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Change the Problem of Intrinsics – Reformulating the Problem of Temporary Intrinsics Without Distracting Semantics and Intrinsics

Introduction

In his book *On the Plurality of Worlds* (1986), Lewis introduces the problem of temporary intrinsics alongside the problem of accidental intrinsics. In the accidental case, the question is how something "can have different [intrinsic] properties as part of different [possible] worlds" (Lewis 1986, 201), while intrinsics are supposed to be independent of the neighbourhood of the object. Lewis's solution comes with the notion of 'counterpart': a representation of an object in another world (1986, 194-195).

This parallels the problem of temporary intrinsics, which revolves around the question how the same object can have different intrinsics at different times, while intrinsics are supposed to be independent of time. To solve this problem of intrinsic change, Lewis introduces 'temporal parts'[1]; different intrinsics are had by different temporal parts of objects.

Lewis's solution, the idea that different intrinsics are had by different parts of the objects, and more general, the problem of change that Lewis states, has been the topic of debate for more than two decades. Notably, Lowe, in his rejoinder to Lewis's 'The Problems of Intrinsic Change' (1988), argues that there are two "problems of intrinsic change - a *semantic* problem and a *metaphysical* problem" (1988, 72). On the other hand, and in a different fashion, Pablo Rychter argued in his recent text 'There is No Puzzle about Change' (2009) indeed that there is no puzzle about change.

In this paper, it will be attempted to remove some confusion in the current debate about temporary intrinsics. This confusion stems from the unwarranted use of semantic arguments in a metaphysical discussion and from a notion of intrinsicality which is somewhat

[1] Note that temporal parts, for Lewis, are indeed parts of an object; they are connected via a 'part-of' relation. Counterparts, in contrast, need not be part of the same object; they are only connected via a 'counterpart relation'.

counterintuitive. Ultimately, a new formulation of the problem of intrinsic change, in which location in space or time is taken to be a property, will be given for the problem of intrinsic change, which avoids this confusion.

In the first section, Lewis's treatment of the problem of temporary intrinsics will be addressed as well as Rychters statement that there is no puzzle about intrinsic change. It will be shown that the issue underlying Lewis's three solutions to the problem, as well as Rychters statement, is the notion of intrinsicality. More specifically, it will be argued that the major argument in the 'grand question' of endurance versus perdurance revolves around the notion of intrinsicality. Also, Rychters statement will be shown to depend on the notion of intrinsic.

In the second section, Lowe's distinction between the semantic and metaphysical problem of intrinsic change will be examined. It will be argued that although Lowe is right in distinguishing the two problems, they cannot be isolated from each other. It will be argued that one has to be careful not to use semantic arguments in the metaphysical debate about change, for this will be shown, with examples, to lead to circular arguments.

With any semantic issues treated in the second section, in the third section, the metaphysical problem of intrinsic change will be addressed. It will be shown that metaphysical endurance and perdurance are incompatible 'total' views, in the sense that accepting one of these views means accepting it in all cases, and rejecting the other. Time, as fundamental to the notion of change, will then be examined; the observation that time is dense will lead to the conclusion that change in incompatible properties is always continuous, and occurs as a series of continuous changes between intermediate properties. The notion of intrinsics will be discussed next, as well as the underlying notion of topological space. It will be argued that the definition of intrinsic in terms of topological neighbourhoods does not always correspond with intuitions about intrinsic change, and thus the idea of time and space as topological spaces will be replaced by the idea of taking location in space or time as property. This will subsequently be shown to lead to a new formulation of the metaphysical problem of temporary intrinsics.

Section One – The Problem of Temporary Intrinsics

Before delving deeper in the problem of temporary intrinsics, some introductory remarks about the origin and development of the debate are in order. First of all, since some philosophers use the phrase 'problem of temporary intrinsics' to refer to the problem Lewis mentioned, while others refer to it by using the phrase 'problem of intrinsic change', both expressions will be used interchangeably in this paper.

As mentioned in the introduction, Lewis introduced the problem of temporary intrinsics alongside the problem of accidental intrinsics. In section 4.2 of his book *On the Plurality of Worlds* (1986), Lewis asks the question how something manages to have modal properties. According to the 'overlap-answer', something has modal properties by "being a shared part common to many worlds, and by having different properties relative to different worlds" (Lewis 1986, 198-199). This answer respects the intuition that having a modal property does not involve some distinct counterpart having a (non-modal) property. However, what Lewis "find[s] problematic – inconsistent, not to mince words – is the way the common part of two worlds is supposed to have different properties in one worlds and in the other" (1986, 199).

Lewis gives the example of Humphrey, who has five, possibly six, fingers on his left hand[2]: "[q]*ua* part of this worlds he has five fingers, *qua* part of that world he has six" (1986, 199). Now this seemingly leads to the contradiction that Humphrey has both five and six fingers. One might object that these fingers are had 'at a world'; according to Lewis "[t]here are several ways for [such] modifiers to remove a contradiction. But none of them apply here" (1986, 200).

First: modifiers can instruct to consider only the parts of the object under consideration at a certain world: Humphrey's 'this-world-part' has five fingers, while his 'that-world-part' has six. However, Lewis objects, "the thesis we are considering is that the *whole* of Humphrey is part of different worlds, with different properties at different ones" (1986, 200). Second: modifiers can indicate a certain viewpoint, but for Lewis, a modal realist, 'at a world' expresses a reality, not an interpretation. Third: take properties to be relations to worlds. In

[2] See Lewis 1986, 198-202 for a detailed account of this example.

that case however, Lewis objects that the properties are had in virtue of worlds, and are thus not intrinsic properties after all.

This is the problem of accidental intrinsics: how can something have different intrinsics in different worlds? According to Lewis, accidental intrinsics parallel temporary intrinsics (1986, 202). Just as he uses the problem of accidental intrinsics as an argument against 'overlap' of different worlds, the problem of temporary intrinsics is introduced as an argument against endurantism, which is, according to Lewis, temporal overlap: "the content of two different times has the enduring thing as a common part" (1986, 202).

Lewis introduces the problem of temporary intrinsics with some terminology[3]. Lewis introduces first a neutral term: something persists iff "it exists at various times" (1986, 202). Then something perdures "iff it persists by having different temporal parts, or stages, at different times, though no one part of it is wholly present at more than one time; whereas it endures iff it persist by being wholly present at more than one time" (Lewis 1986, 202).

As stated earlier, the problem of temporary intrinsics is, for Lewis, an objection to endurance (1986, 203). He gives a clear account of the problem in his text 'Tensing the Copula" (2002): "Things somehow persist through time. When they do, they have some of their intrinsic properties temporarily[; but how] can one and the same thing have two contrary intrinsic properties?" (Lewis 2002, 1).

Here intrinsic properties are taken to be those properties which an object has in virtue of the way it is, in contrast with extrinsic properties, which an object has in virtue of other properties and objects. According to Lewis, "[e]xtrinsic change poses no further problem" (2002, 1; footnote 1), that is, no further problem in addition to the problem of intrinsic change. This is because, according to Lewis, extrinsic change "is derivative: something undergoes extrinsic

[3] Lewis follows Johnston in terminology (Lewis 1986, 202; footnote 4). This terminology is however not without debate. In their text 'The definition of endurance' (2009), Lowe and McCall argue that Lewis's use of 'wholly present' robs endurance of any meaning: "no precise understanding of what 'endurance' means is possible" (McCall and Lowe 2009, 278). This objection was earlier raised by Lowe, who, in his text 'Lewis on Perdurance versus Endurance' (1987), claims not think things endure, as Lewis defines it, for he cannot find an "useful application of the notion of such a thing being 'wholly present' at a time (Lowe 1987, 152). Later in this section, it will be argued that this criticism is however not warranted. Therefore, and because many others also do so, Lewis's terminology will be used throughout this paper.

change when either it or some part of its surroundings undergoes intrinsic change, or when its intrinsic relations to parts of its surroundings change"[4] (2002, 1; footnote 1).

The classification of properties as intrinsic or extrinsic will turn out to be important in determining whether Lewis's above described problem of intrinsic change is a genuine 'puzzle' of intrinsic change. As already mentioned in the introduction, Rychter argues that this is not the case. In the second section of his text 'There is no Puzzle about Change' (2009), Rychter examines Lewis's problem of temporary intrinsics. He claims that "although the way Lewis and others present the [problem of temporary intrinsics] *suggests* that there might be a *puzzle* about intrinsic change, this is only a suggestion and one that we should better ignore" (Rychter 2009, 16). Rychter argues that "we should understand the [problem of temporary intrinsics] as […] the metaphysical problem of explaining in very general terms how persisting objects undergo intrinsic change" (2009, 16).

Lewis's problem of temporary intrinsics is one of the four cases which Rychter examines as an attempt to generate a puzzle about change. He defines a puzzle as

> any set of English sentences that satisfies the following two requisites: (i) each of them, when considered independently of the rest, appears to express a true proposition […]; (ii) using uncontroversial rules of inference, a contradiction or an otherwise patently false conclusion can be derived from the seemingly true propositions that we take the sentences to express.
>
> (Rychter 2009, 9-10)

In all four cases, Rychter claims that either one of the sentences does not appear to be true or that there arises no contradiction. He stresses that in this way, he does not show a solution to a puzzle, but rather that there was no puzzle to begin with (Rychter 2009, 11).

The first case Rychter examines is Sider's example of 'Longhair', who, after a haircut, is still the same person, but now called 'Shorthair' to match is new appearance (2009, 10-11). This, in combination with Leibniz's Law ("the principle according to which if $x = y$, everything that is true of x is true of y" (Rychter 2009, 10)), can make for a puzzle, since Leibniz's Law seems to contradict the assertion that Longhair and Shorthair are the same person. According

[4] Extrinsic properties are also excluded from the problem of accidental intrinsics, but for different reasons (see Lewis 1986, 198-209).

to Rychter however, this attempt fails. He examines the sentences "Longhair has long hair" and "Shorthair *does not* have long hair" and claims that the above 'puzzle' does not "give these English sentences their natural meaning" (Rychter 2009, 12); what is actually meant by these sentences, according to Rychter, are some tensed propositions[5], so the alleged contradiction does not arise: indeed the same person has both long and short hair, but at different times, so there is no puzzle here (Rychter 2009, 11).

Secondly, Rychter examines an attempt to generate a puzzle about change along the lines of Haslanger, which revolves around what Haslanger, misleadingly, according to Rychter (2009, 13-14), has called the "*Law of non-contradiction*: Nothing can have incompatible properties; that is, nothing can be both *P* and not *P"* (Rychter 2009, 13). This, combined with the idea of objects persisting through change in incompatible properties, makes for a puzzle, since the changing, persisting object at stake would have incompatible properties, thus contradicting the law of non-contradiction. According to Rychter however, this law fails to be "intuitively plausible when considered independently" (2009, 13). He argues that "[t]he negation of [said law] is perfectly intuitively plausible: objects *can* have incompatible properties; and of course they *do* have them *at different times*" (Rychter 2009, 13).[6]

In both cases described above, Rychter dissolves the alleged puzzles by mentioning that the properties are had at different times, which removes the contradiction in the assertion that an object has two incompatible properties. Considering Lewis's problem of temporary intrinsics, Rychter states that Lewis "does not state a puzzle explicitly" (2009, 17). He is however urged to consider the contradiction that arises between the statement that an object has different incompatible properties at different times on the one hand, and the statement that said properties are intrinsic on the other. It should be explicitly made clear that if the consideration of this contradiction leads to a puzzle, it is a puzzle about *intrinsic* change, which would not arise for extrinsic properties. The contradiction considered here does explicitly depend on the

[5] Rychter argues that this hold for both an eternalist view on propositions as well as a temporalist view. According to eternalism, (2) and (3) are, since they are present-tensed, different propositions when uttered in different context. In the context of the haircut, it is clear that (2) is supposed to mean that Longhair has long hair *before the haircut*, while (3) is supposed to mean that Longhair as short hair *after the haircut.* According to temporalism, (2) and (3) are single propositions with different truth values at different times, and since there is no common time in which both (2) and (3) are true, no contradiction arises (Rychter 2009, 11).

[6] The third case Rychter addresses is less relevant for this paper and will not be examined at length. In short, Rychter considers a concise formulation of the problem, which he attributes to Oaklander and Varzi: "how can we say of something that it is the same, if it is no longer the same?" (Rychter 2009, 8). According to Rychter, this puzzle can be dissolved by distinguishing between a numerical and a qualitative sense of 'the same' (2009, 15).

properties being intrinsic. So whether or not a puzzle arises is dependent on the use of the concepts of intrinsic and extrinsic properties.

Earlier, intrinsic properties were taken to be those properties which an object has in virtue of the way it is, in contrast with extrinsic properties, which an object has in virtue of other properties and objects. In his discussion of Lewis's problem of intrinsic change, Rychter however explicitly uses the word 'depend' in characterizing the notions of intrinsic and extrinsic properties. He states that "[g]iven that P is intrinsic to x, x's having P should *depend* only on how x is; this is what being intrinsic means" (Rychter 2009, 17; emphasis added). As a consequence, x having extrinsic property P depends on something other than how x is[7].

In his text "Extrinsic Properties" (1983), Lewis also characterizes intrinsic and extrinsic properties in these ways:

> A thing has its intrinsic properties in virtue of the way that thing itself, and nothing else is. Not so for extrinsic properties, though a thing may well have these in virtue of the way some larger whole is. The intrinsic properties of something depend only on that thing; whereas the extrinsic properties of something may depend, wholly or partly, on something else.
>
> (Lewis 1983, 197)

Lewis then shows that this definition is ultimately circular, but suggests that "we could somehow break in from outside" (Lewis 1983, 198). Lewis examines an attempt to do so by Jaegwon Kim in his text "Psychophysical Supervenience" (1982), which is inspired by notion of properties "rooted outside the time which it is had" (Kim 1982, 59)[8], as put forward by Roderick Chrisholm in his book *Person and Object*. In his attempt to define 'internal properties'[9], Kim first defines the notion of a property (G in this case) to be rooted outside the objects that have it analogous to Chrisholm's definition a property rooted outside the times which it is had:

[7] One might include considerations about causality in the discussion about intrinsic and extrinsic properties, but that is beyond the scope of this paper.
[8] The formulation 'rooted in' will be used throughout this paper to indicate some hierarchical connection (i.e. if 'A is rooted in B', B will be regarded as underlying A). It is however beyond the scope of this paper to give an exact account of this connection.
[9] Lewis seems to regard 'internal' as equivalent to 'intrinsic' (see for example the first line of Lewis 1983, 197).

