Original Article doi: 10.1590/0100-512X2025n16004ab

A PROBLEMATIC MEREOLOGICAL ANALYSIS: TRANSITIVITY IMPLIES IDENTITY[1]

UMA ANÁLISE MEREOLÓGICA PROBLEMÁTICA: TRANSITIVIDADE IMPLICA IDENTIDADE

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ABSTRACT *In the present research, it is argued that two different mereological theories incur in the problem according to which the transitivity of proper parthood relation implies identity. The mereological theories are: (i) Kathrin Koslicki's theory presented in her work* The Structure of Objects *(2008) and (ii) the theory according to which Tractarian propositions are analyzed as mereological wholes in the context of Edmund Husserl's theory of wholes and parts. The main objective is to demonstrate that, in formal terms, any mereological analysis that accepts that transitivity implies identity is inconsistent, and also presents certain specific problems that arise for each of the mentioned theories.*

Keywords: *Mereology. Proper parthood. Identity Principle.*

1 Article submitted on: 04/05/2024. Accepted on: 08/05/2025.

RESUMO *Na presente pesquisa, argumenta-se que duas teorias mereológicas diferentes incorrem no problema segundo o qual a transitividade da relação de parte apropriada implica identidade. As teorias mereológicas são: (i) a teoria de Kathrin Koslicki apresentada em sua obra "The Structure of Objects" (2008) e (ii) a teoria segundo a qual as proposições Tractarianas são analisadas como totalidades mereológicas no contexto da teoria de totalidades e partes de Edmund Husserl. O objetivo principal é demonstrar que, em termos formais, qualquer análise mereológica que aceite que a transitividade implica identidade é inconsistente e também apresenta certos problemas específicos que surgem para cada uma das teorias mencionadas.*

Palavras-chave: *Mereologia. Parte apropriada. Princípio da identidade.*

1. The Problem

Mereology is a formal discipline that concerns the relationship between parts and wholes. In general terms, the part–whole relation is neutral, so that different entities, regardless of their nature, can be conceptualized as parts and/or wholes. As Uzquiano says (2006, p. 137), "The part–whole relation, we often hear, applies not only to material objects or objects located in space and time but to all objects whatever." For instance, a mereological analysis may consider physical atoms as parts of molecules, or it may posit that propositions are wholes that have their constituents as parts.

However, mereological analyses encompass different principles concerning the logical properties governing the part–whole relation, or the identity conditions determining wholes, among others. In the following paragraphs, I present a specific mereological analysis that incorporates an identity principle for wholes, along with logical rules governing the parthood relation. The purpose of presenting this analysis is to argue, in subsequent sections —2 and 3—, that two metaphysical theories ultimately commit themselves to the discussed analysis, leading to certain problems for both theories, in addition to certain formal problems presented below. With that in mind, let's proceed.

Firstly, for the present analysis, let's assume that whenever x is part of y, x is a *proper part* of y. Let us denote the binary predicate "*be a proper part of...*" as R. The proper parthood relation is governed by the following principles (Simons 1987, 10):

- Asymmetry: $R(x, y) \rightarrow - R(y, x)$
- Irreflexivity: $- R(x, x)$
- Transitivity: $R(x, y) \wedge R(y, z) \rightarrow R(x, z)$

In the second place, let's consider the identity of wholes in terms of their proper parts. For example, we can formulate the following principle:

- [*Identity Principle A*]: $R(xx, y) \wedge R(xx, z) \rightarrow (y = z)$

This principle says that if the *x*s are proper parts of both *y* and *z*, then *y* is identical to *z*—here, the expression "*xx*" is a plural expression referring to all the proper parts of the whole.[2] Essentially, an identity principle in this context allows us to distinguish a whole by virtue of its proper parts. However, the identity principle relevant to this analysis, in contrast to *Identity Principle A*, only considers *one* part of a whole to determine identity. This principle can be expressed as follows:

- [*Identity Principle B*]: $R(x, y) \wedge R(x, z) \rightarrow (y = z)$

Identity Principle B is logically stronger than *Identity Principle A*, as the former entails the latter: if *y* is identical to *z* by virtue of sharing a single proper part, it follows *a fortiori* that they must be identical when sharing all their proper parts. Although this principle is not typically discussed in mereological debates, Canavotto & Giordani (2022) explicitly adopt it for specific metaphysical motivations —to be commented in section 3. Additionally, the principle is trivially true if *x* is an *improper part*: if *x* is an improper part of *y* and *y* is an improper part of *x*, then $x = y$ (cf. Simons 1987, 11) —which also applies to the case of *x* and *z*. Crucially, this paper does not aim to defend *Identity Principle B* but rather to show that in certain metaphysical theoretical contexts, this principle, or some variant of it, can be *logically expressed*, bringing with it the problems that are noted below.

