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ORIGINAL RESEARCH

An experimental study on the ontology of relations

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Abstract
There is an ongoing debate on the ontology of relations, which features four main competing approaches: *directionalism*, *positionalism*, *anti-positionalism*, and *primitivism*. This paper focuses on a particular version of positionalism, namely *role positionalism*, and proposes the results of an experimental philosophy research concerning aspects of it. We tested the intuitions of ordinary subjects regarding the inter-relational generality of the roles typically assumed for spatial and kinematic relations, namely *source*, *destination*, *theme*, *location*. According to a 2014 paper by Orilia, this generality is rather wide, as it encompasses relations of temporal order, causation, quantitative order, transaction, possession, and parthood. Our findings do not support this proposal, except for parthood, and, in a limited way, for temporal order. We also tested the intuitions of ordinary subjects regarding the contrast between *the pro-converses option*, according to which non-symmetric relations split into distinct converse relations, and *the anti-converses option*, according to which non-symmetric relations have no distinct converses. Although traditionally positionalism is associated to the latter option, in recent works by Orilia role positionalism is associated to the former option for at least some relations, while remaining anchored to the latter option for other relations. Our findings support this mixed line to some extent, but not quite in the way suggested by Orilia in such works.

Keywords Ontology · Experimental philosophy · Relations · Roles · Converses

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1 Introduction

There is an ongoing debate on the ontology of relations, which features four main competing approaches: *directionalism*, *positionalism*, *anti-positionalism*, and *primitivism*. They differ in the way they deal with a crucial phenomenon of relatedness, namely the differential application of non-symmetric relations such as *loving*, *earlier* and *giving* (MacBride, 2020, § 4). One version of positionalism is the *theory of o-roles*, or, as we shall say, *role positionalism*. In this view, positions are *o-roles* (short for *onto-thematic roles*) such as *agent*, *patient*, *source*, *theme*, *destination*, *instrument*, *beneficiary*, etc., i.e., roughly speaking, ontological counterparts of the thematic roles postulated by linguists, e.g., "agent," "patient," "source," "theme," "destination," "instrument," "beneficiary," etc. (Orilia, 2008, 2011, 2014, 2019; Paolini Paoletti, 2016).[1] O-roles are *inter-relational*, i.e., somehow capable of occurring with different relations. For example, *agent* and *patient* can go with both *caressing* and *kicking*. In contrast, the positions of standard positionalism are idiosyncratically confined to just one relation; for example, there are *caresser* and *caressed* positions for *caressing*, and *kicker* and *kicked* positions for *kicking*. In recent works, Orilia (2020, forthcoming) has made room in role positionalism for a thesis typically associated to directionalism, namely, *the pro-converses option*. According to it, non-symmetric relations split into distinct converse relations. For example, there are two amatory relations, *loving* and its converse, *being loved*. In contrast, standard positionalism, in line with anti-positionalism and primitivism, typically prefers *the anti-converses option*, according to which non-symmetric relations have no distinct converses. For example, there is just one amatory relation, *loving*, or *being loved*, as we may also call it.

We singled out role positionalism as a view of specific interest and decided to investigate on it, by doing some experimental philosophy.[2] We focused primarily on its most crucial aspect, namely the inter-relationality of o-roles. As regards it, the issue arises as to which o-roles should be postulated, and how sweeping their inter-relationality is. Orilia (2014) assumes at least *agent* and *patient*, as the o-roles involved in interaction relations, such as *loving* or *kicking*, and *theme*, *location*, *source*, and *destination,* as the o-roles involved in spatial and kinematic relations, such as *being in* or *going*. Moreover, Orilia also hypothesizes that these latter o-roles feature a very general inter-relationality in that they are involved not only in spatial and kinematic relations, but in other sorts of relations as well. We tested the intuitions of ordinary subjects about such alleged generality. We then also dedicated some attention to the rift between the pro-converses and anti-converses options, regarding which, as noted, role positionalism has recently distinguished itself from standard positionalism. We tested the intuitions of ordinary subjects regarding the pro-converses and anti-converses options in different sorts of cases.

The rest of this paper is organized as follows. In Sect. 2, we first briefly clarify how positionalism differs from its competitors in dealing with differential application, and then we turn to role positionalism. We explain how its o-roles set it apart from standard

[1] On thematic roles, see, for example, Fillmore (1968), Jackendoff (1972, 1990), Gruber (1976), Palmer (1994).

[2] On experimental philosophy in general, see for example Knobe and Nichols (2008), Alexander (2012) and Knobe (2017). On experimental metaphysics, see Rose et al. (2017).

positionalism and how they can be used to make room for converse relations. We then specify the hypotheses regarding the inter-relationality of o-roles and the converse relations that we tested. In Sect. 3, we present the explanations we provided to the research participants to make sure they grasped how the notions of relation and role should be understood, and the screening questions we used to exclude participants without a sufficient level of comprehension (we have simplified matters by simply saying "role" rather than "o-role," and we shall stick to this in the following). In Sects. 4 and 5, we turn to the first, and larger, part of our study, regarding the inter-relationality of roles. In Sect. 6, we turn to the second part, regarding converse relations. Finally, in Sect. 7, we provide a summary of our findings and we comment on them.

2 Competing ontologies of relations, role positionalism and the hypotheses under test

Differential application is the fact that non-symmetric relations are capable of applying to relata, or being exemplified by relata, in different ways, possibly giving rise to different relational states of affairs. For example, the amatory relation can be exemplified by Romeo and Juliet in two ways: (i) with Romeo as lover, and Juliet as beloved, which gives rise to the relational state of affairs of Romeo's loving Juliet; (ii) with Romeo as beloved and Juliet as lover, which gives rise to the relational state of affairs of Juliet's loving Romeo. Directionalism, positionalism, anti-positionalism, and primitivism approach this phenomenon differently. We shall now briefly review how.

