at two different places. The question still continues if the atom should be considered as an individual. If the answer is negative, then what is the smallest part of the world which is an individual? Still, according to different properties of atoms I would hardly imagine that anyone successfully defends the negative position.

However, this is not the only scientific question raised by B-type identities. Both of these types of identity raise questions of chirality and the mirror image of an object. Here it is important to note the difference between the mirror image as an image (reflection) of an object, in which case it is identical with an object as any image, is a part of an object and mirror image as a different object in which case they are not identical. Chirality as an argument was one of the major points raised by Imanuel Kant (Kant 1999) in disagreement with Leibniz's relationism of space and time. In regard to chirality we can see an interesting thing – it disappears when changing in dimensionality of space. Two chiral objects or enantiomers become achiral when changing space dimensions. This might be well demonstrated with Möbius Strip which is itself a chiral object. If we draw two chiral objects on it and send them all the way around, then on "the opposite side" of the Möbius Strip these objects become achiral – which is easily seen if the strip is transparent. This example shows that 2D enantiomers when seen from 3D become achiral and the same shall apply to 3D chiral objects when seeing them from 4D, etc.

Γ) IDENTITY IN SPACE BUT NOT IN TIME

This type of partial identity shows that an identical object or objects are in the same space over a period of time or at different moments of time. As it was shown in the A identity analysis, there cannot be two objects at the same position and moment in space and time but there can be either

– Γ1) the same object at the same position in space over the period of time; or

– Γ2) two objects at the same position in space at different moments of time.

The Γ1 type is possible only within a fixed reference system framework. In regard to two or more reference systems this type of identity is impossible. The same applies to the Γ2-type

identity. Therefore, the main question here is what is defined as "the same position in space". If I state that "every time I get back home I get back to the same position in space", then in regard to my house, or its relation to neighbouring houses as a reference system, such a statement would be true. However, if we set a different reference system such as the Moon or Jupiter, then such a statement would not be true anymore. Therefore both Γ cases are relative.

Δ) IDENTITY NEITHER IN SPACE NOR IN TIME

This type of partial identity can be applied to

– Δ1) one and the same object at different positions in space and at different moments of time;

– Δ2) two or more different objects at different positions and moments in space and time thus they do not coexist.

The Δ1-type identity might be illustrated with a famous example of Frege's Venus being a Morning Star and Evening Star (Frege 1952). One and the same object due to its different position and moment in space and time acquires a different name. The Δ2 type-identity may be expressed via predicates of an object, e.g. "this cup is exactly the same as a cup I used to have". Here I state that it is not the same cup with the same lifeline but it is exactly similar to the one I had before. While this type of Δ identity at the first glance might seem as not being spatio-temporal, especially Δ2 type, but at the same time it involves the space and time perspective as an evaluation instrument for objects as not being identical in space and time.

SAMENESS AND SIMILARITY

What comes out of the analysis of these four types of identities is that identity as $x = x$ and $x = y$ does not exist. In other words, A-type identity is impossible. Instead of $x = x$ and $x = y$, we should have $x = xtndn$ and $x = ytndn$ where *tndn* means a certain position of an object in space and time. Both Γ and Δ types of identity are what French and Krause call a trans-temporal identity (French, Krause, 2006) due to differentiation in time.

After the brief analysis of four types of identity according to objects' lifelines through space and time, we can see that the term of Identity or Sameness can be used only in α cases or only if an object has the same lifeline. At the same time the term similarity should be applied to all 2nd cases when objects have different lifelines. Now we can see that Black's two spheres, as he states himself, "are two exactly similar spheres" (Black 1952: 156), not the same *ergo,* not identical. While different objects can have the same properties – let us reduce these to two geometric figures (spheres) without colour, taste or smell and leave just their form in space and time, we still have a clear distinction between their position and momentum in space and time, or in other words, between their lifelines. In other words, all properties of two objects can be the same, except for their position in space-time. That is why I prefer to use the term Similarity instead of French–Krause's Distinguishability. Now let us take a look at what happens here with Frege's Puzzle where identity of an object to itself $a = a$ is trivial? The space-time analysis shows us that objects as events are never in the same relation to themselves over the period of time and position in space: description of type A1 is negative and type Γ1 is only possible within the framework of the same reference system which needs to be static. Therefore, "real" identity is possible only in case Δ1 – we have identity of an object moving through space and time. B1-type identity is problematic as it involves the notion of simultaneity which is constructed upon the notion of identity.