However, *Identity Principle B* may pose challenges in certain contexts, especially when introducing concepts like the overlap relation, which I won't

2 If we assume that (a) proper parts compose a whole, and (b) the identity of wholes is determined by their proper parts, we can express *Identity Principle A* as follows: If *y* and *z* are composed of the same proper parts, then *y* and *z* are identical. This principle is equivalent to the uniqueness of composition principle adopted by classical extensional mereology (cf. Lewis 1981, 74).

delve into here.[3] Instead, I will focus on the following scenario related to *Identity Principle B,* along with the proper parthood relation:

(1) $R(x,y)$
(2) $R(y,z)$

Then, by the transitivity of proper parthood, it follows that:

(3) $R(x,z)$

Therefore, considering (1) and (3), results that:

(4) $R(x,y) \wedge R(x,z)$

Now, applying *Identity Principle B* to (4) leads to

(5) $(y=z)$

According to reasoning (1) – (5), the proper parthood relation combined with *Identity Principle B* results in that *transitivity implies identity*. This conclusion gives rise to at least two formal problems:

- If y is a proper part of z and y is identical to z, then y is a proper part of itself, violating the irreflexivity of the proper parthood relation.
- Let x be a proper part of y, and y be a proper part of z. Furthermore, let a be a proper part of b, and b be a proper part of z. Therefore, $R(x, y)$, $R(y, z)$, $R(a, b)$, and $R(b, z)$, assuming additionally that y and b have no proper part in common. Accepting the truth of *Identity Principle B* leads to $(y = z)$ and $(b = z)$. However, by the transitivity of identity (cf. McGinn 2000, 2), this implies $(y = b)$, even though y and b share no proper part in common. Consequently, *Identity Principle B* is violated.

Due to these problems, it can be concluded that any mereological analysis that incorporates the proper parthood relation along with *Identity Principle B*, or

3 In the present context, if x overlaps with y, then x and y share a common proper part. On the other hand, according to *Identity Principle B* results, in this context, any overlap case implies identity. Then, for example, let us assume that persons are mereological wholes, which have their organs as proper parts. So, in the case of Siamese twins —this is an overlap case (cf. Simons 1987, 12)—, the twins would be identical. This result is not correct, for example, from common sense beliefs or even from general scientific assumptions.

an equivalent principle, is inconsistent. In the following two sections, I examine how two metaphysical theories of distinct natures end up adopting this type of mereological analysis, resulting in the aforementioned formal problems, as well as issues specific to each theory. The theories in question are: (i) Kathrin Koslicki's theory presented in her work *The Structure of Objects* (2008) and (ii) the theory according to which Tractarian propositions are analyzed as mereological wholes in the context of Edmund Husserl's theory of wholes and parts.

2. Koslicki's Mereological Theory

In the present section, the general aspects of Koslicki's mereological theory are presented. What is important here is to examine the idea that a mereological whole is structural, which is determined by what Koslicki calls the formal component, considering that this formal component is a proper part of a whole. Later, a certain identity principle follows from Koslicki's ideas, constructed based on the role that the formal component plays in the whole which it is a part of. Finally, it examines how it follows from these ideas that transitivity implies identity, as well as showing certain problems that this brings to Koslicki's theory.

In the realm of contemporary metaphysics, different theories regarding composition and part-whole relations exist. One such per corresponds to the Neo-Aristotelian hylomorphism. In general, this theory asserts the existence of structured mereological wholes composed of distinct parts (cf. Sattig 2015, 5). It is crucial to highlight that the term "hylomorphism" reflects the fact that the nature of the structured object contemplates both its matter and form. Essentially, Neo-Aristotelian hylomorphism contends that the object's form imposes structural constraints on its matter —these constraints are related to order, levels, or repetition (cf. Cotnoir & Varzi 2021, 202).