> G is *rooted outside times at which it is had* $=_{\text{def.}}$. Necessarily for any object x and for any time t, x has the property G at t only if x exists at some time before or after t.
> [...]
> G is *rooted outside the objects that have it* $=_{\text{def.}}$. Necessarily any object x has G only if some contingent object wholly distinct from x exists.
>
> (Kim 1982, 60)

The qualification 'contingent' prevents the interference of alleged necessarily exiting objects (e.g. numbers, according to some philosophers), while 'wholly distinct' prevents proper parts of the object from interfering. With the notion of 'rooted' thus defined, Kim defines 'internal properties' as:

> G is *internal* $=_{\text{def.}}$. G is neither rooted outside times at which it is had nor outside the objects that have it.
>
> (Kim 1982, 60)

As will be discussed in more detail later in this paper, Lewis takes an object existing at two different times to be the sum of two objects (temporal parts) existing respectively at those time. So, according to him, "if G is rooted outside times at which it is had, also it is rooted outside the objects that have it" (Lewis 1983, 198), which leads to a simplified definition:

> G is *internal* $=_{\text{def.}}$. Possibly some object x has G although no contingent object wholly distinct from x exists.
>
> (Lewis 1983, 198)

Lewis then considers two properties, accompaniment and loneliness, and claims that the above definition comes down to the idea "that extrinsic properties are those that imply accompaniment, whereas intrinsic properties are compatible with loneliness"[10] (1983, 198).

According to Lewis, the above definition of intrinsic properties now fails in two ways. First: "[l]oneliness is just as extrinsic as accompaniment, yet certainly it does not imply accompaniment and certainly is compatible with itself" (Lewis 1983, 199) and would thus seem intrinsic. Second: Lewis demonstrates with examples that it is not possible to "build on

[10] "One properties implies another iff it is impossible to have the first without the second; two properties are compatible iff it is possible to have both" (Lewis 1983, 199).

Kim's proposal, making it the basis for an inductive definition that would cover all the extrinsic properties, leaving the (more important) intrinsic properties as residue" (1983, 199), for the definition of extrinsic is not closed under disjunction and converse implication. Note that these objections cannot be avoided if Kim's original definition is used, instead of Lewis simplified definition, which assumes temporal parts.

How then to define the notions of intrinsic and extrinsic properties? Examining the earlier accounts, which used the notion of 'dependence' and the phrase 'in virtue of', as well as Kim's attempt reveals an underlying principle characteristic for the distinction between intrinsic and extrinsic properties: they all seem to differentiate between the way the object is and things other than the way the object is. This should come as no surprise; after all, since the goal of defining intrinsics is to differentiate between intrinsics and extrinsic, it should be expected that all possible forms in which such a distinction can be cast make a distinction somewhere. Furthermore, what is fundamental to this distinction is that it in some way conveys the intuition that gave rise to the idea of intrinsic and extrinsic properties in the first place: the intuition that there is a certain way an object is, in virtue of which certain properties are had. This intuition is however equivalent to the properties of the properties loneliness and accompaniment described by Lewis above; after all, the way an object is is compatible with loneliness, and everything other than the way an object is implies the existence of something other than the object, thus implies accompaniment. So Lewis's objections to his account of Kim's definition of intrinsics, since they depend on the notions of loneliness and accompaniment, seem to be unavoidable: every definition which does justice to the intuition that there is a certain way an object is will entail the properties loneliness and accompaniment and hence the problems Lewis raises. One could now either give up on the notion of intrinsics, or ignore Lewis's comments. In this paper, the latter will be done.

A definition of intrinsics is thus expected to make a distinction which conveys the intuition that there is a certain way an object is. As said before, the previously mentioned accounts of intrinsics all seem to differentiate between the way the object is and things other than the way the object is, in other words: between the object itself and its neighbourhood[11]. The notion of neighbourhood allows for a general framework in which a definition of intrinsic and extrinsic properties can be given: extrinsic properties are those properties rooted in the neighbourhood

[11] Or some equivalent term indicating all things other than how the object is; e.g. environment.

of the object that has them. Hence, if the object is isolated from its neighbourhood, it will lose its extrinsic properties. The properties that remain after this isolation from neighbourhood are thus defined as intrinsic. This process of isolation is nothing more than subtracting the set of objects which are defined as neighbourhood of the object under consideration from the set of all objects. For example, consider a universe that is only the set containing a door and a doorpost; examine the door and define the doorpost as neighbourhood of the door. Now suppose the door has two properties: being red and being inside the doorpost. Isolating the door from its neighbourhood leaves a set only containing the door; which is still red, but no longer inside the doorpost. The property of being red is thus, with this definition of neighbourhood, intrinsic, while the property of being inside the doorpost is extrinsic.

There are two remarks that must be made in regard of this definition. First, the above merely gives a framework for different definitions; the notion of neighbourhood is deliberately undefined. This makes it possible to easily compare different definitions of intrinsics, once cast in this framework. Only when it is determined what is object and what is neighbourhood in a certain case (whether by general rule or by provisional extensional definition), the above framework gives a definition of intrinsic and extrinsic properties.

Second, the above definition, which uses the idea of isolating an object from its neighbourhood, seems very similar to Lewis account of Kim's definition: the possible world to which the 'possibly' in Kim's definition refers seems similar to the isolated object. However, it must be noted that isolation as it is used in 'isolation from neighbourhood' can also remove possible worlds from consideration; especially on Lewis account, possible worlds consist of objects which, depending on the definition of neighbourhood used, might or might not belong to the neighbourhood of the object under consideration. Furthermore, whereas Kim's definition only 'isolates' a single object, the definition in terms of neighbourhood allows more freedom; what is isolated from its neighbourhood depends on how that neighbourhood is defined.

The definition of intrinsic and extrinsic properties is thus relative; it depends on the particular account of neighbourhood of the object under consideration used[12].

[12] The characterization of the notion of intrinsic in terms of isolation form a neighbourhood will be examined further in section three.

Now recall the contradiction that Rychter was urged to consider; it arose between the statement that an object has different incompatible properties at different times on the one hand, and the statement that said properties are intrinsic on the other. It now becomes clear how this contradiction arises: according to the first statement, an object has different incompatible properties at different times, for instance x has property P_1 at time t_1 and incompatible P_2 at t_2. This leads to the implication that if x has P_1, then x is at time t_1. Now if x's existing at a time is understood as rooted in the neighbourhood of x, it turns out that P_1 is extrinsic, which contradicts the second statement. This contradiction does however not arise if existing at a time is understood as rooted in x itself; i.e. where x to be isolated from its neighbourhood, it would still *exist at a time*. So in the end, the question whether this contradiction arises, thus whether there is a problem about intrinsic change, comes down to the question whether existing at a time is understood as rooted in the object itself or as rooted in the neighbourhood of the object.

Indeed, in his treatment of Lewis's problem of intrinsic change, Rychter could be read as arguing that existing at a time is rooted in the object itself. Rychter essentially tries to give the same argument as in his dissolution of the alleged puzzles of change posed by Sider and Haslanger, namely claiming that it "is perfectly intuitively plausible [that] objects *can* have incompatible properties; and of course they *do* have them *at different times*" (Rychter 2009, 13). In those two cases, such an answer was acceptable, since the problems were posed about properties in general. In Lewis's case however, it is explicitly requested that the properties are intrinsic. Now Rychter can only resort to claiming that the time at which properties are had plays a role, if he also shows that this does not make the properties extrinsic. It was shown above that this entails that time, or existing at a time, must be understood as rooted in the object itself, as opposed to rooted in the neighbourhood of the object.

Rychter does indeed claim that the assumption "that the time at which a property is temporarily had is necessarily something on which the having of the property *depends*" (2009, 17) is mistaken: "being had at a time does not make a property extrinsic" (2009, 17). Here 'depend' should be read as before, when it was used to formulate a definition of intrinsics and extrinsics. That is, '"depend[ing] only on how [the object] is" (Rychter 2009, 17)' is to be read as 'rooted in the object itself' (as opposed to 'rooted in the neighbourhood of an object'). Now in claiming that a property need not be extrinsic if it is had at a time, Rychter seems to confirm that he understands time as rooted in the object itself. For if being had at a time

depended on something (rooted) in the neighbourhood of the object, it would make a property extrinsic.

It thus seems that Rychter's claim that there is no puzzle about change does not fail in all cases. It is justified in the case of extrinsic properties, for in that case, there is no objection to Rychters statement that different properties are had at different times; after all, the properties were already extrinsic. So indeed the assumption that the properties are intrinsic is necessary for the problem to arise: it prevents an easy solution/dissolving by simply stating that although incompatible properties are had by the same object, no contradiction arises because they are had at different times. But also in the case of intrinsic properties, Rychter's claim can hold. It does so however only if being at a time is taken to be rooted in the object itself, rather than in its neighbourhood. This implies that if one wants to examine an object isolated from its neighbourhood, one has to take time into account. In other words: one cannot isolate an object and its properties from the time those properties are had by the object. This view will in the following paragraphs be shown to be essentially a form of endurantism,[13] which is the first of the three solutions Lewis gives for the problem of temporary intrinsics.[14]

It might now be asked whether it is plausible for time, or existence at a time, to be rooted in an object or in a neighbourhood; perhaps one of these options can be outright rejected due to some untenable metaphysics it requires. It turns out however that neither rooting time in object nor rooting time in neighbourhood is revisionary regarding an intuitive conception of existing at a time. For example: one can regard all existing to be either existing 'outside' time or existing at a certain time; in this way, with little effort, time is rooted in objects. As another example: one can regard times as abstract entities, each time related to the objects which exist at those times; in that way time is rooted not in objects, but in their neighbourhood, which contains those abstract times.

Now suppose that there is a puzzle (or less contested, a problem) about intrinsic change. One way of solving it is by viewing intrinsics as "disguised relations, which an enduring thing may bear to times" (Lewis 1986, 204). According to Lewis, this is the 'endurantist' way of dealing

[13] That is, a form of endurance which acknowledges intrinsics not to be disguised relations. More specifically: given that intrinsics are not disguised relations, it will be concluded that endurance entails the view that time is rooted in an object itself.

[14] At this point, one might even argue that Rychter is wrong all together in claiming that there is no puzzle of change and that instead he just fails to see the puzzle because he presupposes the endurance solution (specifically, a relation between properties and time).

with temporary intrinsics: “a persisting thing is multiply located in time: the whole of it is at one time and also at another” (2002, 2) (i.e. it endures), yet the properties are relations to those times and can therefore vary over time. This solves the problem without disposing of endurance, which has the advantage of being more intuitive than perdurance.[15]

Lewis argues however, that if properties are actually relations to time, then an enduring object considered on itself (i.e. independent of time) has no intrinsics; so then “there aren’t any temporary intrinsics” (Lewis 1986, 204). Some might argue “that certain relations to times are just what we *call* ‘intrinsic properties’” (Lewis 2002, 4), and if they are willing to accept the consequences thereof, a stalemate is reached. However, Lewis finds the idea that intrinsic properties are relations “simply incredible, […] we know that it [an intrinsic property] is a property, not a relation” (1986, 204).[16]

Notice that Lewis thus regards the time at which a property is had by an object as rooted in the neighbourhood of an object; after all it is the relation to time which contradicts the alleged intrinsicality of the property. When Lewis thus considers an object in isolation of its neighbourhood, he does not take time into account. It is this mechanic that is responsible for Lewis’s dismissal of endurance as a solution to the problem of temporary intrinsics, given his intuition about intrinsics being properties and not relations. Earlier it was shown that Rychter’s claim about the puzzle of change is, in the case of intrinsic properties, only to hold if existing at a time was rooted in the object itself. This view, which does take time into account when considering an object isolated from its neighbourhood, is opposed to Lewis’s view, but might be seen as an instance of just calling some relations intrinsic properties; after all, the relation between properties and times is a relation within the object if time is taken to be rooted in the object itself, hence they can be called intrinsics while still being relations to times.

Lewis’s dismissal of endurance strongly appeals to the intuition that an intrinsic property “is a property, not a relation” (1986, 204). However, it has been shown that whether this intuition leads indeed to a dismissal of endurance depends on an assumption about the notions of object and time. Taking the time at which an object has a property as rooted in the neighbourhood of

[15] Also, Haslanger, in her text ‘Endurance and Temporary Intrinsics’(1989) states that endurance is needed to “accommodate the idea that the past (causally) constrains the present” (Haslanger 1989, 120).
[16] In the same sense, one might probably argue that it is incredible for an intrinsic relation between two things to actually involve a third relatum; time.

the object, then Lewis indeed seems justified (given his intuition) in his conclusion that "there aren't any temporary *intrinsics*" (Lewis 1986, 204; emphasis added). On the other hand, if the time a property is had by an object is taken to be rooted in the object itself, then time-related properties also satisfy Lewis's intuition: they are still intrinsic. After all, if the object is isolated from its neighbourhood, it still has the properties at a time.

As an example, consider object x which has incompatible intrinsic properties P at t_1 and Q at t_2. Now take time to be rooted in the neighbourhood of x. This only means that if x is isolated from its neighbourhood, it can no longer be said to exist at (a) certain time(s); instead it merely exists 'outside time'. So taking time to be rooted in the neighbourhood of x, x, isolated from its neighbourhood, indeed does not seem to simply have P and Q. Rather, P and Q are related to t_1 and t_2 respectively, both rooted in the neighbourhood of x. On the other hand, take time to be rooted in x itself. This means that if x is isolated from its neighbourhood, it still exists at (a) certain time(s) (provided that it existed at (a) certain time(s) already). So if time is rooted in x itself, P and Q are had if x is isolated from its neighbourhood and hence still intrinsic. After all, x, isolated from its neighbourhood, still exists at t_1 and t_2, since time was taken to be rooted in x itself; hence x, isolated from its neighbourhood, still has P and Q. Contradiction is avoided because x has P at t_1 and Q at t_2, even if x is isolated from its neighbourhood.