According to directionalism, non-symmetric relations are equipped with specific directions, which in turn implies that relata are exemplified by the relation in a given order. For example, there is the amatory relation with a certain direction, *loving*, which is exemplified by Romeo and Juliet, in this order, when it comes to Romeo's loving Juliet, and which is exemplified by Juliet and Romeo, in this other order, when it comes to Juliet's loving Romeo.[3] However, there is also the amatory relation with the opposite direction, *being loved*, which is exemplified by relata in an opposite order: this is exemplified by Juliet and Romeo, in this order, just in case the other amatory relation with the other direction (i.e., *loving*) is exemplified by Romeo and Juliet, in this other order. This view is naturally associated to the pro-converses option: one amatory relation is *loving*, and the other is its distinct converse, *being loved*. In pairs of distinct converses such as this, there are, we may say, different directions, but also a common *content*; in this case an amatory content.[4]

According to positionalism, relations come together with distinct positions, which can be filled by relata.[5] For example, the amatory relation has two positions: the lover position and the beloved position. When it comes to Romeo's loving Juliet, this relation

[3] See Russell (1903), Grossman (1983) and Dixon (forthcoming).

[4] As regards symmetric relations, they can be viewed as having no directions, or as having two opposite directions at once, and as capable of being exemplified by the same relata in multiple orders. For example, if John is next to Mary, *next to* is exemplified by John and Mary, in that order, since it has the direction from John to Mary, and also by Mary and John, in that other order, since it also has the direction from Mary to John (see Paolini Paoletti, 2023).

[5] See Russell (2016), Hochberg (1987), Gilmore (2013), Donnelly (2016, 2021) and Dixon (2018).

applies to Romeo and Juliet in such a way that Romeo occupies the lover position, and Juliet occupies the beloved position. In contrast, it is the other way around when it comes to Juliet's loving Romeo. This view has been typically associated to the anti-converses thesis: there is just one amatory relation (with two positions), rather than two amatory relations distinguished by their different directions.

According to both anti-positionalism and primitivism, there are neither directions nor positions. The former attempts to explain differential application in a comparative way: relations may apply to relata in the same manner as other relations apply to other relata, or in different manners.[6] The latter rejects the very idea that differential application is something that can be explained and thus holds that there is a primitive distinction between the different ways in which a certain non-symmetric relation holds between its relata.[7] Both views have been proposed as in line with the anti-converses thesis. They both hold, e.g., that there is just one amatory relation.

Role positionalism deals with differential application just like standard positionalism. However, it does not assume idiosyncratic positions, such as the *lover* and *beloved* positions of the amatory relation, which feature in standard positionalism. Instead, role positionalism postulates inter-relational roles, which are meant to capture generalities, or aspects that relational states of affairs have in common. For example, Romeo's loving Juliet and his father's hating her father have in common that both involve an agent and a patient, namely Romeo and Romeo's father in one case, and Juliet and Juliet's father in the other case. Similarly, when Tom sits in a certain place and Mary stands up in another, both Tom and Mary play the theme role and both places play the location role. For another example, when Tom walks from his house to the grocery store, and Mary runs from her house to the park, both Tom and Mary play the theme role, and both the grocery store and the park play the destination role.[8]

Besides accounting for generalities, *ceteris paribus*, role positionalism is also more ontologically parsimonious than standard positionalism as regards the number of positions, i.e. roles, that it postulates. However, once we admit inter-relational roles rather than idiosyncratic positions, the issue arises as to which roles there are and what is the extent of their inter-relational generality. Orilia (2014) took for granted that there are at least the roles mentioned in the above examples, corresponding to the most traditional thematic roles of linguistics. He also proposed that *theme*, *location*, *source* and *destination* have a sweeping generality: they are in play not only in *kinematic* relations such as *going*, *walking*, *running*, *traveling* and the like, *from* one place *to* another, or in *spatial* relations such as *staying*, *sitting* or *standing in* some place; they are also in play in a great variety of relations. Among such relations, these sorts of relations are included: (i) temporal order, e.g., when a time is earlier than another time, the former can be seen as source and the latter as destination; (ii) causation, e.g., when an event causes another event, the former can be seen as source and the latter as destination; (iii) quantitative order, e.g., when a certain number is less than another number, the former can be seen as source and the latter as destination; (iv) transaction, e.g., when someone sells something to someone else, the seller can be seen as source and the

[6] See Fine (2000) and Leo (2013).

[7] See Gaskin and Hill (2012) and MacBride (2014).

[8] See the references provided in Sect. 1.

buyer as destination; (v) possession, e.g., when someone owns an object, the owner can be seen as location and the owned as theme; (vi) parthood, e.g., when something is a part of a larger whole, the part can be seen as theme and the whole as location. On the contrary, in Orilia's account, *source* and *destination* are not involved in *interaction* relations such as *kicking* and *loving*, subsisting when an individual acts in such a way that some individual, typically another individual, is affected in one manner or another. For them the roles *agent* and *patient* are reserved, and taken to be distinct from *source* and *destination*. In Sects. 4 and 5, we report on how we tested the intuitions of ordinary subjects on such hypotheses.

As regards converse relations, it is clear that we can distinguish *converse relational predicates*, namely pairs of predicates such that one member of the pair can be seen as the converse of the other member. Typical examples are the following six pairs of relational predicates: "hates" and "is hated," "is above" and "is below," "is before" and "is after," "is taller" and "is shorter," "gives" and "receives," "sells" and "buys." It is less clear however whether the two members in a pair of relational predicates stand for two distinct relations or not. The pro-converses option says that they do, whereas the anti-converses option answers that they do not. As noted by Russell (1903, § 219), there are conflicting intuitions in favor of either option (Orilia, forthcoming). On the one hand, there is a semantic intuition in favor of the pro-converses option: the two members of a pair of relational predicates appear to have different meanings. On the other hand, there is an ontological intuition in favor of the anti-converses option: there seems to be just one state of affairs that is described when one uses two equivalent true sentences, which differ from one another by virtue of which item they pick in a pair of relational predicates. For example, "Romeo loves Juliet" and "Juliet is loved by Romeo" differ in this way and are both made true, one may surmise, by one and the same state of affairs.