In this context, Kathrin Koslicki, in her book *The Structure of Objects* (2008), has proposed a non-classical mereological theory to explain the existence and identity of structured mereological wholes, identified as hylomorphic compounds. To delve deeper, a hylomorphic compound is an entity composed of form and matter: the form, a formal entity, specifies requirements for the existence of hylomorphic compounds, such as the order and kind that the material components or matter must satisfy (cf. Koslicki 2008, 174). However, according to the Koslicki *Neo-Aristotelian Thesis*, both formal and material components are *proper parts* of the hylomorphic compound: "The material and formal components of a mereologically complex object are proper parts

of the whole they compose" (Koslicki 2008, 181). Consequently, hylomorphic compounds are mereological wholes composed of their formal and material proper parts. Notably, the Koslicki mereological theory (hereafter KMT) considers the proper parthood relation as primitive, and this is the *only* parthood relation it accepts (Koslicki 2008, 167). Accordingly, KMT is committed to the mereological or compositional monism thesis (cf. Fine 2010, 561; McDaniel 2010, 414): therefore, if *x* is a material or formal component of *y*, then *x* must be a proper part of *y*. The commitment to monism is an important point for what is analyzed later.

As previously stated, proper parts compose a mereological whole. A successful composition in KMT occurs only when the material proper parts of the whole satisfy the structural restrictions imposed by its formal proper parts. In this sense, the composition relation is restricted: "(…) the current approach takes composition to be restricted: it occurs only when certain conditions are satisfied (…); more generally, they require that the dictates of some particular formal components are satisfied" (Koslicki 2008, 169). This characteristic makes KMT a non-classical mereological theory.[4]

Now, let's consider a case to illustrate the above: assuming a molecule is a mereological whole that has its component atoms as proper parts (cf. Harré & Llored 2014, 189), let *x* be an H_2O molecule that has as two hydrogen atoms and one oxygen atom as its proper parts. This can be represented as follows:

$$x = \sum (H, H', O)$$

Here, "∑" operator denotes a generic composition operation, *H* represents a hydrogen atom, and *O* represents an oxygen atom.

However, within the KMT framework, *x* is considered a structured whole. Consequently, *x* has not only *H*, *H'*, and *O* as proper parts but also *F*, where *F* corresponds to a formal part. Thus, *x* has four proper parts. The formal part *F* imposes restrictions on *x*: determines that *x* can only have entities of the kinds 'hydrogen atom' and 'oxygen atom' as material parts, and, also, specifies that the material parts of *x* must be arranged in a particular order or arrangement. Concerning the latter, the order among the material parts of *x* corresponds to

4 A mereological theory is non-classical if rejects the unrestricted composition principle (cf. Meirav 2003, 42 – 43). The unrestricted composition principle says that whenever there are some things, then there exists a whole composed of those things (cf. Lewis 1991, 74).

the arrangement of the atoms mediated by a covalent bonding relation.[5] This can be represented as follows:

$$x = \sum_{KMT} (H, O, H' /F)^{6}$$

It is crucial to clarify certain ideas. Firstly, the "$\sum_{KMT}$" operator corresponds to a specific composition operation that KMT adopts —as mentioned earlier, composition occurs only when certain requirements are satisfied. Secondly, the material components of *x, H, H' and O*, are arranged in a specific manner: the oxygen atom is positioned between the two hydrogen atoms.[7]

With these points clarified, let's now focus on elucidating how we should understand the identity of the mereological wholes discussed by Koslicki. Initially, the following idea is important:

> (…) the world does not contain numerically distinct, spatiotemporally coincident wholes which share exactly the same parts: for NAT [*Neo-Aristotelian Thesis*], in conjunction with the assumption that objects of distinct kinds have distinct formal components, yields the result that there could be two or more numerically distinct, spatio-temporally coincident objects which belong to *distinct kinds* and which share all their parts. (Koslicki 2008, 182)

Based on this quote, results that two wholes of different kinds will never share, at least, the same formal component.[8] Given this fact, I find it plausible to establish the following *logical* identity principle:

$$[\textit{Identity Principle KMT}]: R(x_f, y) \wedge R(x_f, z) \rightarrow (y = z)^{9}$$

5 The configuration imposed by the form on a whole is determined by the kind to which the object belongs: "Exactly which requirements are specified by some given formal components of course depends on the kind of object under consideration and cannot be settled in abstraction from particular cases" (Koslicki 2008, 172). Therefore, if we analyze, for example, a polymer composed of H_2O molecules, the configuration will not be determined by the covalent bonding relationship but rather by hydrogen bonding.

6 The part *F* of *x* is after the sign "/", unlike the other parts of *x*. This captures that *F*, even though it is part of *x*, is not related to the material parts in the same way that the latter are related to each other.