So given Lewis's intuition that temporary intrinsics are properties and not disguised relations, one does not necessarily have to arrive at Lewis's dismissal of endurance; if one takes time to be rooted in the object itself, one might do justice to said intuition while still endorsing endurance as solution to the problem of intrinsic change. Lewis failure to recognize his background assumption about time being rooted in the object itself, rather than rooted in its neighbourhood, might furthermore be taken to be an objection to his treatment (and dismissal) of endurance, arguing, as above, that the intuition Lewis uses as argument for the dismissal of endurance does not automatically entails such dismissal.

On the other hand, Lewis has shown that taking time to be rooted in the neighbourhood of an object leads to a dismissal of endurance, given that intrinsic properties are not disguised relations. Now with contraposition it can be concluded that if endurance is not dismissed, it must not be the case that time is rooted in the neighbourhood of an object. In other words,

given that intrinsic properties are not disguised relations, endurance entails the view that time is rooted in the object itself. It now has become clear that, as was earlier stated, but left to be argued,[17] the view that an object and its properties cannot be isolated from the time those properties are had by the object is essentially a form of endurantism.

Lowe and McCall, in their text 'The Definition of Endurance' (2009),[18] also raise an objection against Lewis's treatment of endurance. Their main critique is against Lewis is that he "muddies the waters by giving a confused and ultimately untenable definition of endurance" (McCall and Lowe 2009, 277). Important aspect of their criticism is their supposed distinction between 3D and 4D objects. In the introduction of their text, Lowe and McCall already assert that Lewis views objects as "temporally extended 4D objects [which] *perdure*" (2009, 277). After repetition of Lewis's definition of endurance ("a thing *endures* if it persists by being wholly present at more than one time" (McCall and Lowe 2009, 278)[19]), Lowe and McCall unfold their criticism as follows:

> Plainly if there are enduring objects, which lack temporal parts, they cannot be 4D entities. They must instead be 3D. But then, what can it mean to say that a 3D object persist by being 'wholly present' at more than one time? The phrase 'wholly present' contrasts with 'partially present', but since it is unclear what the 'partial presence' of a 3D object would be, Lewis's use of the words 'wholly present' robs the assertion that 3D objects endure of any definite meaning.
>
> (McCall and Lowe 2009, 279)

There are several things that seem to go wrong here. First, it is casually stated that enduring objects lack temporal parts, and this is indeed (part of) the alternative definition that Lowe and McCall propose later in their text. However, this does not automatically follow from Lewis's definition, which only states that enduring objects persists by being wholly present at more than one time. Since the object is a part of itself, at any time an enduring object exists,

[17] See footnote 13.
[18] The same objection is also briefly discussed in Lowe's introduction to his text 'Lewis on Perdurance versus Endurance' (1987).
[19] Note that this is not a verbatim statement of Lewis's (original) definition of endurance from his book *On the Plurality of Worlds* (1986), in which the 'if' is an 'iff' (if and only if); an equivalence instead of an implication. Since Lowe and McCall do not explicitly point out the source of their version of the definition, it remains unclear whether this is in accordance with a weaker definition Lewis explicitly gives elsewhere, or if it is just a typographical error. In this paper, the latter will be assumed, especially because Lowe earlier (1987, 152) does explicitly refer correctly to Lewis's (original) definition, although it must be noted that Lowe and McCalls criticism is warranted if concerning the one-way implication only. After all, the statement that an object endures is indeed devoid from any meaning if endurance only appears as consequent and not as antecedent.

there is a part of the object, namely the object itself, present at that time.[20] So an enduring object can be said to have temporal parts at any time it exits, these parts being the whole of the object. This is perhaps a silly remark, which can easily be avoided by stating that enduring objects lack *proper* temporal parts, but more important is the confusion that arises from associating enduring objects with temporal parts. One might even reflect this argument back to Lowe and McCall, by asking what it means for an enduring object to lack temporal parts, subsequently asserting that it is unclear what it means for an enduring object to have (i.e. not to lack) temporal parts, ultimately arriving at the conclusion that Lowe and McCalls definition of endurance as lacking temporal parts is "confused and ultimately untenable" (McCall and Lowe 2009, 277).

It is no surprise that Lowe and McCalls argument against Lewis's definition could be mimicked into an argument against their own definition, given the symmetry displayed: while Lowe and McCall might argue that Lewis's definition, especially his use of 'wholly present' presupposes temporal parts, their own definition, especially their use of 'lacking temporal parts' might be (and is above) criticized for presupposing a notion of 'wholly present'. Overall, however, one might object against the reasoning that concludes meaninglessness of a sentence containing an assertion from the incomprehensibility of a contrasting assertion (as done by Lowe and McCall with the assertion 'being wholly present' and above with the assertion of 'lacking temporal parts').

Finally, Lowe and McCalls criticism rests on the notions of 3D and 4D objects; these are however not used by Lewis, but introduced and defined by Lowe and McCall. A way of reading their objection is that the notion of 'partial presence' of a 3D object contradicts the idea that one cannot take temporal parts of something that is not temporally extended. Claiming that 3D objects, which have no temporal extension, cannot be partial present (i.e. are wholly present) then seems tautological. If this is indeed Lowe and McCalls objection, then the only confusion which it reveals is on the side of Lowe and McCall. For their objection, as thus conceived, cannot be an objection against Lewis's definition, since Lewis claims nothing about 3D objects. Lewis only states that something "*endures* iff it persists by

[20] Temporal parts simply being parts located at a single point in time. One might object that the notion of temporal parts automatically asserts that "no one part […] is wholly present at more than one time" (Lewis 1968, 202). However, a careful reading of Lewis's definition of temporal parts in *On the Plurality of Worlds* shows that said assertion is included in the definition of perdurance, independent of the notion of temporal parts (1968, 202).

being wholly present at more than one time" (1986, 202). One might conclude, depending on the definition of 3D object, that 3D objects endure, but then it should hardly be any surprise that the statement that 3D objects are wholly present is tautological.

It seems that Lowe and McCall failed to see that their assertion that endurance and perdurance apply to 3D and 4D objects respectively is in fact a definition of endurance and perdurance, rather than a statement of fact. Especially in the case of endurance: considering a temporally flat 3D object automatically implies that the whole of it is present at a single time. This in turn entails that if a 3D object is present at multiple times, all of it is present at those times, which is a definition of endurance. So it seems that the notion of 3D object already entails the notion of 'wholly present'.

So not only is Lowe and McCalls criticism of Lewis's use of 'wholly present' in the definition of endurance unwarranted, but their alternative definition of endurance as persisting 3D object (McCall and Lowe 2009, 278) causes confusion of its own and can even be seen to entail the very notion of 'wholly present' against which they object. Lewis's definition of endurance is thus shown to withstand this critique and will be used in this paper.

Endurance is however not the only solution Lewis gives to the problem of intrinsic change. The second solution that Lewis mentions is presentism, which "rejects persistence altogether" (1986, 204). Objects do not persist (so they also do not endure or perdure), instead a "so-called persisting thing, if it really exists, is located entirely in the present" (Lewis 2002, 2). According to this hypothesis of presentism, only one time, the 'now', truly exists. The problem of intrinsic change disappears; an object cannot have incompatible intrinsic properties over time, for "the only intrinsic properties of a thing are those it has at the present moment" (Lewis 1986, 204). According to Lewis however, "[t]his solution amounts to a denial of persistence and change, and therefore is untenable" (1988, 66).

In the first part of 'Is there a Problem about Persistence?' (1987), Johnston also gives a solution that grants special ontological status to a single time. One can take temporal qualifiers to be sentence operators, which create new sentences with truth values dependent on time (Johnston 1987, 114). In this way, two sentences ascribing incompatible intrinsics to an object at different times will not both be true; only the sentence describing the object now will be. Consequence of this solution is that "[t]he appearance of advancing only arises if we

give a special ontological status to a single time" (Johnston 1987, 114). This can be done, contrary to what Lewis seems to think, without "denying persistence altogether. For the theorist may say that a presently existing object also did exist and will exist" (Johnston 1987, 114). Johnston remarks however that such a theory is difficult to maintain in the light of special relativity (1987, 114).[21]

Presentism is addressed frequently in a more general debate about the nature of time and will not be further discussed in this paper.

Besides endurance and presentism, Lewis offers a third solution to the problem of intrinsic change: perdurance. This is the solution that Lewis favours. The perdurance solution implies that "different temporary intrinsics […], belong to different things" (1986, 204): "persisting things are sums of temporal parts" (Lewis 2002, 1). According to Lewis, the advantage of this solution is that, in contrast to the endurance solution, intrinsic properties are still intrinsic, and not disguised relations (Lewis 2002, 2-4); it does justice to the intuition that an object can 'just plain have' properties, although the object having the property is a temporal part (Lowe 1988, 73-75); "intrinsic properties […] can be had *simpliciter*" (Lewis 1988, 66).

However, in her text "Endurance and Temporary Intrinsics" (1989), Haslanger remarks that Lewis's solution also "requires a trade off in our intuitions about intrinsic change" (Haslanger 119). Her objection is that for Lewis, contrary to intuition, "there is nothing such that it persists through a change in *its* intrinsic properties" (Haslanger 119); the intrinsics are found in the temporal parts of the perduring object, who themselves do not persist.

An extension of this objection can be found in Lowe's rejoinder to Lewis, 'The Problems of Intrinsic Change' (1988). He acknowledges[22] that temporal parts can 'just plain have a property', but questions whether this is an argument for perdurance. More precisely, his argument seems to derive a contradiction between Lewis's appeal to the intuition that intrinsics can be 'just plain had' and his view that intrinsics can only be had by temporal parts. For suppose the latter is the case. Now, Lowe argues, if 'just plain having a property' was an epistemic priority, "we have to learn first what it is for the temporal parts of things to

[21] But not impossible; one can chose cosmic background radiation, as reminiscence of the Big Bang, as the absolute frame of reference.
[22] In treating the semantic problem of temporary intrinsics; see section two.

‘just plain [have a property]’ before we can get to grips with the more complicated situation with changeable , persisting things” (Lowe 1988, 74). But this is clearly not the case: persisting things have been observed before there was any idea of temporal parts. However, now it is asserted that ‘just plain having a property’ is not an epistemic priority, where does the intuition that properties can be ‘just plain had’ come from? (Lowe 1988, 74). So Lewis’s view, which seem to entail that only temporal parts can ‘just plain have’ properties, seems to deny the intuition which is supposed to argue in favour of his view, namely that properties are ‘just plain had’.

It is worth noticing, as Johnston does, that “the view of persisting individuals as four-dimensional aggregate of temporal parts does not commit us to the view that temporal parts are epistemologically primary” (Johnston 115). This does, however, not dispel Haslangers and Lowe’s critique on Lewis’s appeal on intuition, although Lowe’s reasoning can be watered down a bit. To do so, notice that Lowe assumes that the intuition that properties are ‘just plain had’ must be derived from objects that indeed ‘just plain have’ properties. However, one might derive the same intuition from the, according to Lewis, false belief that ‘ordinary objects’ ‘just plain have’ properties. Finding this belief eventually to be false leads to a choice between (1) the intuition that properties are ‘just plain had’ and (2) the intuition that ‘ordinary objects’ do the having of these properties.[23] Perdurantism holds (1) and gives up (2), instead arguing that temporal parts do the (‘just plain’) having of properties, while endurantism holds (2), but gives up (1) in favour of time-related properties. So to answer the question Lowe asks, where does the intuition that properties can be ‘just plain had’ come from, if only temporal parts truly ‘just plain have’ properties? (Lowe 1988, 74); it comes from the, later to be found false, belief that ‘ordinary objects’ ‘just plain have’ properties. Still, it might be argued that perdurance requires a trade off in intuitions, and is in that respect not more or less favourable than endurance.

Although not as intuitively appealing with regard to properties being ‘just plain had’ as Lewis seems to think, perdurance remains the sole solution to the problem of *intrinsic*[24] change which is compatible with the view that time is rooted in the neighbourhood of the object.

[23] So indeed both endurance and perdurance require a trade-off in intuitions, as Haslanger has noted.
[24] That is, intrinsic properties not as disguised relations. The question whether or not the notion of intrinsic equals the notion of a property that is ‘just plain had’ remains unaddressed in this paper.

Besides the problems with Lewis's appeal on intuition, Lowe raises another objection against perdurance, more specifically against Lewis's notion of temporal parts. He argues that Lewis's solution invokes "a category of entities hitherto unknown to layman and scientist alike - 'temporal parts'" (Lowe 1988, 77). In contrast, Lowe offers in his text 'Lewis on Perdurance versus Endurance' (1987) his own solution to the problem of temporary intrinsics[25] which instead uses entities already known to modern day physics (Lowe, 1987, 154). According to Lowe, intrinsic change of an object is merely the rearrangement of the parts of the object, which stay the same. Consequently, "identity over time of certain objects consists in the preservation of certain relationships between their constituents at any given time" (Lowe 1988, 76). The regress that arises "can perfectly well be terminated at a level of *fundamental particles*, which have all their intrinsic properties *unchangeably*" (Lowe 1987, 154). This solution "squares far better with common sense" (Lowe 1987, 153) and does not invoke "entities hitherto unknown" (Lowe 1988, 77), as Lewis's solution does, but indeed uses the known notion of fundamental particles (Lowe, 1987, 154).

However, in his reply to Lowe, 'Rearrangement of Particles' (1988), Lewis states that he does not believe that Lowe's account of change as rearrangement of particles solves the problem of temporary intrinsic. Rather, Lewis argues, the problem is shifted from intrinsic properties to intrinsic relations: the relations between the particles are "intrinsic to the pair of *relata*" (1988, 69); they do not depend on any 'third' thing. Now the problem returns: how can the same two particles have a different intrinsic relation? "What has Lowe gained?" (Lewis, Lewis 1988, 70).