As noted, directionalism favors the pro-converses option. Indeed, we may say, it is intrinsically tied to it, as it distinguishes in a relation a content and a direction. Thus, the members of a pair of relational predicates stand for distinct relations that share a content and differ from one another in direction. Once directions are given up, as in positionalism, anti-positionalism and primitivism, it seems that the anti-converses option gains center stage.

Orilia (forthcoming) has however proposed that role positionalism can make room for the pro-converses option, at least in some cases, in the following way. Pairs of relational predicates can be taken to stand for two distinct "embellished relations," which share a common content ("neutral relation") and differ by being equipped, at least in part, with different roles. For example, "is above" and "is below" stand for two relations sharing a common content, *being situated* or *staying*. They also share one role, namely *theme*, which is the role played by an object somewhere situated, but they crucially differ in another role: in one case there is an *abover* role, and in the other case there is a *belower* role. The idea is that in saying that, e.g., the airplane is above the bird, we point to a state of affairs which is the airplane's staying in a portion of space extending upward from the bird, so that the airplane fills the theme role, and the bird the abover role. In contrast, when we say that the bird is below the airplane, we point to a state of affairs which is the bird's staying in a portion of space extending downward from the airplane, so that the bird fills the theme role, and the airplane the

belower role. In this way, the semantic intuition backing up the pro-converses option can be accounted for. Orilia also proposes that the ontological intuition backing up the anti-converses option can be somehow taken into account, by assuming that there is a unique more fundamental state of affairs that grounds two states of affairs describable, as in the above airplane/bird example, by means of two converse predicates. In Orilia's proposal, this way of distinguishing converse relations by means of different roles works only for relations conveyed by pairs of clearly distinct predicates, such as "is above" and "is below," or "gives" and "receives." In contrast, when it comes to pairs of predicates that differ only by the choice of the active or passive form, as in the pair "hates" and "is hated," the corresponding embellished relations involve the very same roles, *agent* and *patient* in this case, so that the two predicates in the pair in question stand for the same embellished relation. (Orilia acknowledges that even in these cases we could in principle distinguish two relations, by considering the order with which the two roles are presented. That is, we could distinguish between, say, *hate(agent(), patient())*, conveyed by "hates," and *hate(patient(), agent())*, conveyed by "is hated." However, this would make sense only at an extremely fine-grained semantic level, and not at the coarse-grained level of the states of affairs described by the sentences in question.)

In Sect. 6 we report on how we tested the intuitions of ordinary subjects regarding the pro-converses and the anti-converses options with respect to the six pairs of converse relational predicates mentioned above.

3 Screening questions and participants

We conducted our survey on Amazon Mechanical Turk from July 2021 to December 2021. All participants were required to fill a 4-part questionnaire and obtained 2 USD as compensation for this. As we clarified to the participants, the estimated minimum amount of time required to complete the questionnaire was 15 min. 334 surveys were completed.

We could not assume that every participant rightly understood the tasks. Nor could we assume that every participant rightly understood the intended notion of role. Therefore, in order to avoid automated, careless or shallow replies, we restricted our surveys to users of Amazon Mechanical Turk that met its Master qualification. Moreover, the preliminary part of the survey consisted in a short clarification of the notions of role and relation and twelve screening questions. It may be worried here that in providing this clarification and having the participants undergoing this trial, we somehow presupposed role positionalism and possibly talked the participants into it. We do not think so, since we only invoked thematic roles—as they are postulated in linguistics—and some rather uncontroversial cases of attribution of thematic roles. Even if so, however, since this investigation is in fact mainly about role positionalism, this would be a price worth paying in order to ensure an appropriate level of understanding; without any grasp of thematic roles, it would have been impossible to perform the tasks required by the survey. Future experimental research might investigate about preferences of naive subjects regarding competing ontologies of relations, and in this case of course extra

care should be taken in avoiding biases in favor of one or the other of the competing approaches when presenting the matter to the participants.

We selected those participants who made *at most* three mistakes with the screening questions. For we estimated that such participants had a clear enough understanding of the notion of role. This left us with 228 completed surveys. These surveys are the basis of the results described in the following sections.

This is the clarification we provided:

> PLEASE READ CAREFULLY BEFORE STARTING THE SURVEY: With the sentences "Joan strikes the ball with a racket" and "the cake is eaten by Mary with a spoon" we describe, respectively, an event with some participants connected by the striking relation and an event with other participants connected by the eating relation. However, the role played by Joan in the striking event is the same as, or similar to, the role played by Mary in the eating event. Moreover, the role played by the ball in the striking event is the same as, or similar to, the role played by the cake in the eating event. Finally, the role played by the racket in the striking event is the same as, or similar to, the role played by the spoon in the eating event. In sum, we can use a sentence to describe an event, situation, or fact in which different participants play different roles. And the same or similar roles can be played by other participants in other situations described by other sentences.

Here are the screening questions and the results based on 228 completed surveys.