7 This configuration aligns with the diagram of the H_2O molecule, as well as with its molecular representation.

8 According to Koslicki, it is the role of formal parts to distinguish between materially coincident objects: "For, given the dichotomous nature of wholes, the difference between a whole and its material components, on this account, may, in general, be explained by pointing to additional parts which distinguish the whole from its material components, viz., its formal components" (Koslicki 2008, 181). Consequently, it follows that even in the presence of material coincidence between two wholes, identity will not hold unless there is also coincidence concerning their formal parts. In this sense, we can say that material coincidence is a sufficient condition for identity, whereas formal coincidence is a necessary condition for identity.

9 According to the above, it could not be the case that the consequent is true, but the antecedent is false. Consequently, the principle in question is true.

In this principle, the variable "x_f" refers to the formal component of a whole.[10] Thus, *Identity Principle KMT* asserts that if two wholes, y and z, share the same formal component, x_f, then they are identical. This principle implies that it is never the case for two numerically distinct wholes to have the same parts: corresponding to the uniqueness of composition principle (cf. Koslicki 2008, 183; Lewis 1991, 74). It is important to note that any component referred to by the variable "x_f" is a proper part of some whole, which is expressed by the relation R.

As established, KMT is committed to the proper parthood relation plus *Identity Principle KMT*. Under these conditions, KMT's analysis entails that transitivity implies identity, thereby generating the consistency issues discussed earlier —*Identity Principle B*, section 1, entails *Identity Principle KMT*: In general, while the former principle concerns proper parts, the latter specifically targets formal components, which are proper parts. To characterize the above, let us consider the following scenario: let x_f be a proper part of y, and let y be a proper part of z.[11] By the transitivity of proper parthood, x_f must be also be a proper part of z. This can be expressed as follows: $R(x_f, y) \wedge R(x_f, z)$. Now, applying *Identity Principle KMT*, it follows that $y = z$. In essence, if the same proper part, x_f, is a proper part of both y and z —as occurs when x_f is a proper part of y and y is a proper part of z—, by *Identity Principle KMT,* it follows that $y = z$. This last result is what we previously captured by saying that transitivity implies identity. We can note that if y is identical to z, then the proper parthood irreflexivity is violated: if y is a proper part of z, y cannot be a proper part of itself, but if y is identical to z, then y must be a proper part of itself — this is a variant of the formal problem noted in section 1. But other problems also arise for Koslicki's theory. Consider two H_2O molecules, x and y, sharing no common proper parts, neither atomic constituents nor formal components. Suppose both are proper parts of a polymer z. According to the preceding discussion, z would be identical to each molecule, x and y, which is scientifically untenable: a polymer's chemical properties differ categorically from those of its constituent molecules. Moreover, since x and y are distinct, transitivity of identity fails, even though $x = z$ and $y = z$, producing a direct

10 Koslicki discusses formal components, but for the present analysis, I will consider cases involving only one formal component.

11 Koslicki recognize that a hylomorphic compound could be proper part of another whole: "Consider now a proper part of (a proper part of . . .) one of the table's material components, e.g., a single molecule which might be, say, a proper part of (a proper part of . . .) one of the table's legs. By the transitivity of parthood, the single molecule in question is a proper part of the table as well.
If tables are hybrid objects [hylomorphic compounds], consisting of formal and material components, then so are molecules, since the same considerations apply in both cases." (Koslicki 2008, 186).

contradiction —all of this corresponds to an application of the second formal problem of section 1.

However, a KMT defender might seek to avoid the implication that transitivity implies identity. To achieve this, the defender could deny that formal components are proper parts and, with this, deny that formal components are governed by the property of transitivity; unlike material components, which would be proper parts. Opting for this alternative would entail committing oneself to two types of parthood relations: a relation that is not transitive —for the case of formal components—, and the proper parthood relation —governing material components. In other words, the KMT defender would have to commit oneself to mereological pluralism, thereby rejecting the monism to which the theory subscribes —as indicated at the beginning of this section.

Based on the above, KMT faces the following dilemma:

> [*First horn of the dilemma*]: KMT accepts that transitivity implies identity.
>
> Or,
>
> [*Second horn of the dilemma*]: KMT accepts two parthood relations, one of which is not transitive. Therefore, KMT must adopt mereological pluralism.

As pointed out, both horns, in one sense or another, pose problems for KMT.

3. *Tractarian* Propositions as Mereological Wholes

In this section, I expose that considering the propositions dealt with by Wittgenstein in the *Tractatus Logico-Philosophicus* as mereological wholes, based on Husserl's ideas about wholes and parts, incurs the problem according to which transitivity implies identity. It is important to note that the proposal that *Tractarian* propositions are mereological wholes *à la* Husserl is constructed from what Peter Simons exposes in his work "Unsaturatedness" (1981); as well as from understanding the relation of *foundation* that Husserl uses to describe certain aspects of the parts and wholes as a type of ontological dependence.