Lewis tries to solve Lowe's problem by offering a solution in which "[e]nduring particle have their distances [intrinsic relations] in a derivative and relational way" (Lewis 1988, 70), without using temporal parts of individuals. Instead, he proposes temporal parts of spacetime regions. An enduring particle then is wholly present at each temporal part of its spacetime trajectory. The intrinsic relations are then not between particles themselves, but between the temporal parts of the spacetime trajectory instead. However, according to Lewis, "[w]hat makes this picture of endurance barely acceptable is that it has so much *per*durance mixed in" (Lewis 1988, 71).

[25] That is, to the metaphysical problem of intrinsic change; see section two.

Lowe does indeed find this picture of endurance barely acceptable. He acknowledges that the perdurantist can give an explanation for change in intrinsic relations, for example the distance between two particles, by using temporal parts. However, the endurantist can, according to Lowe and McCall in their text 'The 3D/4D Controversy: A Storm in a Teacup' (2006),[26] give an equally good explanation of the change in distance: "the 3D particles are *moving* relative to on another" (McCall and Lowe 2006, 576). It is worth mentioning that the concept of motion can only be defined for 3D objects, enduring continuously over a time interval; in the 4D view, motion is an illusion (McCall and Lowe 2006, 577). A detailed discussion about the 3D and 4D view is beyond the scope of this paper, so these remarks will not be further addressed.

Aside from questions about Lewis's alleged solving of the problems he poses for Lowe's view, one can asked whether this criticism of Lowe, resting on the notion of intrinsic relation, is justified. Earlier it was shown that the definition of intrinsic depends on an assumption about the object and its neighbourhood: a property was regarded as intrinsic if it was had by an object even in isolation from its neighbourhood. The idea of intrinsic relation is ultimately a consequence of this relative notion of intrinsic. As was shown in the discussion of Rychters views[27] above, time could be treated as rooted in the neighbourhood of an object. In a similar manner, one might view the objects between which the intrinsic relation is supposed to hold each as not belonging to the neighbourhood of the other. That is, isolating the one object from its neighbourhood, the other object does not vanish; hence the relation, rooted in both objects, still obtains, and is thus intrinsic. With this relative notion of intrinsic, it appears that Lewis's notion of intrinsic relation is well defined. Lewis's objection thus seems justified, however it remains dependent on an assumption about the notion of object, namely that the neighbourhood of an object with an intrinsic relation does not include the relata.[28] This conclusion must come as no surprise: it was already established that Lewis's problem of intrinsic change and his dismissal of endurance depended on a particular account of neighbourhood, so little wonder that Lewis's notion of intrinsic relation shows the same dependency.

[26] See the end of section two for a discussion of the main feature of this text: a translation scheme between a 3D and 4D view, which makes use of Lowe's idea's about fundamental particles.
[27] Rychter holds that "being had at a time does not make a property extrinsic" (2009, 17).
[28] One can replace this assumption with the assumption that the composition of two objects is an object in its own right; the relation between the earlier objects becoming a property. In that way, the definition of intrinsic property given above can apply without any modification.

Another objection Lewis raises against Lowe is that even if one accepts Lowes enduring particles and their rearrangement, it still is the question whether individuals, composed of the particles, endure. The endurantist cannot take the individual as identical to its particles, for the supposed beginning and end of an individual would then be just another rearrangement of particles. So "to say that my particles endure is simply not to address the question whether *I* endure" (Lewis 1988, 71).

Lewis also objects to Lowe's characterization of fundamental particles as having their intrinsic properties unchangeably (i.e. having no *temporary* intrinsics). According to Lewis "it is far from certain, and far from necessary" (1988, 68) that particles have no temporary intrinsics; "Lowe's solution is at risk from scientific surprises" (Lewis 1988, 68). Lewis claims that one is not entitled to firm intuitions about intrinsic properties of (sub)atomic particles, for one is not acquainted to them as one is to macroscopically large objects (Lewis 1988, 69). Note that Lewis actually raises two objections here. First, there is Lewis's claim that no one is entitled intuitions about particles, which no one is acquainted with. This might seem an odd objection from someone who holds firm intuitions about "a category of entities hitherto unknown to layman and scientist alike - 'temporal parts'" (Lowe 1988, 77), but is justified nevertheless.

Second, there is Lewis's worry about "scientific surprises" (1988, 68). A metaphysical theory is supposed to hold regardless of physical theories, hence the 'meta'. So indeed it is unacceptable for a metaphysical theory to derive its credibility from physical assumptions. This seems to be the case with Lowe's fundamental particle solution to the problem of intrinsic change; it derives its credibility from the assertion that fundamental particles have no temporary intrinsics. However, this is an assertion that might be disproven by science and if it were, Lowe's theory collapses, while it should have hold regardless of such physical scientific results. One can however interpret Lowe's use of fundamental particles in a broad sense; not referring to the concrete fundamental particles known to present day science, but to a more abstract concept of fundamental particle as seen in for instance atomism or the corpuscularian hypothesis.

The worry about scientific surprises is also uttered by Johnston in the first part of the text 'Is there a Problem about Persistence?' (1987), yet in this case as objection against Lewis's idea's about temporal parts. He argues that "the temporal part theorist who takes the route of

constructive mereology […] poaches on empirical preserves" (Johnston 1987, 117). This objection builds on the distinction between 'particle theory' and 'field theory', which represents the world as consisting of persisting particles and as "a distribution of qualities and dependencies over space-time" (Johnston 1987, 117) respectively. A 'mixed theory' represents the world as persisting particles moving in a field. Temporal parts theory however, "identifies temporal parts with fusions of properties and space-time regions or positions", which is in accordance with a pure field theory, but also "identifies persisting individuals with certain interdependent sums of these [temporal parts, as described above]" (Johnston 1987, 118), which is in accordance with a mixed field theory. So according to the temporal parts view, there is no useful distinction between a mixed and a pure field theory; the world can thus be adequately described by a pure field theory. This is however, so Johnston's objection runs, an empirical question, so "the temporal part theorist […] has wrongly given hostages to empirical fortune"[29] (Johnston 1987, 118). Since it is beyond the scope of this paper to discuss the notions of particle theory and field theory in detail, it will now only be noted that it can be argued that Lewis's theory of temporal parts is, just as Lowe's theory of fundamental particles, susceptible to scientific surprises.

In this section, the problem of temporary intrinsics, as conceived by Lewis in his book *On the Plurality of Worlds*, was discussed, as well as Lewis's three solutions of endurance, presentism and perdurance. However, first it was asked by Rychter whether this problem posed an actual puzzle of change. It was concluded that it did so only in the case of intrinsics, where the notion of intrinsic was found to be relative to particular accounts of neighbourhood in given situations. Depending on whether or not time rooted in the neighbourhood of an object, intrinsic change poses a genuine puzzle.[30] Furthermore, Lewis's dismissal of endurance, the idea that objects persist by being wholly present at every time they exist, was found to be in the same way depended on the conception of intrinsic and neighbourhood. In the process, Lowe and McCalls criticism on the use of 'wholly present' was dismissed. Of Lewis's three solutions, presentism was the least substantially discussed, since it mostly features is a more general debate about time, beyond the scope of this paper. With regard to the third solution, perdurance, which holds that intrinsics are had by temporal parts of object, there were several objection discussed. First, it was noted that perdurance, just like endurance,

[29] Johnston gives two examples to illustrate this point, with Forbes replying. These are however to detailed to include in this paper.
[30] That is, intrinsic change poses a puzzle if time is rooted in the neighbourhood of an object, rather than in the object itself.

required a trade off in intuitions. Second, Lowe objects that Lewis's solution invokes "a category of entities hitherto unknown to layman and scientist alike - 'temporal parts'" (1988, 77). Third, Johnston attempted to show that temporal part theory "poaches on empirical preserves" (1987, 117). Finally Lowe's alternative solution to the problem of intrinsic change was examined, which holds that intrinsic change is merely the rearrangement of the parts of the object, which stay the same; the regress to be terminated at the level of fundamental particles. It was noted that this theory also 'poaches on empirical preserves', and furthermore derives its credibility from intuitions about fundamental particles, which, according to Lewis, cannot be had. With the relative notion of intrinsic, Lewis further objected against Lowe's fundamental particle theory that it just returns the problem of temporary intrinsic relations.

Leaving aside the question whether the problem of change poses a genuine puzzle and Lewis's second solution of presentism, the 'grand question' addressed in this section appears, simply put, to be: 'endurance or perdurance?' Lowe's criticism of the definition of endurance and his theory of fundamental particles have been substantially discredited, so what is left is the observation that both solutions require a trade off in intuitions, Lowe's argument that temporal parts were hitherto unknown things and Johnston's accusation of poaching on empirical preserves. The trade off in intuitions can simply be seen as an unproblematic consequence of both theories; after all, in many cases the world differs from the intuitions one has about it. Lowe's argument can for the moment also be disregarded, for it will on its own not enforce endurance. Johnston's accusation might discredit temporal parts on its own, but is for now too unclear; it will therefore also be disregarded. The major argument in the question 'endurance or perdurance?' seems to revolve around the notions of time and neighbourhood: if time is rooted in the neighbourhood of an object, 'perdurance' will be the answer, otherwise, it will be 'endurance'. The problem of intrinsic change, presented thus far, thus seems in need of a more precise understanding of the notions of time and neighbourhood.

Section Two – The Semantic Problem

There is however more to say about the problem of temporary intrinsics, even without a more precise understanding of the notions of time and neighbourhood. Lowe, in his rejoinder to Lewis's 'The Problem of Intrinsic Change' (1988), made an important remark concerning the nature of the problem. Lowe argued that Lewis's treatment of the problem of intrinsic changes is flawed because it fails to distinguish two separate problems. According to Lowe, there are

two “problems of intrinsic change - a *semantic* problem and a *metaphysical* problem” (1988, 72). Not distinguishing, Lewis ends “up with both bad semantics and bad metaphysics” (Lowe 1988, 77).

Lowe describes the semantic problem as “the problem of specifying the logical form of sentences ascribing temporary intrinsic properties to persisting objects, in such a way that we do not run into contradiction in describing such an object as undergoing a change from possessing one such property to possessing another incompatible one” (1988, 72-73).

The metaphysical problem, on the other hand, is “the problem of how there can *be* objects for the description of which the semantic problem arises” (1988, 76). What is questioned here is not how one can describe intrinsic change, but how intrinsic change actually works.

According to Lowe, Lewis’s solution fails “because it attempts to cope with both problems at once” (Lowe 1988, 72). Lowe therefore proposes to separate the semantic from the metaphysical problem. The remainder of his rejoinder to Lewis is divided in two sections, the second of which is dedicated to his solution to the metaphysical problem (Lowe 1988, 76-77), while the first gives three solutions to the semantic problem (Lowe 1988, 72-75).

The first of Lowe’s solutions to the semantic problem corresponds to Lewis’s first solution of endurance. This solution amounts to ascribing a temporal property to an object, as opposed to the third solution which Lowe mentions, corresponding to Lewis’s third solution, which ascribes a property to a temporary object (a temporal part). According to Lowe’s second solution, which does not correspond to Lewis’s second solution, but rather to Haslanger’s ‘adverbial variant’,[31] the ascription of a property to an object is temporally qualified.

These three solutions can be best reconstructed by taking a sentence ‘object x has property P’ and asking in which part of this sentence the relation to time can be specified. Since there are basically three words in this sentence (‘x’, ‘has’, ‘P’), there are three straightforward options. Lowe’s first solution places the indication of time ‘-at-t’ in the property P (x has P-at-t), his second solution in the copula has (x has-at-t p) and this third in the object x (x-at-t has P).

[31] See the end of this section for a discussion of this ‘adverbial variant’.

Constructed this way, it becomes clear that, at least in the semantic case, the second solution is not merely a variant of the first, as Lewis seems to think.

The three solutions all seem to be viable options for "specifying the logical form of sentences ascribing temporary intrinsic properties to persisting objects" (1988, 72-73). A 'logical form' is here, following Lowe, taken to be the way of parsing a sentence, as demonstrated above. Since the three logical forms examined above are internally consistent, the problem seems solved: there are multiple ways of "specifying the logical form of sentences ascribing temporary intrinsic properties to persisting objects, in such a way that we do not run into contradiction in describing such an object as undergoing a change from possessing one such property to possessing another incompatible one" (1988, 72-73).

So it turns out that there is no real semantic problem: all consistent semantics are equally viable as a solution. Lowe, though, continues by stating that "if we have to accept one or other of these three solutions of the semantic problem of intrinsic change, then we had better plump for solution (ii)" (1988, 73). In an earlier paper, it was argued that Lowe, by continuing in this way, did not see that semantic considerations are only relevant in so far they concern describing metaphysics. In that sense, the logical form chosen to describe a certain metaphysics, is derivative from the metaphysical idea. As a consequence, in solving the metaphysical problem, i.e. choosing, form several competing metaphysics, the one that describes how intrinsic change actually works, arguments involving the alleged superiority of a certain logical form are not allowed. Semantics are merely used in describing the metaphysical ideas; for, as was shown in above, they are multiple 'equally good' logical forms, although tied to different metaphysics. So Lowe was right in separating the semantic problem from the metaphysical problem of intrinsic change. Even more, as it will turn out, several things seem to go wrong when semantics are used as more than just describing the metaphysical ideas they are tied to.

First, letting semantic arguments into the metaphysical discussion can lead to circular arguments. If one favours a certain metaphysical idea because of the alleged superiority of a certain logical form, one can ask why this logical form is 'better' than the others. Since 'better' effectively means 'better at reaching the goal', the question is first what the goal of the logical form is. The goal cannot be describing ordinary language or comparison, for the logical form is used as an argument in favour of a certain metaphysical idea, and, as shown

the preceding section, a logical form describing ordinary language or used for comparison cannot give such grounds. The logical form thus must be ‘better’ at reaching the metaphysical goal. Since all logical forms were ‘equally good’ and only differed in their connection with metaphysics, it must be something about the metaphysics which makes the logical form the ‘better’ one. But the issue now has returned to the starting point: the metaphysical idea was supposedly favoured on basis of a logical form. So since semantics are derived from metaphysics, one cannot choose a semantic ground for a certain metaphysical idea.