1. Assume that the following sentences are true: (A) Brutus stabs Caesar; (B) Juliet kisses Romeo. Is it True or False that Brutus and Caesar are connected by the stabbing relation?
   a. True (right answer): 91.7%
   b. False: 8.3%
2. Assume that the following sentences are true: (A) Brutus stabs Caesar; (B) Juliet kisses Romeo. Is it True or False that Juliet and Romeo are connected by the kissing relation?
   a. True (right answer): 95.6%
   b. False: 4.4%
3. Assume that the following sentences are true: (A) Brutus stabs Caesar; (B) Juliet kisses Romeo. Is it True or False that Brutus and Juliet play the same role, or at least similar roles?
   a. True (right answer): 89.9%
   b. False: 10.1%
4. Assume that the following sentences are true: (A) Brutus stabs Caesar; (B) Juliet kisses Romeo. Is it True or False that Caesar and Juliet play the same role, or at least similar roles?
   a. True: 6.6%
   b. False (right answer): 93.4%

5. Assume that the following sentences are true: (A) Brutus stabs Caesar; (B) Juliet kisses Romeo. Is it True or False that Caesar and Romeo play the same role, or at least similar roles?

   a. True (right answer): 93.4%
   b. False: 6.6%

6. Assume that the following sentences are true: (A) Brutus stabs Caesar; (B) Juliet kisses Romeo. Is it True or False that Brutus and Romeo play the same role, or at least similar roles?

   a. True: 4.4%
   b. False (right answer): 95.6%

7. Assume that the following sentences are true: (A) John goes from Trafalgar Square to Piccadilly Circus; (B) From Paris the train reaches Naples. Is it True or False that John, Trafalgar Square and Piccadilly Circus are connected by the relation of going from one place to another?

   a. True (right answer): 91.7%
   b. False: 8.3%

8. Assume that the following sentences are true: (A) John goes from Trafalgar Square to Piccadilly Circus; (B) From Paris the train reaches Naples. Is it True or False that Paris, the train and Naples are connected by the relation of reaching one place from another?

   a. True (right answer): 93%
   b. False: 7%

9. Assume that the following sentences are true: (A) John goes from Trafalgar Square to Piccadilly Circus; (B) From Paris the train reaches Naples. Is it True or False that Piccadilly Circus and Naples play the same role, or at least similar roles?

   a. True (right answer): 96.5%
   b. False: 3.5%

10. Assume that the following sentences are true: (A) John goes from Trafalgar Square to Piccadilly Circus; (B) From Paris the train reaches Naples. Is it True or False that John and Paris play the same role, or at least similar roles?

    a. True: 9.2%
    b. False (right answer): 90.8%

11. Assume that the following sentences are true: (A) John goes from Trafalgar Square to Piccadilly Circus; (B) From Paris the train reaches Naples. Is it True or False that Trafalgar Square and Naples play the same role, or at least similar roles?

    a. True: 19.3%
    b. False (right answer): 80.7%

12. Assume that the following sentences are true: (A) John goes from Trafalgar Square to Piccadilly Circus; (B) From Paris the train reaches Naples. Is it True or False that Trafalgar Square and Paris play the same role, or at least similar roles?

    a. True (right answer): 94.3%
    b. False: 5.7%.

Through questions 1–6, we tested the understanding of *agent* and *patient* in paradigmatic interaction relations, i.e., *stabbing* and *kissing*. Through questions 7–12, we tested the understanding of *theme*, *source* and *destination* in paradigmatic kinematic relations, i.e., *going from* one place *to* another and *reaching* one place *from* another. In questions 7–12, in the sentence "From Paris the train reaches Naples," we inverted the usual ordering of words, in order to test if the understanding of roles was appropriately disentangled from the ordering of words. This expectedly resulted in a higher rate of mistakes, especially with question 11.

It was mandatory to answer all the questions, except for those on personal data, to which we now turn.

We asked our participants to provide some personal data for statistical purposes only.[9] Here are the results based on the 228 selected surveys:

[9] We included the following Privacy Policy statement:

Survey "The Ontology of Relations" – Privacy Policy.

We inform you that the General Data Protection Regulation (EU Regulation 679/2016, from now on "GDPR") assumes that the protection of physical persons—with respect to the treatment of personal data—is a fundamental right. Following the GDPR, personal data processing should comply with the principles of accuracy, lawfulness, transparency and protection of confidentiality and of personal rights. This Privacy Policy is introduced in fulfilment of the Article 13 of the GDPR. The legal grounds of personal data processing are based on the Article 1, clause 1E, of the GDPR.

1. Data Controller.
The Data Controller of the personal data you sent by filling the survey is the University of Macerata, based in Macerata, via Crescimbeni 30-32, and the Legal Representative is its "Magnifico Rettore". You can get in contact with the Data Controller either at that address, or by sending a message to https://www.urp@unimc.it or to the PEC address https://www.ateneo@pec.unimc.it.
2. Data Protection Officer.
The Data Protection Officer is based at the Data Controller and is appointed in compliance with the Article 37 of the GDPR. You can get in contact with the Data Protection Officer by sending a message to https://www.dpo@unimc.it.
3. Nature and Purpose of Processing.
Personal data will be processed for research purposes only and will not be shared—not even under pseudonymization. Only the results of the statistical analysis of personal data will be shared and made public. Moreover, the Investigators will not be able to identify the respondents and they will not be able to associate the personal data collected with the identity of each respondent.
4. Data Diffusion.
In connection with the purposes described above and only within their scope, personal data will not be shared – as described above.
5. Profiling.
Personal data will not be subjected to automatized decision-making processes (including profiling).
6. Data Retention Duration.
Personal data will only be retained until the purposes of their processing will be reached—as described above.
7. Data Recipients and Potential Data Transfer.
Personal data collected for the purposes specified above will only used by the Principal Investigator of the research project for those purposes. Personal data will not be transferred to any extra-EU country.

1. Age:
    a. 36–45: 35.1%
    b. 26–35: 33.3%
    c. 46–55: 18%
    d. 56–65: 9.7%
    e. 66–75: 2.6%
    f. 18–25: 0.9%
    g. Prefer not to say: 0.4%
2. What is the highest degree or level of school you have completed?
    a. Bachelor's/first-level degree: 52.2%
    b. High school: 18.5%
    c. Trade/technical/vocational training: 13.6%
    d. Master's/second-level degree: 11.4%
    e. Doctorate degree: 3%
    f. Prefer not to say: 0.9%
3. Is English your native language or among your native languages?
    a. Yes: 89.5%
    b. No: 8.3%
    c. Prefer not to say: 2.2%
4. Country:
    a. United States of America: 78.1%
    b. India: 11.4%
    c. Other countries: 2.6%
    d. Prefer not to say: 7.9%.