To pursue the stated objective, this section is articulated as follows: first, it specifies what is to be understood as a *Tractarian* proposition, differentiating an elementary proposition from a molecular proposition. Later, it is considered Simons' suggestion that an elementary proposition can be analyzed as a

mereological whole following the Husserlian ideas about wholes and parts developed in *Investigation III* of his *Logical Investigations*. What is crucial here is the idea that the structure of a proposition is a part of the proposition, which is a dependent part or *moment* of the whole. Then, it is argued that the relation between a *moment* and a whole must be understood as a relation of ontological dependence —specifically, identity dependence—, considering the Husserlian notion of foundation. At this point, it is specified how the conditions that result in the problem that transitivity implies identity are satisfied from what has been analyzed. Finally, I note the consequences of this problem in the context of the *Tractatus*.[12] Having said this, let us begin.

Among the different ideas put forward by Wittgenstein in the *Tractatus*, we find that according to which propositions are *truth functions* of what the author calls elementary propositions (*T* 4.21 - 4.28)[13] —Russell, in the introduction to the *Tractatus* calls the former molecular propositions (cf. Wittgenstein 2001, xv). For the present investigation, an elementary proposition is taken to have names as its immediate components (cf. Black 1962, 206). Wittgenstein says in *T* 4.22: "An Elementary proposition consists of names. It is a nexus, a concatenation of names". On the other hand, what Russell calls a molecular proposition, unlike an elementary proposition, has as its components different elementary propositions —and not names. Thus, an elementary proposition is elementary or basic since it does not consist of other propositions as its components, unlike a molecular proposition. I already warned that this distinction would be fundamental for the conclusion of this section.

However, a proposition, either elementary or molecular, consists of a determined configuration. Wittgenstein says about this: "A proposition is not a blend of words. —(Just as a theme in music is not a blend of notes.) A proposition is articulate" (*T* 3.141). For the sake of argumentation, it is assumed that the configuration of the proposition's elements corresponds to the structure of the proposition (cf. Simons 1981, 90). Let us focus a moment on this idea. According to the picture theory of language put forward in the *Tractatus*, a proposition is a *picture* (*T* 4.01) and every picture is a fact (*T* 2.14), as Ramsey points out: "A picture is a fact, the fact that its elements are combined with another in a definite way (...) These co-ordinations constitute the representing relation which makes the picture a picture" (1923, 466). It is important to note

12 It is important to note that we will not go into the different interpretations of the ideas put forward by Wittgenstein in the *Tractatus*, nor into the different analyses of Husserl's philosophy.

13 Quotations and references from the *Tractatus Logico-Philosophicus* are specified with the letter "*T*" followed by the corresponding paragraphs.

that, according to what Ramsey says, the elements of a picture are combined or arranged in a certain configuration in coordination with the elements of what is pictured or represented. Wittgenstein says in *T* 2.15:

> The fact that elements of a picture are related to one another in a determinate way represents that things are related to one another in the same way.
> Let us call this connection of its elements the structure of the picture, and let us call the possibility of this structure the pictorial form of the picture.

Based on this quote, the determined configuration or arrangement of the elements of a picture corresponds to its structure —an arrangement possible by the *pictorial form* that every picture has (*T* 2.151, 2.17). So, for example, let "*ab*" be an elementary proposition, which has as elements the names "*a*" and "*b*". The arrangement according to which the name *a* precedes the name *b* corresponds to the specific structure of the elementary proposition in question, which is determined by the pictorial form that the proposition as a picture has.

Let us now proceed to review how a *Tractarian* elementary proposition can be conceived as a Husserlian mereological whole. Peter Simons, in "Unsaturatedness" (1981), develops the Fregean concept of saturation to explain the formation of propositions in the context of what Husserl proposes in the *Logical Investigations*, specifically in *Investigation III*. In the development of this work, Simons considers what Wittgenstein posed in the *Tractatus* about elementary propositions to illustrate how the components of a proposition are structured. Simons says:

> Such considerations bring us close to the Wittgenstein of the *Tractatus*, who distinguished the elements of a Tractarian elementary sentence [proposition], names, from their mode of combination, the structure of the sentence. While the names in a sentence are isolable from it, and can occur in another sentence, bare structure cannot exist: roughly speaking, names are self-sufficient, structure is not; names are pieces; structure are moments, of sentences. We can call names the matter of sentences, and structure the form.
>
> (…)Wittgenstein on the other hand appears to suggest —more radically than either Husserl or Frege— that for elementary sentences this matter/form distinction can be aligned with the distinction between independent and dependent parts of sentences; the names carrying all and only the matter of sentence, the form corresponding to its structure or arrangement. In our terms, a Wittgensteinian elementary sentence consists of a number of pieces, names unified or held together, by a moment, the structure (Simons 1981, 90 – 91)

According to the quotation, Simons differentiates between the elements of an elementary proposition and its structure, which corresponds to how the elements are arranged —as previously noted, the elements of an elementary

proposition are the *Tractarian* names. Simons emphasizes that names are independent of the proposition they compose,[14] while the structure of a proposition is not. Thus, a name could be an element of different elementary propositions, while the structure of a proposition is *particular* to the proposition. Therefore, different elementary propositions have different structures.[15] Later, Simons calls names as *pieces* and structures as *moments*. Husserl, in §2 and §3 of *Investigation III*, states that there are parts that are independent of the whole and others that are dependent upon the whole. The former he calls *pieces*, and the latter *moments*. It is possible to illustrate the difference between *pieces* and *moments* in modal-existential terms: if *x* is a *moment* of *y*, if *y* exists, then necessarily *x* exists; unlike if *x* is a *piece* of *y* (cf. Johansson 2004, 128). Finally, Simons appeals to describe the proposition in terms of matter and form, where the names are the matter or content of the proposition, while the structure corresponds to the form, i.e., that which determines the components arrangement of the proposition. Now, it is pertinent to point out that, according to what Simons says, a *Tractarian* elementary proposition must be understood as a *narrow whole*: a narrow whole is defined as a mereological whole "in which a number of entities are bound together into a unit by a further entity which Husserl calls 'unifying moment' [or *moment*]" (Simons 1982, 121).

We have reviewed, in the first place, how the notion of proposition should be understood according to Wittgenstein's *Tractatus* and, in the second place, how an elementary proposition can be conceived as a mereological whole in the context of certain notions coming from Husserl's philosophy. As stated at the beginning of this section, it is now time to review the relation between a *moment* and the whole which it is a part of. It has been previously said that a *moment* is a dependent part of a whole. The dependence between a *moment* and a whole, according to *Investigation III*, is resolved in terms of the foundation relation. Thus, a *moment* is dependent on the whole which it is a part of, insofar as the *moment* is founded in the whole (cf. Husserl 2001, *Investigation III* §14). The foundation is a relation given in terms of the essence or particular nature of that which is founded to that which founds it, as Husserl points out

14 What Simons says considers paragraph 2.0122 of the *Tractatus*: "Things are independent in so far as they can occur in all possible situations (...)". Here it is important to note the following: according to the thesis of language–reality isomorphism that Wittgenstein adopts in the *Tractatus*, there is a correspondence between objects or things and names.

15 This is consistent with Ramsey's following idea of the facts: "But it seems from remarks later in the book [the *Tractatus*] that the structure of the fact is not a merely the way in which the objects hang together but depends also on what objects they are, so that two different facts never have the same structure" (Ramsey 1923, 466). Ramsey here speaks of a fact; let us remember that a picture is a fact and that a proposition is a picture, as previously indicated.

in *Investigation III* §21: "*A content of the species A is founded upon a content of the species B if an A can by its essence (i.e., legally, in virtue of its specific nature) not exist unless a B also exists*."[16] Basically, if *x* is founded on *y*, then in virtue of the essence of *x*, *x* exists only if *y* exists. On the other hand, it is useful to consider that it is not only that a *moment* cannot exist without the whole which it is a part of —which is an aspect of its essence—, but also that two distinct wholes cannot have the same moment as parts. Regarding the latter, it is useful what Fine says on this subject:

> He [Husserl] begins his study with the consideration of objects in the psychological sphere. A typical example of the kind of object he has in mind is that of a visual datum, a red patch, let us say, and its various aspects or 'moments' —its colour, say, or its extension. He takes each of these moments to be peculiar to the object in question; no other datum, will have the very same moments. He also takes the moments to be, in a suitably broad sense, part of the given object (Fine 1995a, 463)