An example can be found in the second part of the text ‘Is there a Problem about Persistence?’ (1987) by Forbes. Forbes literally claims that “[i]t is the capacity to give precise descriptions that supports the stage-theorist’s claim that his ontology is fundamental” (1987, 152). It is clear that the ability to give precise descriptions is a semantic virtue; so Forbes argues for a metaphysical idea on semantic grounds.

Forbes does this again when he argues in favour of an ontology of stages on basis of the observation that it is favourable to view identity as a relation of degree (Forbes 1987, 145). The latter is derived from the observation that, according to Forbes, one would rather have more options than yes or no when presented the question whether an object with several of its parts replaced is still the same (Forbes 145-146). Disregarding the exact details of his argument, what must be noticed is that the question whether identity is a relation of degree is a semantic issue, which is used to argue for a metaphysical standpoint (an ontology of stages).

As another example, suppose one favours, in metaphysics, Lewis’s temporal parts theory of intrinsic change. The circular argument now would be that this metaphysical idea is favoured because the associated logical form (i.e. tensing the temporal parts of objects), appears to be ‘better’. Now one might ask with respect to what goal this logical form is better. It will not be better in giving an ordinary language account for intrinsic change, for this provides no ground for metaphysics. The same goes for comparison. So the logical form can only be better in describing the metaphysics of temporary intrinsics. However, other logical forms, for instance tensing the property, are just as good in describing their metaphysics (endurance in the case of tensing the property). So it must be something about the metaphysics that makes the logical form the better one. And indeed, temporal parts were the metaphysically favoured theory. The circularity is now apparent: this is exactly what one started with.

The circular arguments that arise above originate in the use of semantic arguments in the metaphysical discussion. This cannot be allowed if circularity is to be prevented. This follows directly from the assertion that the only relevant goal for a logical form is the metaphysical one, with the notion of all logical forms being 'equally good', only differing in their connection with a certain metaphysical idea. A semantic argument presupposes superiority of a logical form, which can, as demonstrated above, only be grounded in metaphysics. A semantic argument in favour of a metaphysical idea is thus nothing more than an argument in favour of the metaphysical idea on basis of its presupposed superiority.

The same kind of circularity can be found in negative arguments: semantics must also not be allowed in arguing against a metaphysical view.[32] Again, that will come down to arguing against a metaphysical view a basis of its presupposed inferiority, for the inferiority of a logical form can only be grounded in metaphysics.

The earlier mentioned objection to perdurance from Johnston falls prey to this kind of circularity. He argues that "the temporal part theorist […] poaches on empirical preserves" (Johnston 1987, 117). According to Johnston, the temporal part theorist must hold that the world can be adequately described by a so-called pure field theory. Regardless of the empirical preserves , this claim is ultimately one about the description of intrinsic change, not about how intrinsic change actually occurs. Johnston thus dismisses the metaphysical theory of temporal parts by using an argument that poaches on semantics.

It might also be argued that this kind of circularity is encountered by Lewis when he argues against endurantism by stating that he finds the idea that intrinsic properties are relations "simply incredible, […] we know that it is a property, not a relation" (1986, 204). It might seem that he dismisses the metaphysical view of endurantism on basis of a feeling about the logical form of intrinsic properties (i.e. that it cannot be relations). It should be noted however that although the notion of relation seems to belong to the semantic discussion, Lewis objection is still valid when relation is interpreted in a metaphysical sense.

[32] Even if a metaphysical view deviates substantially from any ordinary semantic view, that is, from 'ordinary language', it loses no credibility on that account. If it indeed does deviate that much, it may lose credibility from its 'counterintuitive feel', but this must be a 'feel' about metaphysics to be allowed in the debate.

A third possible consequence of confusing the semantic and metaphysical problem of intrinsic change, is that one tries to solve the wrong problem altogether; instead of doing metaphysics, one does semantics. An example of this is Haslanger's idea of an 'adverbial' solution to the problem of intrinsic change.

Haslanger favours endurance because it can "accommodate the idea that the past (causally) constrains the present" (Haslanger 1989, 120), but not in the way presented by Lewis. She argues that treating all temporary properties as relational is not the only option. Instead, Haslanger proposes the 'adverbial' option, in which objects have properties, while time modifies the 'having'. According to Haslanger, this can be done in a temporalist way, in which tenseless propositions are evaluated at times (Haslanger 1989, 121), and a eternalist way, which includes "temporal elements in the proposition without incorporating them into the semantical value of the predicate (or the subject)" (Haslanger 1989, 121). Both ways however, are analogous to a framework with a "three-place relation" (Haslanger 1989, 121), in which there is a relation between object, property and time.

Lewis objects to Haslangers first idea of propositions that are evaluated at times. According to Lewis, such a proposition "seems to behave exactly like a property of times" (Lewis 2002, 12). Lewis takes this to be equivalent to the a time-relational property, with a intrinsic property as constituent. But this is just "the very thing we were trying to explain: the notion of an enduring thing having a monadic intrinsic property at a time" (Lewis 2002, 12).

Both Haslanger's solution and Lewis's objection deal however clearly with the semantic problem of intrinsic change. Since there are no conclusions drawn for the metaphysical case, no harm is done, although for the metaphysical debate, nothing is gained either.

Lowe gives an account of Haslanger's second idea of incorporating time somewhere else than in the property. Lowe's solution to the semantic problem of intrinsic change holds that temporary intrinsic properties can be ascribed to persisting objects by using temporally qualified ascriptions of properties to objects (Lowe 1987, 73). Lowe argues that the second solution is the one most in line with common sense, and that it is not, as Lewis seem to think, merely a variant of the first (1987, 73). Also, Lowe does not share Lewis's problems with this second solution.

Lewis's objection is that in this way, 'intrinsic' still involves a relation. The advantage of Haslanger's solution however, is that one can just take an object as instantiating a property at a time, while "[t]he fact that we can further define a three-place relation […] need not commit us to treating the basic notion of an object's instantiating its properties as relational" (Haslanger 1989, 122). Lowe makes a similar remark, however, instead of stating that the three place relation is not fundamental, as Haslanger does, Lowe denies it altogether: "To say that the *having* (instantiating, exemplifying) of a [property] is related to a time is to say that the holding of a *two*-place relation is related to a time, not that a *three*-place relation is involved" (Lowe 1987, 74).

Even then, in considering by example the property of being straight, Lewis wonders what "standing in some relation to straightness has to do with just plain being straight?" (Haslanger 1989, 120), and therefore dismisses the three place relation idea. It was already mentioned that Lowe denies this argument any power, stating that it is not clear to him what 'just plain having' means. If it denotes "some atemporal mode of property exemplification" (Lowe 1987, 73), then one can deny that it can ever be applied to persisting physical objects. According to Lowe, Lewis even seems committed to that view, for his objects only have properties via their temporal parts (Lowe 1987, 73-74).

Furthermore, Lewis's "worry is that a temporary predication […] does not adequately capture the connection between an object and its intrinsic properties" (Haslanger 1989, 122). According to Haslanger, Lewis argument comes down to the idea that enduring objects have no properties intrinsically, and therefore have them by standing in relation to them, which is unacceptable (Haslanger 1989, 123). Haslanger however, questions why one has to say that temporary properties are extrinsic: "An endurance theorist will demand a temporally sensitive construal of [intrinsic properties]" (Haslanger 123); in denying such a construal, "one fails to address the endurance theorist's position" (Haslanger 1989, 124). Note that this remark brings the discussion back to the earlier raised question about the notion of intrinsic[33]. With her remark, Haslanger effectively claims the endurantist position to be that time is rooted in the object itself, rather than in its neighbourhood; just like was concluded in section one.

[33] See section one and three for discussions about intrinsics.

However, the whole discussion about Haslanger's adverbial solution is ultimately a discussion about semantics, and not about metaphysics. Haslanger proposes temporally qualified ascription of properties to objects, but does so in purely semantic terminology. This becomes most clear in her reply to Lewis criticisms: "[a]n endurance theorist will demand a temporally sensitive construal of [intrinsic properties]" (Haslanger 1989, 123); the word 'construal' betrays the semantic approach to the problem. It indicates that Haslanger's demand is about a logical form, a construal.

Johnston also gives an adverbial solution to the problem of temporary intrinsics, derived from the problem of accidental intrinsics. Analogous to the modal case, Johnston argues that one can understand temporal "qualifiers as sentence forming operators on sentences" (Johnston 1987, 126); temporal qualifiers "are typically adverbs which modify the copula of predication" (Johnston 1987, 128). So "the function of temporal qualification in reports of change is to modify the relation of instantiation" (Johnston 1987, 128). It comes down to tensing the copula: "[i]nstantiating a property, it turns out, is instantiating at some time the property" (Johnston 1987, 129; Lewis 2002, 4).

Lewis objects against this idea that it still makes for a relation: a "relation of things to properties and times" (2002, 5). One could argue that "*all* having of properties is relational" (Lewis 2002 , 5), but according to Lewis, this leads to 'Bradley's regress': since 'having a property' is in itself a property, it is a relation; so it becomes 'having the 'having a property' property', ad infinitum. If these statements are equivalent, Lewis argues, one can take just as well the first one: 'just having a property'.

On Lewis view, Bradley's regress especially poses problems for Johnston's 'tensing the copula' solution, for it gives infinitely many options for inserting the relation to time, without a way to choose between them. The best response, according to Lewis, is to give up on tensing copulas.

In another objection, Forbes argues that Johnston's idea of taking temporal modifiers as modifying the relation of instantiation is merely rewriting the problem:[34] it still requires objects with different intrinsics at different times to be the same (Forbes 1987, 140).

[34] For example, an object instantiating the property 'straight' today and 'bent' tomorrow still amounts to that object having incompatible properties 'straight' and 'bent' at different times.

As with Haslanger's adverbial solution, Johnston's idea of tensing the copula is only a solution to the semantic problem. This fact is already shows in the use of the expression 'copula', which is in the end a linguistic term. Johnston thus seems to discuss the semantic problem, while his text seems to be written with the intend to treat a metaphysical issue.

A similar kind of confusion between metaphysics and semantics is found in Lowe and McCall's text 'The 3D/4D Controversy: A Storm in a Teacup' (2006), in which they elaborate on the earlier mentioned position that one can define endurance for 3D objects as "precisely and rigorously" (McCall and Lowe 2009, 279) as perdurance for 4D objects. However, instead of giving arguments in favour of endurance or objections to pedurance, they state that "equally precise and rigorous ontological foundations may be constructed using either 3D or 4D building blocks" (McCall and Lowe 2006, 570). Furthermore, they argue that the 3D and 4D view are "intertranslatable without remainder" (McCall and Lowe 2006, 570).

To show this, Lowe and McCall define enduring objects as 3D object that "exist at more than one time" (2006, 572) and perduring objects as 4D object with temporal parts. They furthermore assert that the 3D and 4D view are separated: a 4D temporal part might be viewed as a 3D object with a fixed temporal location, but it is not enduring, so will not be treated from the 3D view (McCall and Lowe 2006, 572).

To create a translation scheme, they give an account of a 3D and 4D ontology. In the 4D ontology, a 4D object O is the mereological sum of its temporal parts $T(O,t)$. The 3D ontology, they argue, ranges over enduring elementary particles. The variables in this 3D ontology range over enduring elementary particles, which combine into macroscopic objects, often defined as the set of particles in a certain space-region. One can form ordered pairs of such objects with time to represent the object at a time. That is, a 3D object at a time can be represented as the ordered pair $< S,t >$, with S the set of particles located in an O-shaped volume at time t. Notice that S differs for different t, in correspondence with O gaining or losing a particle.

The translation scheme of Lowe and McCall builds upon the "close similarity between the set of 3D particles which constitute an enduring object O at a time t, and the instantaneous 4D temporal part of O at t" (2006, 573); that is, between the pair $< S,t >$ and the temporal part $T(O,t)$. One can now translate enduring 3D objects into perduring 4D objects by taking the

pairs $< S, t >$ of enduring 3D object O for all times it exist and rename them into $T(O, t)$, the temporal parts of the, now 4D, object O. Vice versa, one can take the temporal parts $T(O, t)$ of a perduring 4D object and create the set S with all the particles of $T(O, t)$. Via the ordered pair $< S, t >$, one can now, for every time, retrieve an enduring 3D object O as the sum of the particles from S.

This does indeed show that particular "3D and […] 4D descriptions of the world are equivalent in the sense of being intertranslatable without remainder" (McCall and Lowe 2006, 570), but again, this is a semantic result: that the logical forms of describing those metaphysical entities can be translated is not an argument for the metaphysical equivalence.

It might however be argued that Lowe and McCall seem to aim for such an result. In the introduction of their text they state that "[a]lthough it might appear that philosophers are faced with a clear-cut *ontological* choice [between a 3D and 4D view], we shall argue that this is not so" (McCall and Lowe 2006, 570; emphasis added). If this was indeed their goal, they seemingly didn't reach it; although their text might show the equivalence of the descriptions, one still faces an ontological choice between the 3D or 4D view. After all, objects cannot be both 3D and 4D, although they might be described in both ways. As was argued in this section: the semantics pose no real problem; it is about the metaphysical problem of intrinsic change, in this instance, whether objects are 3D or 4D. Showing that both objects can be described as the other adds nothing to this metaphysical discussion.

Finally, Rychter also confuses metaphysics with semantics when he states that

> we do not need to suppose that there really is a puzzle about intrinsic change in order to make sense of Lewis's discussion. Instead of talking about 'solutions' that explain how something (otherwise impossible) is possible, Lewis might well have said: 'I know of only three *general descriptions* of what happens whenever I change my shape'.
>
> (Rychter 2009, 17-18)

This limits Lewis's views however to the semantic realm, whereas the aim was to do metaphysics.

In this section, it was argued that although Lowe was right in distinguishing between the metaphysical and the semantic problem, the semantic problem is not a real problem, and only relevant in so far it concerns describing metaphysics. Nonetheless, it was argued that one has to be careful not to use semantic arguments in the metaphysical debate about intrinsic change: it was shown, with examples from the discussion about intrinsic change, to lead to circular arguments.

