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What Makes an Agent an Agent? Comparing the Semantic Properties of Instruments and Prototypical Agents in Subject Position

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Abstract This study investigates the defining properties of Agents and the interplay of syntax and semantics in semantic inferences, based on Dowty's Proto-Role Hypothesis. Five properties from Dowty's list were selected, and 39 Italian sentence pairs showing the Instrument-subject Alternation were created. 93 participants rated how much Agents, Instrument-subjects, Instrument-PPs and Patients exhibit each property. Results show that while some properties are sensitive to syntactic realization, others are linked to lexical semantics and world knowledge, supporting the view that semantic inferences arise from an interaction between syntax and semantics.

Keywords Proto-Role Hypothesis. Inferences. Thematic roles. Semantics-syntax interface. Proto-Agent. Proto-Patient. Instruments.

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1 Introduction

This study investigates how Italian speakers make inferences about thematic roles, drawing on Dowty's (1991) Proto-Role Hypothesis. According to this hypothesis, there are two fundamental proto-roles – Proto-Agent and Proto-Patient – each defined by a set of core semantic properties. Traditional thematic roles can be understood as varying degrees of similarity to these proto-roles. Moreover, the hypothesis predicts that the greater the presence of Proto-Agent properties in a role, the more likely it is to function as the subject of a sentence; conversely, roles exhibiting more Proto-Patient properties are more likely to appear as objects.

Previous psycholinguistic studies (Kako 2006; Reisinger et al. 2015) have demonstrated that semantic Proto-Agent and Proto-Patient properties are inferred by speakers from the syntactic roles of subject and object, as outlined by Dowty (1991), even in the absence of known words (i.e. with nonce words).

Building on these findings, our current research investigates the Instrument role in Italian. Instruments are known to exhibit the [+ cause] and [+ motion] Proto-Agent properties, while also being causally affected like Proto-Patients (Dowty 1991), thus occupying an intermediate position between the two. Furthermore, they can undergo the Instrument-Subject Alternation, i.e. they can appear as either prepositional phrases or subjects when the Agent is left unexpressed (e.g. *John opened the door with the key* / *The key opened the door*). For these reasons, Instrument roles are central to our investigation, as they allow us to disentangle the respective contributions of semantics and syntax in shaping speakers' semantic inferences. Our study addresses two main research questions: (RQ1) Are different properties attributed to Instruments when they occur as subjects, compared to subjects expressing prototypical Proto-Agents, assuming that semantic properties are inferred from syntactic roles? (RQ2) Does the Instrument role align more closely with the Proto-Agent or the Proto-Patient, depending on its syntactic realization (i.e. as a prepositional phrase versus as the subject of the sentence)?

Building on Kako (2006), we selected five properties from Dowty's (1991) inventory, namely VOLITIONAL INVOLVEMENT, SENTIENCE, CAUSES A CHANGE, UNDERGOES A CHANGE OF STATE, and INDEPENDENT EXISTENCE, and designed an online experiment using minimal pairs of sentences. In each pair, one sentence featured an Instrument realized as a prepositional phrase (e.g. *Il pescatore ha catturato il pesce con una rete* 'The fisherman caught the fish with a net'), while the other featured the same Instrument in subject position (e.g. *La rete ha catturato il pesce* 'The net caught the fish'). A sample of Italian speakers was then asked to rate the extent to which each participant exhibited each of the five target properties. The participant under evaluation

included the prototypical Agent (in our example, *the fisherman*), the Instrument in subject position (*the net*), the Instrumental PP (*the net*), and the Patient (*the fish*), exhibited each of the five target properties. Our results indicate that Volition and Sentience are core characteristics of prototypical Agents, while Causality is also attributed to Instruments when they occur in subject position. Moreover, the findings underscore the interaction between semantic content and syntactic realization in shaping speakers' inferences about thematic roles.

The structure of the paper is as follows. Section 2 outlines the main tenets of Dowty's (1991) Proto-Role Hypothesis (2.1) and introduces the role of Instruments within this framework (2.2). Section 3 reviews psycholinguistic studies that have investigated the psychological validity of the Proto-Role Hypothesis. Section 4 presents our experimental study, beginning with the research questions (4.1) and concluding with a discussion of the results (Sections 4.4 and 4.5). Finally, Section 5 offers some general conclusions.

2 From Semantics to Syntax and Back: Proto-Roles and Argument Selection

2.1 Proto-Agent and Proto-Patient

Thematic roles, their number, nature, and how they map onto syntax, are central concerns in many linguistic theories. Over time, they have been conceived either as semantic primitives (e.g. Fillmore 1968; Chomsky 1981) or as relational concepts (e.g. Jackendoff 1990; Grimshaw 1990). Despite differences in how their nature is defined, traditional approaches generally conceptualize thematic roles as more or less fine-grained discrete categories with clear-cut boundaries. This perspective, however, faces a major challenge: if the inventory of roles is kept small and general, it becomes difficult to clearly distinguish one role from another. Conversely, adopting a more fine-grained, detailed list of highly specific roles undermines the ability to capture broader generalizations, an issue Dowty (1991) referred to as *role fragmentation*.