From this fact, I think it is possible to establish that *what moment* is a certain *moment* that is determined by the whole, which it is a part of. This is compatible with the following idea of Husserl: "(…) it is enough to say that a non-independent object [*moment*] can only be what it is (i.e. what it is in virtue of its essential properties) in a more comprehensive whole" (Husserl 2001, *Investigation III* §10). For the present investigation, it is illuminating to illustrate what is being said through the case of sets: it is possible to determine what set is a certain set by appealing to its members (cf. Koslicki 2013, 171). That is, the difference between different sets, or their identity, is determined by their members, such that if two sets differ in their members, they are distinct, whereas if two sets share the same members, they are identical —according to the axiom of extensionality of sets. Based on this, what happens to a *moment* with respect to the whole which it is a part of is analogous to what happens to a set with respect to its members. From this analogy, and considering that a *moment* is what it is in virtue of the whole which it is a part of, it is plausible to hold that, if *x* is a *moment* of a whole *y*, then *x* depends upon *y* for its identity —analogous to what is postulated about a set with respect to its members (cf. Fine, 1995b; Koslicki, 2013; Tahko & Lowe, 2020). Briefly, according to Tahko & Lowe (2020), identity dependence can be defined as follows:

16 For the present research, the foundation relation is considered in ***objectual*** terms, thus if *x* is founded on *y*, *x,* and *y* are two individuals or objects (cf. Correia 2004, 350; Fine 1995a, 465) —and each one is relative to its respective species (cf. Correia 2004, 354).

[*Identity dependence*]: x depends for its identity upon $y =_{df}$ There is a relation *"R"* such that it is part of the essence of x that x is related by R to y.

As said previously, and in consideration of the definition of identity dependence, it results that, if x is a *moment* of y, then it is part of the essence of x being a part of y[17] —as also that, if x exists, then y exists, given that x as a moment is founded in y.

However, it is possible to establish the following *logical* identity principle in the context of the discussion:

[*Identity Principle MW*][18]: $R(x_m, y) \wedge R(x_m, z) \rightarrow (y = z)$

The variable "x_m" here refers to a dependent part or *moment*.[19] What is being stated in the above principle is that if two wholes share the same *moment*, then they are identical. Now I proceed to remark on why we should accept *Identity Principle MW*. Canavotto & Giordani in their paper *An Extensional Mereology for Structured Entities* (2022), propose a mereological analysis of certain types of wholes that have the fundamental characteristic of being structural. One of the main theses that the authors maintain is that a fundamental aspect of this type of wholes is that their parts are *potential parts*, where a potential part depends for its identity on the whole which it is a part of (Canavotto & Giordani 2022, 2360). In the context of this analysis, the authors say the following: "Since the identity of an entity cannot depend on more than one principle, no entity can be a potential part of two composites [wholes] at the same time" (Canavotto & Giordani 2022, 2361).[20] From this principle, the authors end up establishing a logical identity principle for structural wholes according to which if two wholes share the same potential part, i.e., the same dependent part, then they are identical (Canavotto & Giordani 2022, 2364). Now, if we assume what Canavotto & Giordani state in the context of the present research,

17 Here it is assumed that relative aspects of an entity's identity are the source of essential facts about the entity (cf. Fine 1994, 9; Fine 1995b, 275).

18 The abbreviation "*MW*" is due to "*Moment-Whole*".

19 According to *Identity Principle MW*, a dependent part or *moment* is a proper part of the whole —given that the expression "*R*" is used. While it has not been justified whether a *moment* is a proper part, I follow Correia (2004) here regarding the possibility of considering parts in the context of Husserl's *Logical Investigation III* as a proper part (cf. Correia 2004, 264). On the other hand, what is relevant for the present investigation is that a dependent part or moment is governed by the property of transitivity, and this will be duly justified below —independent of assuming from now on that dependent parts or moments are proper parts.

20 In fact, if a potential part can be a potential part, i.e., a dependent part, of two distinct wholes, an ontological overdetermination problem arises (cf. Briones 2023, 307).

it is possible to state *Identity Principle MW*.[21] Indeed, according to what has been said above, a *moment* is a dependent part of a whole and, in coherence with what Canavotto & Giordani say, from this fact, it is possible to establish a principle according to which two wholes are identical if they share the same *moment*, which corresponds precisely to what *Identity Principle MW* says.