Section Three – The Metaphysical Problem

So instead of focussing on the derivative semantic problem of temporary intrinsics, one should address the metaphysical problem of intrinsic change. Lowe's description of said metaphysical problem might be a good starting point for this. According to Lowe, the metaphysical problem is "the problem of how there can *be* objects for the description of which the semantic problem arises" (1988, 76). What is questioned here is not how one can describe temporary intrinsics, but what actually exists. Rather than asking where to put the addition '-at-t' in 'x has P', the metaphysical side of the problem concerns questions about how x can actually have P at t.

As mentioned before, logical forms occurring as solution for the semantic problem of intrinsic change can be used to describe certain metaphysical theories. It is therefore not strange that those solutions have metaphysical parallels. The perdurantist solution chops objects in temporal parts: 'x-at-t' is in metaphysical perdurantism not merely a way of saying that object x is at time t, but actually refers to the temporal part of x that is at t. The endurantist solution on the other hand relates properties to times: 'P-at-t' is in metaphysical endurantism again not merely a way of saying that property P is had at time t, but actually relates P to that t.

Given just one object x, one property P and one time t, it might seem that in metaphysics, there doesn't really arise a problem. After all, consider one's front door which, at leaving in the morning, is red. This simply is an object, a property and a time, which metaphysically makes sense, without any inconsistencies or problems. The real metaphysical problem of temporary intrinsics shows up when one considers more than one property and time; in other words, when one considers change.

For instance, take as object x one's front door. At a certain time t_1, say when leaving in the morning, it had property P: being red. Suppose later, at t_2 (say in the evening, upon returning), it has property Q: being blue. Regardless of the exact way of this change of colour (it probably was painted over), a property of the door has changed. So x has P at t_1, and Q at t_2; the front door is red in the morning, and blue in the evening. Suppose furthermore that P and Q are intrinsic properties;[35] they are just the way x is. In terms of the example: the front door is red (or blue) in itself, independent from its neighbourhood. Now assume P and Q are incompatible properties; they cannot both be had by an object. In the example: the door cannot both be (totally) red and blue. But now the problem appears, for it was just stated that the door was red and blue; how can the same object have different incompatible properties? The endurance solution claims that it has to do with time: x has both the property P at t_1 and Q at t_2; the properties are related to times. The perdurance solution, on the other hand, claims that the different properties are actually had by different objects, namely the temporal parts of the object: the t_1 part of x has P, while the t_2 part of x has Q; objects are simply the sum of their temporal parts. Anyway, it is clear that the metaphysical problem manifests itself when change is considered.

Notice that endurance and perdurance, considered as metaphysical principles, are incompatible; an object cannot both have (proper) temporal parts and exist totally at a time.[36] Also note that the metaphysical perdurantist cannot in hindsight point out the temporal parts; that is, he must hold that even objects that do not change have temporal parts. After all, metaphysical perdurantism is not just a statement about change (that would be semantic perdurantism), but rather a view on the nature of objects (that is, objects are composed of their temporal parts). In section two, Lowe and McCall's translation of enduring objects into perduring objects (and vice versa) was mentioned, however, it was also concluded that this was merely a semantic transformation; the metaphysical problem is precisely that enduring and perduring objects are *not* compatible: they might be referred to as both enduring and perduring (as Lowe and McCall showed with their translation scheme), but metaphysically, a temporally extended object with temporal parts being present at a time cannot be the same sort of object as a temporally flat object without temporal parts, being wholly present at all times it exists.

[35] Disregarding for a moment the remarks from section one; thus with a naive understanding of intrinsic.
[36] Unless the whole object only exists at a single time, but then there is no problem, since it cannot change (for it simply doesn't have the time to).

Considering this, it is interesting to review one of Johnston's arguments against Lewis's perdurance. Johnston takes Lewis's view to be that "*F*-ish temporal parts are short-lived F-like things" (Johnston 1987, 116), with the whole *F*-thing made up from different *F*-ish temporal parts. He asserts that this is not to be taken as an empirical hypothesis. Rather, it is a mereological claim: "a persisting individual turns out to be a succession of related objects" (Johnston 1987, 116).

Johnston's objection against this idea is that it excludes all enduring particulars, while not providing an argument why some particulars (in particular objects that do not change for a given period) do not endure[37] (Johnston 1987, 117). He elaborates on this point by using the paradoxes of material constitution. Consider Dion and Theon, who is Dion without his left foot. Now suppose Dion's left foot is destroyed. According to Johnston, one of two problems arises after the destruction: either there is cohabitation, or there are formerly temporally distinct objects that become identical. Temporal parts can solve the second problem, but only by requiring the unchanging Theon to consist of two different temporal parts. On Johnston's view, temporal parts for an unchanging object cannot be motivated by the problem of intrinsic change (Johnston 1987, 122-123).

Johnston might be right in the sense that temporal parts for an unchanging object are not directly motivated by the problem of intrinsic change. However, they are a consequence of a more general view about the nature of objects, the perdurantist view, which is in turn motivated by the problem of intrinsic change. It is clear that the observation that this general view is not motivated by every particular instance is not an argument for the dismissal of said general view.[38]

Furthermore, Johnston's own solution to the problem of intrinsic change does not recognize metaphysical endurance and perdurance as incompatible. Johnston calls his view 'partial endurance': "On this view the intrinsically unchanged material parts of a particular of any sort *F* endure" (Johnston 1987, 123). Identity over time is now no longer required for persistence, instead F now persists through change if it leaves *F* "substantially the same in *F*-important

[37] Forbes however, replies that such arguments can be given, and gives them (Forbes 1987, 143).
[38] After all, the theory of general relativity is not motivated by, for instance, a front door, however the front door still abides by the laws of general relativity.

respects" (Johnston 1987, 123). What is *F*-important is determined by the sort of *F*.[39] Johnston makes a distinction between substances, which have important parts that stay the same through all changes, and complexes, which can change all their parts while staying the same. According to Johnston, advantages of his 'minimalist view' are that it does not commit one to a specific world hypothesis, and that it is justified by perceptual evidence.[40]

According to Forbes, a disadvantage of Johnston's view is that it "is trapped by a Sorites paradox" (1987, 146). Johnston argues that some F-thing persists through all but F-important changes; however, as Forbes mentions, "a sequence of insubstantial changes can add up to a substantial one" (1987, 147). According to Forbes's 'possible constancy claim',[41] it is possible that a complex consist entirely of original parts, while it is also possible that the same complex consists entirely of replacement parts. The replacement of one of the parts is here not regarded as a '*F*-important' change, so after one replacement, both complexes are still the same. However, if all parts are replaced one by one, both complexes are still the same according to Johnston, despite having entirely different parts. From this contradiction, Forbes claims, "we are inevitably led to the perdurance construal of persistence for [everything] for which the Sorites set-up makes sense" (Forbes 1987, 149).

An even greater disadvantage appears when one examines an important feature of Johnston's partial endurance, namely that it does not commit one to a specific world hypothesis, and that it is justified by perceptual evidence. This ultimately means that is not a metaphysical theory after all. It tries to combine the incompatible views of perdurance and endurance, but at the same time tries to commit no one to a specific world hypothesis. The specific problem is that, on Johnston's view, an object only perdures if it changes, and endures otherwise. This is highly implausible when considering an object that *might* change; i.e. there is a possible world in which it changes, and a possible world in which it does not change. Now according Johnston's partial endurance idea, the object perdures in the former possible world, but

[39] Johnston characterizes the main idea about sorts as follows: "*F* is the same sort as F^* just in case necessarily all and only *F*s are F^*s and substantial sameness in *F*-important respects is a condition necessarily equivalent to substantial sameness in F^*-important respects" (Johnston 1987, 125).
[40] One might ask: "By what right do we represent the world as made up of persisting objects" (Johnston 1987, 130-131)? Johnston replies that "[r]epresentation is our characteristic activity" (Johnston 1987, 132); one makes perceptual judgements of persistence "spontaneously and non-collusively […] on the basis of perceptual experience" (Johnston 1987, 132). "It is something we spontaneously and dogmatically employ as a fundamental theme in our everyday representation of the way the world is" (Johnston 1987, 132).
[41] The possible constancy claim holds that for an object consisting of parts, it is possible that its parts are never replaced over time.

endures in the latter. Regardless of the precise understanding of possible worlds, it at least seems strange that the answer to a fundamental question as ‘does this object endure or perdure?’ can differ across worlds. Furthermore, from an epistemological viewpoint, partial endurance lacks the ability to predict future results; after all, since perdurance requires change, one can only know whether an object endures or perdures if one knows if it changes, which is unknown for (large parts of) the future.

The above considerations have made clear that perdurance and endurance are incompatible, ‘total’ views, in the sense that accepting one of these views means accepting it in all cases, and rejecting the other view. Furthermore, the perdurantist must hold that all objects have temporal parts at all times they exist. Now in section one it was concluded that the major argument in the question ‘endurance or perdurance?’ seems to revolve around the notions of time and neighbourhood: if time is something in the neighbourhood of an object, ‘perdurance’ will be the answer, otherwise, it will be ‘endurance’. Before addressing the notion of neighbourhood, however, it will turn out to be useful to examine time further.

The fundamental observation that has to be made is that time is *dense*; which can be best understood as the principle of ‘finding a third’. The assertion that time is dense comes, according to that principle, down to the idea that for every two times, a third one might be found, which is later than one of the two, but prior to the other. For example, between morning and evening, noon can be found, and between three and four o’clock, half past three can be found.

Regarding time as dense in this fashion has several consequences. First it follows that every time interval contains a smaller interval. To use the last example: since half past three is also a time, there is another time, say a quarter past three, to be found between three and half past three. Now the time-interval from quarter past three to half past three is contained in the interval which one started with, which was from three to four o’clock.

Another consequence of time being dense shows when this process of ‘finding a third time’ is iterated. Since it can be repeated endlessly, there are an infinite amount of times between every two times. This leads to the conclusion that there are as many points in time between morning and evening as there are between three and four o’clock.

The next consequence has, potentially, a far greater impact on the debate about the problem of temporary intrinsics. With the conception of time being dense via the principle of 'finding a third', it becomes impossible to single out the time that immediately follows a given time. For suppose that it can be done, then, due to the time being dense, there is another time to be found between the given time and the time that was taken to immediately follow it. This new time is now the time that immediately follows the given time; again this process can be repeated endlessly, thereby never able to single out the right time that follows the given time. To make this more clear, consider the time t_0. Now suppose t_1 (with $t_0 < t_1$) is the time that immediately follows t_0. Due to time being dense, there now is a t_2 (with $t_0 < t_2 < t_1$) which actually seems to be the time that immediately follows t_0. Repeating this process yields the existence of t_3 (with $t_0 < t_3 < t_2 < t_1$) which in turn seems to be the time that immediately follows t_0. This process can be repeated endlessly. It is important to note here that this does indeed mean that there is no such thing as a 'direct successor' to times; given a point in time, there is no time that immediately follows it. [42]

The observation that time is dense also has some consequences for the notion of temporal part. It follows that temporal parts, if they exist, cannot have a duration. For suppose they can have a duration, then, due to time being dense, there is a time[43] to be found in the duration of the temporal part. First, this means that the temporal part endures, since it is (wholly) present at more than one time (namely at all the infinite many times in the duration). Since metaphysical endurantism and perdurantism were taken to be incompatible, temporal parts cannot have a duration. Second, if temporal parts would have a duration, they would not contribute to a solution to the problem of temporary intrinsics, for during said duration, change in incompatible intrinsic properties can occur. If it does, then the same object, the temporal part at stake, has two incompatible properties; so the problem of intrinsic change has returned.

Since time is central to the notion of change, it is no surprise that the observation that time is dense also has its consequences for the notion of change, notably the consequence that change must be continuous and cannot be instantaneous. Here instantaneous change is a process

[42] Although there is a well-ordening to be found on every set, it can be proven that this ordering cannot be a dense linear order. Since the ordering under consideration (the natural ordering on time) is a dense linear order, it follows that time is not well-ordered, hence there are no 'direct successors' (or 'direct predecessors') to a given time.

[43] Or time interval, depending on the underlying assumption about change, which will be discussed later.

without duration; the change itself doesn't take any time. Continuous change, on the other hand, occurs during a certain time interval; it has an begin, an end and a duration. Continuous change is thus extended in time, whereas instantaneous change is not.

The metaphysical question now at stake is thus whether change is actually instantaneous or continuous. What is questioned here is what changes are actually occurring when an object changes from having property P at time t_1 to having incompatible property Q at time t_2. There are three possibilities. First, there might be a single instantaneous change occurring at some time between t_1 and t_2. The second possibility for the actually occurring change regards all change as continuous. The third possibility is that the change is continuous in that it occurs during a time interval, but is made up of a series of instantaneous changes.

It will turn out that instantaneous change in incompatible properties is impossible, so that leaves only the second possibility; change in incompatible properties as continuous. Change may thus appear to be instantaneous, but it actually must be continuous change during a very small, but non-zero time interval.[44] To arrive at this conclusion, continuous and instantaneous change must first be examined more closely.

Taking change to be continuous leads to the question what property an object has while it is undergoing continuous change from having P at t_1 to having incompatible Q at t_2. It is obvious that it cannot have both P and Q, since P and Q are given as incompatible. If an object has one of the properties between t_1 or t_2, then the interval during which the change occurs can be taken smaller. The question can then however be iterated, leading to untenable results. For example, someone who stands up from lying down in five seconds, would, after a few iterations of the above question, be standing up in only two seconds (i.e. a smaller time interval). So selecting one of the properties as an answer to the question which property an object undergoing continuous change has is not an option. Also answering 'none' is not viable, for that would mean that a person standing up from lying down in ten seconds has no shape during those five seconds. The same example shows that claiming that the object has indeterminate properties during the continuous change is also not tenable: it would imply that one would be unable to identify the shape of the person standing up during all the five

[44] Note that this would not introduce an arbitrary smallest interval at which change can occur; due to time being dense, the interval can always be chosen smaller, but will always be an interval and never reduce to a single time.

seconds that it takes, even when he does so by first sitting before standing. The only possible answer is that the object has certain intermediate properties; like sitting in the example of the person standing up from lying down.