Footnote 9 continued

8. Data Subjects' Rights (the right to be informed, of access, to rectification, to erasure, to restrict processing, to revoke consent, to object).

All the subjects involved in personal data processing have the right to ask the University of Macerata (as the Data Controller and in compliance with the Articles 15, 16, 17, 18, 19 and 21 of the GDPR):

- to access their own personal data and the information specified in the Article 15 of the GDPR;
- to rectify inexact personal data and to integrate incomplete personal data;
- to erase their personal data;
- to restrict data processing in the cases specified in the Article 18 of the GDPR;
- to object to their personal data processing;
- to revoke their consent to non-mandatory personal data processing, without making illegitimate data processing performed before the revocation.

These rights can be exercised by sending a message to the Data Protection Office to the e-mail address: https://www.dpo@unimc.it.

All the subjects involved in personal data processing can also lodge a complaint with the Data Protection Authority in compliance with the Article 77 of the GDPR.

By filling Part 5 of the survey "The Ontology of Relations", you accept the terms and conditions of this Privacy Policy. You also give your consent to the use of the data only for the purposes and only in the ways specified in this Privacy Policy (EU Regulation 679/2016).

As you can see, most participants had English as native language and came from the United States. In the future, it may be interesting to conduct the same survey with speakers of other languages and from other countries and compare the results.[10]

4 Kinematic relations

In the first part of our research we focused on kinematic relations, such as *going*, *walking*, *running*, *travelling* and the like, *from* one place *to* another, which are typically taken to involve the roles *theme*, *source*, and *destination*. We aimed at finding out to what extent our research participants were inclined to identify the roles involved in these relations with the roles involved in relations of the following type: interaction, temporal order, causation, quantitative order, transaction. To elicit participants' intuitions about these issues, we made use of a *reference sentence*, talking about a paradigmatic kinematic relation:

(1) Bus 232 goes from Columbus Avenue to Lincoln Square.

The assumption here is that (1) can be taken to say that the *going from… to…* relation holds between Bus 232, Columbus Avenue and Lincoln Square. And that it holds in such a way that Bus 232 plays the *theme* role, Columbus Avenue the *source* role and Lincoln Square the *destination* role.

We proposed (1) many different times, in comparison, each time, with different *test sentences*, as we may call them. Such test sentences can be taken to say that relations of the above-mentioned types hold between certain items, playing different roles. For example, sentences such as these:

(2) Tom kicks the ball.

(3) The party lasts from 6 p.m. to 10 p.m.

In all cases, we asked the participants to what degree they saw a similarity between the roles played by Columbus Avenue, Lincoln Square and Bus 232, and the roles played by the items named in the test sentence in question. We used a Likert scale, with 1 as the lowest degree of resemblance (highly dissimilar, fully distinct) and 10 the highest degree of resemblance (highly similar, fully identical).

As we saw, typically, for a given predicate there is a corresponding converse predicate. We wanted to ensure that choosing one predicate rather than its converse, or vice versa, did not influence our participants in one way or another. Accordingly, we proposed the test sentences in two forms, thus using both members in a pair of converse predicates. For example, in addition to proposing (2) and (3), we also proposed:

[10] It may be thought that we could have used additional screening questions regarding converses, based on the assumption that, for at least some relations, there is consensus on whether or not the relation in question has a distinct converse. As far as we know, no relation is such that there is consensus on this and thus we did not consider this option. We felt however that, although the screening questions focus mainly on roles, they somehow also provide, if answered successfully, some evidence of a competence about relationality that is relevant for a proper understanding of the questions regarding converses, which will be discussed in Sect. 6.

(2') The ball is kicked by Tom,

and

(3') The party ends at 10 p.m. and starts at 6 p.m.

The following subsections are dedicated to the relation types that we compared to kinematic relations. Each subsection shows all the questions we posed for a given relation type, in connection with the reference sentence (1). For each question, we report the mean value of the replies offered by our participants and the Population Standard Deviation,[11] thereby obtaining what we call a *question/result list*. We interpreted the results by focusing, for each question, on the mean result obtained, with the idea that there is a significant tendency to see a similarity between two roles when the mean is above the midpoint value 5.5 in the Likert scale. To check whether the results are statistically significant, we performed a t-test for a single sample with alternative hypothesis > 5.5, and then an analogous t-test with alternative hypothesis < 5.5. It turned out that the results are statistically significant, with p value < 0.001, for all questions except the following ones: 7 and 17, among those with mean result < 5.5, and 8, 9, and18, among those with mean result > 5.5. We shall take this negative result into account in commenting the data below.

4.1 Interaction relations

As we saw, in Orilia (2014, p. 298) interaction relations involve the roles *agent* and *patient*, which are taken to be distinct from *theme*, *source* and *destination*. To inquire about this, we proposed to our participants test sentences talking about the interaction relations *loving* and *kicking*. The answers of our research participants are very much in line with the idea that the roles *agent* and *patient* are distinct from *theme*, *source* and *destination*, as can be seen from the following question/result list, in which the mean result is very low in all cases.

1. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) John loves Mary; (C) Mary is loved by John. On a 1–10 scale, to what degree are the roles played by John and Columbus Avenue similar?
   Mean = 2.886; Population Standard Deviation = 2.6854.
2. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) John loves Mary; (C) Mary is loved by John. On a 1–10 scale, to what degree are the roles played by Mary and Lincoln Square similar?
   Mean = 3.7807; Population Standard Deviation = 3.0582.
3. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Tom kicks the ball; (C) The ball is kicked by Tom. On a 1–10 scale, to what degree are the roles played by Tom and Columbus Avenue similar?
   Mean = 2.8377; Population Standard Deviation = 2.6173.

[11] The Population Standard Deviation measures the degree of variation among the individual results. It can be taken to reflect how much the participants converge on, or diverge from, the mean value.

4. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Tom kicks the ball; (C) The ball is kicked by Tom. On a 1–10 scale, to what degree are the roles played by the ball and Lincoln Square similar?
   Mean = 3.7018; Population Standard Deviation = 2.9814.

4.2 Temporal order

Orilia (2014, p. 299) proposed that the roles *source* and *destination* could be identified with the roles involved in temporal order relations with two items: the role of the item coming first in temporal order is *source*, and the role of the item coming second in temporal order is *destination*. To investigate this, we proposed to our participants test sentences talking about the following sort of temporal order relations: *lasting from … to …* and *before* as involving times, as well as *before* as involving events. Orilia's proposal was confirmed to a rather limited extent, as we shall now see. Here is the question/result list.

5. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) The party lasts from 6 p.m. to 10 p.m.; (C) The party ends at 10 p.m. and starts at 6 p.m. On a 1–10 scale, to what degree are the roles played by 6 p.m. and Columbus Avenue similar?
   Mean = 6.4035; Population Standard Deviation = 3.2044.
6. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) The party lasts from 6 p.m. to 10 p.m.; (C) The party ends at 10 p.m. and starts at 6 p.m. On a 1–10 scale, to what degree are the roles played by 10 p.m. and Lincoln Square similar?
   Mean = 6.8421; Population Standard Deviation = 2.8964.
7. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) April 3, 2020 is after April 1, 2020; (C) April 1, 2020 is before April 3, 2020. On a 1–10 scale, to what degree are the roles played by April 1, 2020 and Columbus Avenue similar?
   Mean = 5.3158; Population Standard Deviation = 3.0294.
8. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) April 3,2020 is after April 1 2020; (C) April 1 2020 is before April 3, 2020. On a 1–10 scale, to what degree are the roles played by April 3, 2020 and Lincoln Square similar?
   Mean = 5.5482; Population Standard Deviation = 3.0011.
9. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) The Battle of Austerlitz is before the Battle of Waterloo; (C) The Battle of Waterloo is after the Battle of Austerlitz. On a 1–10 scale, to what degree are the roles played by the Battle of Austerlitz and Columbus Avenue similar?
   Mean = 5.6447; Population Standard Deviation = 3.0258.
10. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) The Battle of Austerlitz is before the Battle of Waterloo; (C) The Battle of Waterloo is after the Battle of Austerlitz. On a 1–10 scale, to what degree are the roles played by the Battle of Waterloo and Lincoln Square similar?
    Mean = 5.8684; Population Standard Deviation = 2.9385.

In the light of questions 5–6, according to our participants, the *lasting from… to…* relation between times seems to involve *source* and *destination*. Or at least the mean

degrees of similarity between the roles involved in the former relation and *source* and *destination* are clearly above the midpoint value of our Likert scale (5.5).

When it comes to *before*, as applying to either times or events, however, we do not have a clear verdict. The mean result for question 10 may suggest that *source* and *destination* are still involved, at least when it comes to events. As noted above, however, the results obtained for questions 7, 8 and 9 are not statistically significant. Thus, as regards *after* and *before*, Orilia's proposal is hardly supported, although it is not rejected either.

We surmise that this difference has to do with the fact that the *lasting from… to…* relation appears to be more dynamic than *after* and *before*. The former suggests that something happens (i.e., a certain event) and that it takes time to happen. On the contrary, the latter suggests a more static temporal order between times or between events. Therefore, the former is more likely to elicit the idea of a movement, and thus the roles *source* and *destination*.

4.3 Causation

According to Orilia (2014, p. 300), *source* and *destination* could be identified with the roles involved in causation: the cause has the source role and the effect has the destination role. To inquire about this, we asked participants to consider a single paradigmatic example, namely that smoke causes cancer. The proposal was not supported by our participants, as the following question/result list shows.

11. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Smoke causes cancer; (C) Cancer is caused by smoke. On a 1–10 scale, to what degree are the roles played by smoke and Columbus Avenue similar?
12. Mean = 3.5965; Population Standard Deviation = 2.8322.
    (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Smoke causes cancer; (C) Cancer is caused by smoke. On a 1–10 scale, to what degree are the roles played by cancer and Lincoln Square similar?
    Mean = 4.1228; Population Standard Deviation = 3.0070.

4.4 Quantitative order

Orilia (2014, p. 300) also proposed that *source* and *destination* could work as the roles involved in quantitative order relations such as *less* or *more*, on the ground that the number series may be taken to have a directionality going from smaller to larger numbers. For instance, in the claim that 3 is less than 6, one can see 3 as source and 6 as destination. We tested this hypothesis and the result we got did not support it, as the mean degrees of resemblance were below the midpoint value:

13. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) 3 is less than 6; (C) 6 is more than 3. On a 1–10 scale, to what degree are the roles played by 3 and Columbus Avenue similar?
    Mean = 4.2149; Population Standard Deviation = 3.0390.

14. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) 3 is less than 6; (C) 6 is more than 3. On a 1–10 scale, to what degree are the roles played by 6 and Lincoln Square similar?
Mean = 4.3684; Population Standard Deviation = 3.0697.

We surmise that this may be due, at least in part, to the fact that in quantitative order neither the direction from lower to higher values, nor the direction from higher to lower values, is felt as privileged. In contrast, in kinematic relations the direction of movement from departure to arrival is clearly privileged.

4.5 Transaction

Furthermore, Orilia (2014, p. 299) proposed that *source*, *theme* and *destination* could be involved in transaction relations such as *selling/buying* and *giving/receiving* (Orilia explicitly considers only the former). Here the idea is that, when these relations are exemplified, there seems to be an item, to be viewed as theme, that moves from a seller or giver to a buyer or receiver, to be viewed, respectively, as source and destination. Here are the results.

15. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Elizabeth sells a book to Jack; (C) Jack buys a book from Elizabeth. On a 1–10 scale, to what degree are the roles played by Elizabeth and Columbus Avenue similar?
Mean = 4.6359; Population Standard Deviation = 3.0681.
16. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Elizabeth sells a book to Jack; (C) Jack buys a book from Elizabeth. On a 1–10 scale, to what degree are the roles played by Jack and Lincoln Square similar?
Mean = 5.0965; Population Standard Deviation = 3.0211.
17. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Bob gives the ball to Tom; (C) Tom receives the ball from Bob. On a 1–10 scale, to what degree are the roles played by Bob and Columbus Avenue similar?
Mean = 5.3684; Population Standard Deviation = 3.0983.
18. (A) Bus 232 goes from Columbus Avenue to Lincoln Square; (B) Bob gives the ball to Tom; (C) Tom receives the ball from Bob. On a 1–10 scale, to what degree are the roles played by Tom and Lincoln Square similar?
Mean = 5.6579; Population Standard Deviation = 3.0221.

Even in this case the results do not support the hypothesis. Questions 15–16, regarding *giving/receiving*, provide values below the midpoint 5.5. On the other hand, the results for questions 17–18, regarding *selling/buying*, are not statistically significant, as reported above.

5 Location

Location relations typically involve two roles: *theme* and *location*. For example, when John is in Rome (i.e., the *being in* relation holds between John and Rome), John plays the *theme* role and Rome the *location* role. Orilia (2014, pp. 298–299) hypothesized

that these very roles could also be at play in possession and in parthood relations. In possession relations, the possessor would work as location and the possessed as theme; and in parthood relations the whole would work as location and the part as theme. That is, for example, if a car belongs to Mary, or Mary owns the car, Mary works as location and the car as theme. Similarly, given that Manhattan is part of New York, Manhattan works as theme and New York as location.

We first tested our participants' intuitions with respect to possession, by considering the relation *belonging to* or *owning*. We asked them if the role played by the owner is similar to the location, and if the role played by the owned thing is similar to the theme role. The result strongly disconfirmed Orilia's hypothesis, as the mean degrees of similarity were in both cases far below the midpoint value:

19. (A) John is in Rome; (B) The car belongs to Mary; (C) Mary owns the car. On a 1–10 scale, to what degree are the roles played by Mary and Rome similar?
Mean = 3.136; Population Standard Deviation = 2.6934.
20. (A) John is in Rome; (B) The car belongs to Mary; (C) Mary owns the car. On a 1–10 scale, to what degree are the roles played by John and the car similar?
Mean = 3.3904; Population Standard Deviation = 2.8688.

Next, we turned to parthood and asked our participants if the role played by the whole is similar to location; and if the role played by the part is similar to theme. In this case, the results were rather favorable to Orilia's hypothesis:

21. (A) John is in Rome; (B) Manhattan is part of New York; (C) New York contains Manhattan. On a 1–10 scale, to what degree are the roles played by John and Manhattan similar?
Mean = 6.1223; Population Standard Deviation = 3.1053.
22. (A) John is in Rome; (B) Manhattan is part of New York; (C) New York contains Manhattan. On a 1–10 scale, to what degree are the roles played by Rome and New York similar?
Mean = 6.7939; Population Standard Deviation = 2.8341.

We surmise that, in this case, what accounts for the higher mean degree of similarity is the fact that *being in* typically involves the occupation of a certain region of space by a certain entity, where such a region is part of a larger region occupied by another entity. For example, when John is in Rome, he occupies a certain region of space, which is a part of a larger region (i.e., the region occupied by Rome). Nothing analogous happens in the former case, i.e., with *belonging to* or *owning*.

6 Converses

In the last part of our survey, we studied converses by testing the intuitions of our participants regarding the pro-converses and the anti-converses options. As already noted, we focused on these six pairs of predicates: "hates" and "is hated," "is above" and "is below," "is before" and "is after," "is taller" and "is shorter," "gives" and "receives," "sells" and "buys." For each of these pairs, we selected a paradigmatic example provided by a pair of sentences describing a relation between two relata,

such as "the airplane is above the cloud" and "the cloud is below the airplane." For each such pair of sentences, we asked the participants to choose, on the assumptions that the sentences are true, among the following alternatives: (a) the two relata are connected by only one relation, which is characterized in two different ways; (b) the two relata are connected by two distinct relations; (c) the relata are connected by only one relation, expressed by the predicate used in one of the two sentences, e.g., "is above"; (d) the relata are connected by only one relation, expressed by the predicate used in the other sentence, e.g., "is below"; (e) the relata are not connected by a relation; (f) I don't know.

The idea here is that the pro-converses option is supported by those who pick alternative (b), while the anti-converses option is supported (in different ways) by those who pick one of the alternatives (a), (c) and (d). Of course, neither option is supported by those who chose (e) or (f). Our findings favor the anti-converses option in the first four cases and the pro-converses option in the remaining two:

1. Consider the following sentences: (A) Macbeth hates King Duncan; (B) King Duncan is hated by Macbeth. If both sentences are true, King Duncan and Macbeth are connected by:

   (a) only one relation, characterized in two ways: 46.9%
   (b) two distinct relations: *hating*, *being hated*: 31.5%
   (c) only *hating*: 12.3%
   (d) only *being hated*: 7.5%
   (e) no relation at all: 0.9%
   (f) I don't know: 0.9%
   (a)+(c)+(d) = 66.7%

2. Consider the following sentences: (A) Macbeth is taller than Lady Macbeth; (B) Lady Macbeth is shorter than Macbeth. If both sentences are true, Macbeth and Lady Macbeth are connected by:

   (a) only one relation, characterized in two ways: 56.2%
   (b) two distinct relations: *being taller*, *being shorter*: 37.7%
   (c) only *being taller*: 4%
   (d) only *being shorter*: 0.4%
   (e) no relation at all: 0.4%
   (f) I don't know: 1.3%
   (a)+(c)+(d) = 60.6%

3. Consider the following sentences: (A) Year 2021 is after Year 2020; (B) Year 2020 is before Year 2021. If both sentences are true, Year 2020 and Year 2021 are connected by:

   (a) only one relation, characterized in two ways: 54.8%
   (b) two distinct relations: *being after*, *being before*: 39.5%
   (c) only *being after*: 3%
   (d) only *being before*: 0.9%
   (e) no relation at all: 0%
   (f) I don't know: 1.8%

(a)+(c)+(d) = 58.7%

4. Consider the following sentences: (A) The airplane is above the cloud; (B) The cloud is below the airplane. If both sentences are true, the airplane and the cloud are connected by:

   (a) only one relation, characterized in two ways: 52.6%
   (b) two distinct relations: *being above*, *being below*: 40.9%
   (c) only *being above*: 3%
   (d) only *being below*: 0.9%
   (e) no relation at all: 1.3%
   (f) I don't know: 1.3%
   (a)+(c)+(d) = 56.5%

5. Consider the following sentences: (A) Macbeth gives Lady Macbeth a gift; (B) Lady Macbeth receives a gift from Macbeth. If both sentences are true, Macbeth, Lady Macbeth and the gift are connected by:

   (a) only one relation, characterized in two ways: 38.2%
   (b) two distinct relations: *giving*, *receiving*: 54.8%
   (c) only *giving*: 2.6%
   (d) only *receiving*: 2.6%
   (e) no relation at all: 0.9%
   (f) I don't know: 0.9%
   (a)+(c)+(d) = 43.4%

6. Consider the following sentences: (A) King Duncan sells Macbeth his castle; (B) Macbeth buys a castle from King Duncan. If both sentences are true, King Duncan, Macbeth and the castle are connected by:

   (a) only one relation, characterized in two ways: 36%
   (b) two distinct relations: *buying*, *selling*: 57.9%
   (c) only *selling*: 2.6%
   (d) only *buying*: 2.2%
   (e) no relation at all: 0%
   (f) I don't know: 1.3%
   (a)+(c)+(d) = 40.8%.

As we saw, directionalism is typically associated to the pro-converses option and positionalism to the anti-converses option. In contrast to both, role positionalism suggests a flexible view in which there is room for both options: some pairs of converse predicates correspond to just one relation and some others correspond to distinct relations. Our mixed results may be taken to support the flexible view, albeit with a preference for the anti-converses option, more successful in four out of six cases. Nevertheless, the predictions made in Orilia (forthcoming) for some specific relations are supported by our findings only to a limited extent, as we shall now explain.

As we saw, Orilia proposes that, for pairs of converse predicates involving the active/passive transformation, the pro-converses option is not justified by role positionalism. The preference for the anti-converses option in example 1, involving the pair "hates"/ "is hated," offers some support for this claim.

Orilia also proposes that, for pairs of converse predicates involving clearly distinct predicates, such as "is above"/ "is below" or "gives"/ "receives," role positionalism suggests the pro-converses option. However, questions 5 and 6 provide results that support this claim, whereas the results for questions 2, 3 and 4 point in the opposite direction. The latter questions involve the pairs "is taller"/ "is shorter," "is after"/"is before" and "is above"/ "is below." In these cases, the anti-converses option is more successful. Questions 5 and 6 involve the pairs "gives"/ "receives" and "sells"/ "buys." In these other cases, the pro-converses option is more successful. We could make two hypotheses regarding the difference in our results between the former and the latter cases. Perhaps, the difference has to do with the fact that the former three cases have nothing to do with the agent/patient distinction, whereas the latter two cases involve it: givers and sellers can be viewed as agents, or, alternatively, receivers and buyers can be viewed as agents. Or perhaps the difference has to do with the fact that the former three cases have nothing to do with movement or change, whereas the latter two cases involve it: one object goes from a source (a giver, a seller) to a destination (a receiver, a buyer). Since there are two distinct directions in such movements, this may suggest that two distinct movement relations are at stake. The two hypotheses are compatible and may be complementary. It may be interesting to explore these issues with further empirical investigations.

7 Conclusions

Role positionalism assumes that the exemplification of relations involves inter-relational roles and the issue arises as to how general the inter-relationality of roles is. Orilia (2014) makes some specific proposals concerning the roles *agent*, *patient*, *source*, *destination*, *theme*, *location*. The latter four are widely general, in that they are not in play just with spatial and kinematic relations, but they also occur with relations of temporal order, causation, quantitative order, transaction, possession, and parthood. This generality, however, is not so wide to cover interaction relations. For them, *agent* and *patient* work as dedicated roles, not to be confused with *source* and *destination*. This latter point is clearly supported by our findings. On the other hand, the former point did not receive much support. As regards temporal order, there is a favorable indication only with the *lasting from… to…* relation, but when it comes to *after* and *before* there was not enough statistical significance. As regards causation and quantitative order, there is a clear rejection. As regards transaction, again there was not enough statistical significance. As regards possession, there is a clear rejection. Finally, as regards parthood, there is a significant consensus. Thus, with the possible exception of parthood, our results do not suggest that these kinds of relation have to do with the same roles involved in spatial and kinematic relations.

Traditionally, positionalism, including role positionalism, is associated to the anti-converses options, whereas directionalism is associated to the pro-converses option.

However, more recently, Orilia (forthcoming) has presented role positionalism as a flexible view that can accept the anti-converses option in some cases and the anti-converses option in other cases. Our findings provide some support for this option, though not quite in the way suggested by Orilia. In line with Orilia's prediction, the anti-converses option prevails, when it comes to relations expressible by relational predicates distinguishable merely by the active/passive transformation, as in the pair of predicates "hates"/"is hated." According to Orilia's prediction, however, the pro-converses option should be favored for all the other pairs of relational predicates that we have considered, which do not involve the active/passive transformation. Our findings are in line with this hypothesis only for two out of the five cases of this sort that we have considered, namely for relations such as *giving/receiving* and *buying/selling*. As regards the other three cases, involving relations such as *taller/shorter*, *after/before*, *above/below*, the anti-converses option is again favored.

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