We can note that what says *Identity Principle MW* is similar to *Identity Principle B* —mentioned in the first section—, only that now the principle contemplates a dependent part or *moment* notion. It is important to note that *Identity Principle MW* satisfies one of the two requirements necessary for the generation of the problem, according to which transitivity implies identity. Regarding the second requirement, this is that the type of part specified in the identity principle —in this case, *Identity Principle MW*— is governed by the property of transitivity, and it is equally satisfied in the context of Husserl's ideas about wholes and parts. This is made explicit in *Proposition 4*, paragraph §14, of *Investigation III*: "*If C is a non-independent part of a whole W, it is also a non-independent part of every other whole of which W is a part*".[22] Here, Husserl establishes that the dependent part or *moment* of the part of some whole is also a *moment* of this whole. So let *x* be a *moment* of *y* and *y* a part of *z*, then *x* is a *moment* both of *y* and z. Now, if one considers what *Identity Principle MW* says, given that *x* is a *moment* of *y* as well as of *z*, it follows that *y* must be identical to *z*. Therefore, based on the ideas reviewed so far, the conditions are fulfilled that allow the problem, according to which transitivity implies identity, to appear. It is essential to note that, given the aforementioned, the formal problems mentioned in the first section arise in this context, rendering the present mereological analysis inconsistent.

To conclude this section, let us apply what has been analyzed to the case of *Tractarian* propositions. To begin with, let us recall that, according to Wittgenstein, in the sphere of language we have elementary propositions and molecular propositions —let us remember that the former are obtained from names, while the latter are obtained from elementary propositions. Secondly, we have that, according to Simons, elementary propositions are a type of Husserlian mereological whole, a narrow whole, which has among

21 The reasoning behind the statement above is as follows: Canavotto & Giordani establish a principle of identity according to which there is identity among mereological wholes whenever they share the same dependent part by virtue of what it is to be an ontologically dependent part. Thus, if a mereological analysis accepts ontologically dependent parts, the principle in question follows. If this is correct, and it is assumed to be so here, since a *moment* is an ontologically dependent part, then *Identity Principle MW* can be established. A separate issue is whether what Canavotto & Giordani say is false.

22 The transitivity is a property that applies to all types of parts in the Husserlian analysis (cf. Correia 2004, 264; Fine 1995a, 469).

its parts a dependent part or *moment* and this part counts as the structure of the proposition, i.e., the whole —additionally, a proposition has as parts the *Tractarian* names, although these Simons conceives them as independent parts or *pieces*, i.e., they are not founded in the whole which they are parts of. Now, let us assume that a molecular proposition is also a mereological whole, only that, unlike an elementary proposition, it has as parts elementary propositions (cf. Simons 1992a, 343).[23] According to what has been said, it is possible to construct the following scenario: let y be an elementary proposition, which is part of the molecular proposition z. Since y is an elementary proposition, it has as part a *moment*, which counts as its structure; let x be this. Thus, x is a moment of y, and y is a part of z. From what is established in *Proposition 4*, it follows that x is a *moment* of the elementary proposition y, as it is also a *moment* of the molecular proposition z. Consequently, given *Identity Principle MW*, it follows that y is identical to z. In other words, the elementary proposition y is identical with the molecular proposition z which it is a part of. However, if an elementary proposition is identical to the molecular proposition that has it as part, the following difficulty arises: according to the *Tractatus*, molecular propositions are truth functions of elementary propositions, so the truth or falsity of a molecular proposition depends on the truth or falsity of the elementary propositions from which it is obtained. In this context, let p be the molecular proposition obtained from two elementary propositions, q, and r, and be of the form $(q \wedge r)$. Let us assume, also, that q is a true proposition, while r is a false proposition; hence, p is a false proposition. If we now consider what was said previously, such that q is identical with p, it should occur that p must be a true proposition, such as q. Nevertheless, this is contradictory to the result yielded by the functional analysis of p. Given this scenario, we can conclude that, if an elementary proposition is identical to the molecular proposition that has it as a part, then it is not possible to coherently assert the theory according to which molecular propositions are truth functions of elementary propositions. This fact is problematic because it goes against what Wittgenstein himself affirms in the *Tractatus*.

23 Simons states that in *Tractarian* ontology we find atomic complexes and non-atomic complexes (cf. Simons 1992b, 336) —the former are obtained from *Tractarian* objects, while non-atomic complexes are obtained from atomic complexes. Which can be conceived as mereological wholes, such that atomic complexes have objects as parts, while non-atomic complexes have different atomic complexes as parts (cf. Simons 1992a, 343 - 344). However, according to the *Tractarian* thesis of language-reality isomorphism, it is possible to assume that names correspond to objects, atomic complexes correspond to elementary propositions, and non-atomic complexes correspond to molecular propositions. Based on this, if complexes are mereological wholes, it is plausible to consider propositions as mereological wholes.

Acknowledgment

I am grateful for the comments and suggestions of Camila Riquelme (Universidad de Concepción) and Javier Vidal (Universidad de Concepción).

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