So an object x continuously changing from having property P at t1 to incompatible Q at t2 turns out to have intermediate properties M_α at $t_1 < t_\alpha < t_2$. Such an intermediate properties are properties nevertheless, so it might be asked whether an intermediate property is compatible with the earlier or later incompatible properties; i.e. whether M_α is compatible with P or Q. Since the change is symmetric in the sense that x could just as well have changed from having Q at t_1 to having P at t_2, it is implausible that M_α is only compatible with one of the properties P or Q, while being incompatible with the other. So either M_α is compatible with both properties or with none of them. Now suppose intermediate properties are compatible with both properties they are intermediate between. This makes it impossible for Q to be an intermediate property between P and some later, incompatible Q_2, since Q was incompatible with P. To use a situation from an earlier example; suppose someone sits up from lying down. This sitting up seems to be a change in incompatible properties just as described above: having P (lying down) at t_1 and having Q (sitting) at t_2. However, suppose the person in this situation is to proceed to a standing up position; now it seems that sitting was merely an intermediate property between lying down and standing up. It was assumed however, that intermediate properties were compatible with the properties they are intermediate between; in this case sitting would be assumed to be compatible with lying down and standing up. This contradicts the earlier assertion that sitting was incompatible with lying down, so the assumption clearly is false. This leaves only the possibility that intermediate properties M_α are also incompatible with P and Q.

Notice that now new instances of continuous change appear: x seems to change from having P at t_1 to having incompatible M_α at t_α. This again yields intermediate properties, which give again rise to continuous change. Due to time being dense, this infinite regress does not pose any problems: since there is always a third time between two times, there is always a time at which an intermediate property can be had. The question that arises however is whether these changes are ultimately instantaneous or continuous. After all, if x changes continuously from having P at t_1 to having Q at t_2 by having infinitely many intermediate properties M_α, it might well be that it changes instantaneously from having one immediate property to another;

continuous change in that case being nothing more than a series of instantaneous changes. The answer to this question seems to depend on whether the time interval during which the continuous change occurs is open or closed.[45] In the second case, continuous change occurring in an closed interval $[t_1, t_2]$ will consists of infinitely many changes during intervals $[t_{\alpha_1}, t_{\alpha_2}]$, with t_{α_1} and t_{α_2} approaching each other until they are equal in the limit. In that case, the interval will be $[t_{\alpha_1}, t_{\alpha_1}]$, which is, due to the interval being closed, not empty, but only contains t_{α_1}. So in this limit, the change no longer has a duration, but is instantaneous and occurs exactly at t_{α_1}. So if continuous change occurs during closed intervals, it is merely a series of instantaneous changes. On the other hand, the above reasoning goes awry if continuous change occurs in an open interval; it will consist of infinitely many changes during intervals $(t_{\alpha_1}, t_{\alpha_2})$, with t_{α_1} and t_{α_2} approaching each other. However, since $(t_{\alpha_1}, t_{\alpha_1})$ is empty, t_{α_1} will never be equal to t_{α_2}, hence change will still be continuous.

In the above discussion, the second and third possibilities mentioned earlier for change were covered. It turned out that change occurring during a time interval consists either of infinitely many continuous changes (iff the interval is open) or of infinitely many instantaneous changes (iff the interval is closed). It is important to note here that the first possibility mentioned above, which had instantaneous change occurring between two times, also can give an account of change that appears to be continuous, including intermediate properties. Just like the third possibility, it holds that continuous change can be reduced to a series of instantaneous changes. However, in contrast to the third possibility, it holds that there are only finitely many intermediate properties; after all, allowing infinitely many intermediate properties would make the change actually continuous, instead of merely appearing continuous. Both the first and the third possibility thus hold that the actual change that occurs is solely instantaneous.

Instantaneous change was earlier be said to have no duration, occurring at a single time. Since time is dense, it follows directly that a description of instantaneous change indicating two times between which the change occurs necessarily contains a certain indeterminacy about when the change exactly did occur. After all, there are infinitely many times to be found

[45] An open interval between the times t_1 and t_2 will be denoted by (t_1, t_2) and consists of all the times between t_1 and t_2, but not t_1 and t_2 themselves. The closed interval $[t_1, t_2]$ consists of t_1 and t_2 in addition to the open interval.

between every two times. So instantaneous change can only satisfactory be described by indicating explicitly the time at which the change occurs. Again, the question that arises is what property the object has exactly at that time. First of all, the existence of the object at the time of change must be assured, for it is possible to argue that, in the case of instantaneous change, an object quickly flashes out of existence at the time of change, thus avoiding the above question. However, this option is problematic when the reduction of continuous change to instantaneous change is considered; for if continuous change is merely a series of instantaneous changes, and objects do not exist at the time of instantaneous change, they also don't exists at the interval of continuous change. This is highly problematic, especially when clear examples as someone standing up from a sitting position are considered; this person will, in the view just sketched, stop existing when initiating his standing up, only to become existent again when the stands perfectly straight.

With the existence of an object undergoing instantaneous change (say changing from having property P to incompatible Q at time t) argued, one can now ask what property this object has at t.[46] Just as in the continuous case, it is obvious that it cannot have both P and Q, for they were given as incompatible. Also it cannot have one of P or Q, for then the time t would not be the time of change. Another option is to claim that the object has neither P nor Q, or that it is indeterminate. However, as with the denial of existence at the time of change, denying properties at the time of change causes problems when continuous change is regarded as a sequence of instantaneous changes. So the only option left is that at t, the object has some intermediate property.

It thus follows that an object x that changes instantaneously at t from having property P to having incompatible property Q, has property P at all times before t, has property Q at all times after t and has an intermediate property M exactly at t. As in the continuous case, this intermediate property is a property nevertheless. Now regardless whether M is compatible with P or Q, one must acknowledge that x changes from having P to having M. Furthermore, this change must be instantaneous, for if it is continuous, then the whole change of x from having P to having Q becomes continuous, which contradicts the assertion that x changes instantaneously from having x to having x. But now a contradiction arises: to have t be the time at which x changes from having P to having Q, t can be the only time at which x has M,

[46] Indeed instantaneous change has no duration, but neither has a single point in time.

hence the instantaneous change from having P to having M must occur at the time directly preceding t. However, as was shown in the earlier discussion about the observation that time is dense, there are no 'direct predecessors' to times. So it turns out that the only option that was left for the property that an object has at the time instantaneous change occurs, an intermediate property, is also not viable. Hence the only possible conclusion is that change cannot be instantaneous.

From the three possibilities for change given earlier, only the second one now is left, due to the impossibility of instantaneous change. Change is thus always continuous change during an open time interval. So an object x changing from having property P at t_1 to having incompatible property Q at t_2 thus undergoes continuous change during the open interval (t_1, t_2). Since this interval is open, one can say t_1 to be the last time x had P, and t_2 to be the first time x has Q. The time intervals at which x has P and Q are thus closed. These remarks will prove to be useful in the discussion of boundaries below.

With time being examined as above, the notion of intrinsic can now be addressed. As asserted in section one, a property was taken to be intrinsic if it was had by an object isolated from its neighbourhood. In addressing the metaphysical problem of temporary intrinsics, this definition calls for a metaphysical differentiation between an object itself and its neighbourhood. This amounts to pointing out the boundary of the object; the place where the object itself ends and the neighbourhood begins. It is important to note that the notions of neighbourhood and boundary, naïvely understood, require (at least) a topological space.[47] For example, for a front door to have a neighbourhood, say the doorpost (inter alia), it must be located in space in the first place. For consider a universe that is only the set containing the front door and the doorpost; there is no notion of neighbourhood whatsoever. As in section one, one can now simply define the doorpost to be the neighbourhood of the front door; however, this amounts to endowing the set with a topology, i.e. giving a structure which indicates which objects are close to each other. Neighbourhood can only be defined topologically. By giving such a structure, one effectively, in this case, provides spatial dimensions along which the boundary between the object itself, the front door, and its neighbourhood, the doorpost, can be drawn. Location in (three dimensional) space is thus

[47] A set endowed with a structure indicating which subsets are 'open', hence giving an indication of which elements are close to each other. Notice that it indeed are the topological properties (more specific, the metrizability) of naïve space (or space-time) that give rise to a sense of 'location', and not the algebraic properties.

required for the notion of spatial boundary. Analogous, location in time is required for the notion of temporal boundary. Generalizing from these examples leads to the earlier assertion that (location in) a topological space is required for a general notion of boundary and neighbourhood. Also, a topology makes it possible to talk about 'dimensions', as naïvely used (e.g. in the statement that there are three spatial dimensions).

Notice that only location in a topological space is required, and not necessarily extension in said topological space. Temporal parts for instance, are not extended in the temporal dimension, however they are located in time. Their neighbourhood along the time-dimension consists of all times except the time at which the temporal part exists. As a another example, recall that the presentist held that only one time, the 'now', truly exists. As a result, not only are the presentist's objects not extended in time, they aren't even located in time in the same way non-presentists objects are located in time. Surely, for the presentist, objects are located in the present time; however, since there is only one time to be located in, this location in time comes with existence trivially: everything that exists does so either at that time or not at a time at all. Time, for the presentist, cannot be a topological space, since there is only one time.

So to have a neighbourhood and boundary, an object must be located in a topological space. Conversely, if an object is located in a topological space, it has a boundary and neighbourhood along the arisen dimension. For example, for an object located in time, there will be a point in time at which the object starts to exists, as well as a point in time at which the object ceases to exist. Those points form the temporal boundary of the object. Notice that for temporal flat object (e.g. temporal parts), those two points coincide. The temporal neighbourhood of the object are now all times except those in the interval between the boundary points.

The notion of intrinsic thus seems to depend on the location of an object in a certain topological space. Within this space, the boundary of an object can be defined, enabling a distinction between the object itself and its neighbourhood, which in turn enables the definition of a property as intrinsic if it is had by an object isolated from said neighbourhood. The question that arises however is whether the boundary itself is part of the neighbourhood or part of the object. To use the example from the preceding paragraph, consider an object x located in time, say it is extended in time over an interval ranging from t_1 to t_2; the set $\{t_1, t_2\}$

is the temporal boundary of x. Now the question is whether this boundary is part of the time-interval during which x exists, i.e. whether x exists during the open interval (t_1, t_2) or the closed interval $[t_1, t_2]$.

Recall that it was earlier shown that change in incompatible intrinsic properties can only occur continuously during an open time interval. It was also asserted that, as a result, the time intervals at which an object has the different properties are closed. Consider now an object that is changing during all the time it exits; that is, an object x with temporal boundary $\{t_1, t_2\}$, changing from having intrinsic property P to having incompatible intrinsic Q during the interval (t_1, t_2). It is now immediately clear that x must exists during the closed interval $[t_1, t_2]$; i.e. the temporal boundary is part of the time-interval during which x exists. After all, due to the change occurring during (t_1, t_2), x must have P at t_1 and Q at t_2, which entails the existence of x at t_1 and t_2. The temporal boundary of objects (located in time) is thus part of the temporal extension of the objects themselves (i.e. of the interval during which the object exists), and not of the temporal neighbourhood.

Generalizing from the preceding paragraphs it can be found that in general, a topological boundary belongs to topological extension of the object it bounds, and not to the neighbourhood; i.e. every object is closed along the dimensions it is located in. For example, since space is also dense, change along a spatial dimension must also occur in an open interval.[48] Objects thus have their properties in a spatially closed interval which, according to reasoning analogous to that in the preceding paragraph, leads to the conclusion that spatial boundaries are also included in the spatial extension of object itself, instead of in the neighbourhood of the object.[49]

This conclusion has however some consequences for the notion of intrinsic. Recall that a property was defined as intrinsic if it was had by an object isolated from its neighbourhood. Now consider a red front door, which gets painted blue. In the preceding paragraphs this change was taken to be a change in intrinsics, however, this was never checked with the definition of intrinsic as given above. So isolate the front door from its (spatial) neighbourhood; now the door is still red before the painting. However, since the blue paint

[48] Although the correct term would be 'space', since there are actually three spatial dimensions. 'Interval' will be used however, to establish more clear the analogy with the temporal dimension and to prevent confusion with the other use of 'space'.
[49] Note that the naïve use of 'object' often implicitly also refers to the spatial extension of the object.

was put *on* the door, it never penetrated the spatial boundary, hence belongs to the neighbourhood; it thus turns out that the door, isolated from its neighbourhood, and thus from the blue paint, is still red, even after the paining. The red front door being painted blue thus does not seem to undergo intrinsic change according to the given definition.[50]

Since intuitively, a red front door being painted blue, does undergo intrinsic change, one may attempt to counter the above argument. One can argue for instance that by painting the front door, its spatial boundary changes in such a way to encompass the paint. Isolating the front door from its neighbourhood after this change in boundary will result in a blue door after the painting, hence defining the change in colour as intrinsic. However, such change in boundary must then also be allowed for change which intuitively seems extrinsic, leading again to untenable results. For example, someone putting on a hat intuitively undergoes no intrinsic change; however, analogous to the previous example, one can argue that the spatial boundaries of said person change to encompass the hat, leading to the conclusion that someone who puts on a hat undergoes intrinsic change. It is important to note that although it seems that the arbitrariness in the change in boundary can be fixed by defining when such a change in boundary is allowed, this amounts to giving a new definition for intrinsics. It thus seems that the definition of intrinsic given above, which makes use of the notion of neighbourhood, does not correspond to intuitions about intrinsic properties and intrinsic change.

One might object against the above example that it is merely an example, and a rather silly one. It must me noted however, that examples such as the above might be given for any change that can potentially transgress a boundary. For instance, change in colour, as in the example above, is defined as intrinsic as long as the change happens on the right side of the boundary. Here, two intuitions collide: on the one hand the intuition about what the boundary of an object is, on the other hand the intuition about what changes are intrinsic. The fact that the definition of intrinsics under consideration allows for such a collision might rightly be regarded a weakness.

[50] A similar example can be given for alleged intrinsic change in shape: consider a sphere which is changed by attaching a similar sphere to its surface. This object now underwent change in shape: from spherical to ‘bispherical’. The neighbourhood of the initial sphere would however intuitively be determined as everything which is not the sphere, hence the sphere isolated from its neighbourhood is still spherical after the alleged change.