SIMULTANEITY

Commonly we describe simultaneity as having two or more objects (events) at the same time. Such notion of simultaneity might be found in Aristotle's "Categories" – he emphasizes "appearance" and "becoming" (Aristotle 1995). So, simultaneity clearly applies to cases A2 and B2, the first one being impossible due to lack of the spatio-temporal continuum. A special case of simultaneity can be seen in B1 as here we have a simultaneous existence of one object in two places. While two objects can be not identical at all, their existence still can be simultaneous. However, in order to state that two objects are simultaneous we need to have a notion of identity as a relation in time or sameness because simultaneity simply means the same moment in time. Therefore, simultaneity is identity in time. Without this identity as a relation in time we cannot have the notion of simultaneity. This identity is not necessarily the identity of objects (their predicates), but rather it is the identity of time moments when two lifelines of objects coexist in time. We also perfectly know that this coexistence in time or notion of simultaneity is quite problematic. Einstein clearly showed that simultaneity is relative unless we speak of the same reference system. In other words, there are no simultaneous events unless a clear reference system framework is applied. It is also worth noting that according to Einstein: "It is neither the point in space, nor the instant in time, at which something happens that has physical reality, but only the event itself" (Einstein 2003: 30). We can add that it is not identity which has physical reality but it is applied to objects (events). Therefore, in order to describe objects as simultaneous we need to have the notion of simultaneity which is constructed after we have the notion of identity which is constructed after we can compare objects in different moments and positions in space and time. To explain this more clearly – as we have seen, A1-type identity is impossible because we lack a record of the lifelines of objects, and all statements about this kind of identity are tautologies. We cannot compare an object to its previous states. Therefore, we cannot say if it is the same object. As soon as we involve space and time, we can compare the present and previous states of an object and thus identify whether it is the same or different object. Space and time give us the ideas of identity and differentiation. This is how the notion of an identity appears. Now the notion of simultaneity derives from the notion of identity as "being at the same time". However, we do know that simultaneity is relative and depends on a reference system to which object is assigned. Therefore, it is logical to assume that identity is also relative at least in some cases where it forms the notion of simultaneity. As we have seen from the comparison of sameness and similarity, the notion of identity should be applied only if an object has the same lifeline. And relative simultaneity, which describes two lifelines intersecting "at the same time", should be understood as similarity. Therefore, it would be correct to apply the term simultaneity only to type B1 while cases A2 and B2 should be referred as a relative similarity which is always relative anyway.

CONCLUSIONS

The following can be concluded after the analysis of identity and spatio-temporal relations. The notion of identity is impossible without space and time which are the main properties of any identity of objects. There is no identity which would have the same position and moment in space and time. A-type identity does not exist as it is impossible to prove it. Therefore there is no identity neither as $x = x$ nor $x = y$. This becomes obvious upon separation of sameness and similarity according to the lifelines of objects. And that is where the notions of sameness and similarity refer to objects with different lifelines. Therefore, B2-type identity based on simultaneity is similarity and the only form of simultaneity is B1 type. The identity type with

such similarity is relative. So are both cases of Γ-type identity and so is Δ-type identity too. Therefore, the spatio-temporal analysis of identity leads to the relativity of identity. However, only Δ1-type identity, even if being relative, can be called a "real" identity.

Received 30 March 2017
Accepted 28 June 2017

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Apie tapatybę ir vienalaikiškumą

Santrauka

Dažnai nagrinėjant skirtingas tapatybės formas nepastebima, kad bet kuris klausimas „kas yra tapatu?" arba „kaip yra tapatu?" priklauso nuo išankstinių klausimų „kada yra tapatu?" ir „kur yra tapatu?". Kadangi kiekvienas objektas yra įvykis, todėl bet kas, kas įvardijama kaip vienalaikiška, taip pat turi būti įvardijama kaip tapatu laike. Tačiau nors vienalaikiški objektai (įvykiai) laikomi tapatūs laike, ne visi tapatūs objektai (įvykiai) yra vienalaikiški. Remiantis tokia erdvės, laiko ir tapatumo sąsaja, straipsnyje analizuojami keturi erdvėlaikinės tapatybės tipai. Bet kuris objektas (-ai) (įvykis(-iai)) gali būti tapatus(-ūs): a) erdvėje ir laike; b) laike, bet ne erdvėje; c) erdvėje, bet ne laike; d) nei erdvėje, nei laike. Todėl visi objektai (įvykiai), kurie laikomi tapačiais, patenka į vieną šių erdvėlaikinių tapatybės tipų. Straipsnyje atskleidžiama, kad tik negatyvioji tapatybės apibrėžtis turi prasmę.

Raktažodžiai: tapatybė, erdvė, laikas, vienalaikiškumas, reliatyvumas