Another problem with the notion of intrinsic as given above shows when the idea of isolation from a neighbourhood is examined. For what happens when isolating from a neighbourhood? In section one, isolation was said to be nothing more than subtracting the set of objects which are defined as neighbourhood of the object under consideration from the set of all objects. So in future examinations, everything that was located or rooted outside the closed interval at which the object is located (i.e. everything (rooted) in the neighbourhood), cannot be considered. It is important to remark here that the object, after the isolation, is still located at a specific point in the dimension. If now a certain property is rooted in this specific point, it is intrinsic according to the above definition. This is however counterintuitive; after all: 'standing in front of the Eiffel Tower' is a property rooted in specific spatial point, but intuitively not intrinsic.

It seems that intuitively, what was intended with isolation was actually a generalisation from being located at a certain point in a dimension to being merely located in said dimension. It was not intended to 'totally isolate' an object from being located in a dimension at all; after all, one still wants to consider the objects as extended in the dimension, only disregarding all 'location specific' properties. For example, in considering the intrinsic properties of a front door, one wants to consider for instance its colour and its extension in three spatial dimensions, but disregard the distance to the nearest window. Hence an isolation from its spatial neighbourhood will generalize the front door from being located at a specific spatial location (for instance two meters from the nearest window), to being located in three dimensional space in general; as said one still wants to consider the front door as having a length, width and height. But again the current definition of intrinsics in terms of neighbourhood seems not to correspond with intuitions about intrinsics.

It might now be proposed to use instead the definition of intrinsic with the idea of isolation from neighbourhood, this time with 'isolation' defined as a generalization from dimensions as described above. There are however also several problems with this definition. First, in defining intrinsics this way, i.e. as properties which are had even if the dimensional location of an object is generalized, the only possible extrinsics are properties rooted in at least one of the same dimensions as the object is located in. As example, a spatially located object standing in relation with a certain non-spatially located object will still stand in that relation if it is generalized from its spatial dimension; after all, since the relation concerns a non-spatially located object, it makes no difference whether the original object is located at a

specific point in space or merely located in space. Second, recall that in section one, it was concluded that if time is rooted in the neighbourhood of an object, ‘perdurance’ will be the solution to the problem of temporary intrinsics, otherwise, it will be ‘endurance’. However, with the notion of generalizing from the temporal dimension, there seems to be some ambiguity as to whether time is rooted in the neighbourhood of an object. For on the one hand, every time at which a property is had by an object is necessarily not part of the temporal neighbourhood of the object. On the other hand however, if the object is generalized from the times it has its properties, these properties, if they are still had, can indeed be had at times, but are not had at specific times; so in a sense, the objects becomes isolated from these specific times. Anyway, taking isolation from neighbourhoods as generalization from dimensions does not solve the discrepancies between a definition of intrinsic using these notions and an intuitive notion of intrinsics.

The idea of generalizing from a dimension does however point to an alternative way of treating dimensions, specifically time and space. In generalizing from, for instance, specific times to locations in time in general, a dimensional location is turned into a property; being at time t is generalized to the property of ‘being temporal’. Inspired by this example, and in the light of the problems shown to arise by treating time and space as topological space, it might be useful to regard location at a specific point in a dimension also as a property. Thus an object located at a certain point in space has the property of being located in said point of space; an object existing at a certain time analogously has the property of being at said time. In this view, a single object extended in space has multiple properties indicating its location at a point in space; analogously, an object existing during the time interval $[t_1, t_2]$ has infinitely many properties indicating it being at a certain time, including the properties T_1 (being at t_1) and T_2 (being at t_2).

It is important to recognize the metaphysics of the assertion that being at specific points in space or time are properties. Where regarding time and space as topological spaces metaphysically amounted to granting a special ontological status to time and space, by taking location at specific points in space or time as properties, time and space gain the same ontological status as ‘ordinary’ properties. This is especially viable in an ontology which has objects as ontologically fundamental, since it is hard to ground the special ontological status of time and space in objects alone.

As with the introduction of intermediate properties, the question arises whether the properties of being at a point in space or time are compatible with one another; more specifically, the question is whether T_1 and T_2 are compatible or incompatible properties. It now seems that the 'grand question', which was addressed in section one, appears again: 'endurance or perdurance?'. For the endurantist has to hold that T_1 and T_2 are compatible; after all, endurantism must allow for an object to exists wholly at both T_1 and T_2. The perdurantist, on the other hand, is inclined to hold that T_1 and T_2 are incompatible; they are indeed had by different objects, namely temporal parts. Notice that perdurance does not logically entail the incompatibility of T_1 and T_2; after all, the perdurantist might hold that T_1 and T_2 are compatible, but that there simply are no objects which have them both. However, since it in practice turns out that T_1 and T_2 are never had by the same object, the incompatibility of T_1 and T_2 might be seen as a practical implication.

It thus seems that by regarding time as a property, the problem of intrinsic change is not needed as catalyst for a choice between metaphysical endurance or perdurance. However, this is not entirely true; change is indeed necessary for a problem to arise, although now, since time is regarded as property, it is not a change *over* time that causes the problem, but a change *in* time. The new problem of change comes down to an object x existing during a time interval, thus having, inter alia, properties T_1 and T_2. As asserted above, the endurantist solves, or rather avoid, this problem by taking the properties to be compatible, whereas the perdurantist takes x to be multiple objects (i.e. temporal parts).

Now compare this problem to the original problem of change, in which, besides the properties T_1 and T_2, the incompatible properties P and Q are also had by x.[51] Notice that since there is no definition of intrinsics, properties P and Q cannot be classified as intrinsic or extrinsic. After all, the earlier definition of intrinsics in terms of neighbourhoods was found to be flawed; the underlying idea, time and space as topological spaces, was replaced by the idea of locations in space or time as properties, and no new definition of intrinsic was given yet. Now suppose, to mimic the original problem, that P is had at the time designated by the property T_1 and Q at the time designated by T_2. Like in the original problem, for the endurantist, this amounts to a relation between the properties P and T_1 and between Q and T_2. In the case of perdurance, the properties P and Q are already tied to the properties T_1 and T_2 respectively,

[51] The intermediate times and properties will be ignored, since their consideration does not contribute to the case.

since they belong to the same temporal parts of x. Thus far, the results do not seem to differ from those obtained from the original problem. Especially in the case of perdurance; the same solution, temporal parts with only a single 'time-indicating' property, arises. The same arguments for and against perdurantism, as mentioned in section one, seem to apply.

There is a difference however, in the case of endurance: x has properties T_1 and T_2, which are compatible, but also P and Q, which are given as incompatible. The problem that thus arises, x having incompatible P and Q, is similar to the earlier problem the endurantist faced, namely x having both T_1 and T_2. The last problem was avoided by taking T_1 and T_2 to be compatible. Since P and Q are given as incompatible, such a solution is not possible; however, it might be argued that due to their respective relation to compatible T_1 and T_2, P and Q are compatible. In that case, P and Q are incompatible, but become compatible as soon as they relate to some other compatible properties. Notice that this solution is similar to the way Rychter tried to dissolve the puzzle of intrinsic change;[52] by relating incompatible intrinsic properties to times, but excluding those times from the neighbourhood,[53] he made them compatible: "objects *can* have incompatible properties; and of course they *do* have them *at different times*" (Rychter 2009, 13). In section one it was shown that this way of dissolving the puzzle of intrinsic change was depended on the account of neighbourhood given. However, in the case at hand, there is no account of neighbourhood, since topological space and time were done away with. In the light of the above solution to the new problem of change, one is faced with two options for the definition of intrinsics: either one allows intrinsics to be properties that change their compatibility when they relate to some other compatible properties, like P and Q above, or one does not allow that. If the former, then endurance through change in intrinsics is possible; if the latter, then changing properties are necessarily extrinsic if objects endure.

The metaphysical problem of temporary intrinsics, if locations in space or time are taken to be properties, thus seems to reduce to the question whether properties are compatible. Three positions, corresponding to three possible solutions, are possible: perdurance, endurance with intrinsics and endurance without intrinsics. According to the first position, perdurance, properties indicating times are incompatible, while they are, according to the second and third endurance positions, compatible. According both the endurance positions, incompatible properties change their compatibility when they relate to compatible properties, however the

[52] See section one.
[53] In section one, the definition of intrinsics in terms of neighbourhoods was used.

third position, endurance without intrinsics, holds that this cannot occur with intrinsic properties.

The advantage of the above formulation of the metaphysical problem of intrinsic change is that it is much less depended on the notion of intrinsic; it is only used in distinguishing between two different kinds of endurance. The advantageous consequence is that one can now attempt to answer the 'grand question' of metaphysical perdurance versus metaphysical endurance without worrying about the definition of intrinsic properties.

In this section, it was shown that metaphysical endurance and perdurance are incompatible 'total' views, in the sense that accepting one of these views means accepting it in all cases, and rejecting the other. Also, it was found that, due to the fact that time is dense, change in incompatible properties is always continuous, and occurs as a series of continuous changes between intermediate properties. Furthermore, the conclusion was reached that a definition of intrinsics in terms of topological neighbourhoods does not always correspond with intuition. It was proposed to take location in space or time as being properties, which was subsequently shown to lead to a new formulation of the metaphysical problem of temporary intrinsics.

Conclusion

In this paper, the problem of temporary intrinsics was examined. In the first section, Lewis's treatment of the problem of temporary intrinsics was addressed, as well as Rychters statement that there is no puzzle about intrinsic change. It was shown that the issue underlying Lewis's three solutions to the problem, as well as Rychters statement, was the notion of intrinsics. A framework for definitions of intrinsically was given, according to which intrinsic properties are those properties an object still has were it to be isolated from its neighbourhood; whereby this definition depends on the account of neighbourhood. It was that the major argument in the 'grand question' of endurance versus perdurance revolved around the notion of intrinsic; more specifically, around the question whether time is rooted in objects or in neighbourhoods, returning endurance or perdurance respectively as answer. Also, Rychter statement was shown to depend on the notion of intrinsic, thus on the account of neighbourhood.

In the second section, Lowe's distinction between the semantic and metaphysical problem of intrinsic change was examined. It was argued that although Lowe was right in distinguishing

the two problems, they cannot be isolated from each other. It was argued that one has to be careful not to use semantic arguments in the metaphysical debate about change, for, as was shown with some examples, this leads circular arguments.

In the third section, the metaphysical problem of intrinsic change was addressed. It was shown that metaphysical endurance and perdurance were incompatible, 'total' views, in the sense that accepting one of these views means accepting it in all cases, and rejecting the other. Time, fundamental to the notion of change, was then examined; via the observation that time is dense it was concluded that change in incompatible properties is always continuous, and occurs in a series of continuous change between intermediate properties. The notion of intrinsic was discussed next, as well as the underlying notion of topological space. It was argued that the definition of intrinsic in terms of topological neighbourhoods does not always correspond with intuitions about intrinsic change, and thus the idea of time and space as topological spaces was replaced by the idea of taking location in space or time as a property. This was subsequently shown to lead to a new formulation of the metaphysical problem of temporary intrinsics.

In this formulation, location in space or time is taken to be a property, which makes a definition of intrinsics in terms of neighbourhood void. The answer to the metaphysical question whether objects endure or perdure was shown to depend on whether the properties designating times were mutually compatible. If they are incompatible, perdurance is the answer, while if they are compatible, the answer is endurance. This formulation is clear than Lewis's original formulation, which not only was, in section two, shown to be highly susceptible confusion due to unwarranted semantic arguments, but was also, in section one, shown to depend on a notion of intrinsics which was, in section three, found to be somewhat counterintuitive.

Although the three sections of this paper thus ultimately lead to a new formulation of the problem of temporary intrinsics, each of them also give rise to some related questions, which might be interesting both in their own right as in relation to the problem of intrinsic change. For instance an elaboration of the notion of neighbourhood as central to the definition of extrinsic properties, as put forward in section one, may spark some interesting results, especially when the properties of accompaniment and loneliness are also examined. Section two may give rise to further questions regarding the relation between semantics and

metaphysics in the problem of intrinsic change as well as in general. Also there are three major issues emerging from section three: what are the consequences of the conclusions that time is dense and change is always continuous between intermediate properties for related areas of metaphysics, such as the debate about the nature of time, (personal) identity (over time) and causation? Furthermore, the notion of topological spaces could be explored further, especially when combined with the idea that location in such dimension might be regarded as a property, as was the case with space and time in the last part of section three.

As a final remark, note that the problem of temporary intrinsic has changed over the course of this paper from Lewis initial definition to a new formulation, and only time can tell whether this change is fruitful.

References

- Haslanger, S. 1989, "Endurance and Temporary Intrinsics", Analysis, Vol. 49(3), pp. 119-125
- Johnston, M. & Forbes, G. 1987, "Is there a problem about persistence?", Proceedings of the Aristotelian Society, Supplementary Volumes, Vol. 61, pp.107-135 + 137-155
- Kim, J. 1982, "Psychophysical Supervenience", Philosophical Studies Vol. 41(1), pp. 51-70
- Lewis, D. 1983, "Extrinsic Properties", Philosophical Studies, Vol. 44(2), pp. 197-200
- Lewis, D. 1986, *On the Plurality of Worlds*. Oxford: Basil Blackwell.
- Lewis, D. 1988, "Rearrangement of Particles: Reply to Lowe", Analysis, Vol. 48(2), pp. 65-72
- Lewis, D. 2002, "Tensing the Copula", Mind, Vol. 111, No. 441, pp. 1-13.
- Lowe, E.J. 1987, "Lewis on perdurance versus endurance", Analysis, 47(3), pp. 152-154
- Lowe, E.J. 1988, "The Problems of Intrinsic Change: Rejoinder to Lewis", Analysis, Vol. 48(2), pp. 72-77
- McCall, S and Lowe, E.J. 2009, "The definition of Endurance", Analysis, Vol. 69(2), pp. 277-280
- McCall, S and Lowe, E.J. 2006, "The 3D/4D Controversy: A Storm in a Teacup", Noûs 40(3), pp. 570-578
- Rychter, P. 2009, "There is No Puzzle about Change", Dialectica, Vol. 63(1), pp 7-22