The Proto-Roles Hypothesis (PRH) (Dowty 1991) is precisely aimed at overcoming these shortcomings and marks a shift from traditional approaches to thematic roles. This hypothesis, indeed, postulates only two roles: Proto-Agent and Proto-Patient. The two are characterized as sets "of entailments of a group of predicates with respect to one of the arguments of each" (522). In other words, considering two-place predicates ($x\ V_1\ y$, $x\ V_2\ y$, etc., where $V_{1,2,\ldots,n}$ are transitive predicates, x occupies the subject position and y the object one), the relevant

properties of the Proto-Agent role entailed by the predicates are those concerning the subjects of such predicates, whilst for the Proto-Patient are those concerning the objects. For example, regarding the Proto-Agent entailments,

> consider the subject argument of the two-place predicates *x murders y*, *x nominates y*, and *x interrogates y*: entailments they all share include that *x* does a volitional act, that *x* moreover intends this to be the kind of act named by the verb, that *x* causes some event to take place involving *v* (*y* dies, *y* acquires a nomination, *y* answers questions-or at least hears them), and that *x* moves or changes externally (i.e. not just mentally). (552)

Dowty (1991) proposes a set of entailments, or properties, that enable generalization from lexical entailments, i.e. entailments that apply to a specific predicate, to role entailments, which are properties broadly characterizing the Proto-Agent and Proto-Patient role types and that hold across classes of predicates.

Table 1 Properties of Proto-Agent and properties of Proto-Patient.

Properties of Proto-Agent		**Properties of Proto-Patient**	
a.	Volitional involvement in the event or state	a.	Undergoes change of state
b.	Sentience (and/or perception)	b.	Incremental theme
c.	Causing an event or change of state in another participant	c.	Causally affected by another participant
d.	Movement (relative to the position of another participant)	d.	Stationary relative to movement of another participant
(e.	Exists independently of the event named by the verb)	(e.	Does not exist independently of the event, or not at all)

Dowty (1991) also specifies that the two proto-roles should not be understood as discrete categories with clear-cut boundaries, but rather as cluster concepts or prototypes in the sense of Rosch (Rosch, Mervis 1975; Rosch 1978). Accordingly, membership in a given role type can vary in degree. That is, each subject or object NP may exhibit all, some, or none of the Proto-Agent or Proto-Patient properties. A subject NP that displays all the Proto-Agent properties (e.g. the subject of the predicate *to build*) corresponds to the role traditionally referred to as Agent. A subject NP that does not exhibit volitional involvement (e.g. in the case of the predicate *to fall*) would align with the traditional role of Patient, and so on. This approach eliminates the need to posit additional role types, as each traditional role can be defined in terms of the number and type of Proto-Agent or

Proto-Patient properties it exhibits – or, in other words, by its degree of similarity to either prototype.

Under PRH, the number of properties an argument shares with either of the proto-roles is also an influencing factor in its syntactic realization. In general, the presence of at least one Proto-Agent entailment, when Proto-Patient entailments are absent, tends to qualify an argument for subject status; conversely, the presence of Proto-Patient entailments supports object status. This is articulated by the *Argument Selection Principle*, which stipulates that

> In predicates with grammatical subject and object, the argument for which the predicate entails the greatest number of Proto-Agent properties will be lexicalized as the subject of the predicate; the argument having the greatest number of Proto-Patient entailments will be lexicalized as the direct object. (Dowty 1991, 576)

The proto-roles and the *Argument Selection Principle* give rise to the hierarchy of traditional thematic roles shown in (1), where the ranking reflects each role's likelihood of occurring in subject position (578).

(1) Agent > Instrument/Experiencer > Patient > Source/Goal

In such a hierarchy, the Instrument occupies an intermediate position between the traditional roles of Agent and Patient. This means that Instruments are more likely candidates for the subject position than prototypical Patients. This is particularly relevant, as the possibility of (certain kinds of) Instruments to occur as subjects is leveraged in this work.

2.2 The Instrument Role

The Instrument role has traditionally been defined in causal terms.[1] Specifically, it has been characterized as the "intermediary between agent and patient in a causal chain" (Goldberg 2002, 340). For example, in a breaking event (2), the boy causes the rock (Instrument) to come into contact with the window, and the rock, in turn, causes the window to become broken. These subevents are understood as

1 For instance, see Talmy 1976; Jackendoff 1990; Croft 1991; Goldberg 2002.

sequential and causally linked, forming a causal chain initiated by the (Proto-)Agent and that ends with the (Proto-)Patient.[2]

(2) The boy broke the glass with the rock

It has been observed that Instruments do not always play a causal role in the event denoted by the predicate and additional instrumental subroles that do not function as causal intermediaries have also been proposed.[3,4] Nonetheless, this work focuses exclusively on *intermediary* Instruments. Only these Instruments are indeed characterized by Dowty (1991), as having the Proto-Agent properties of CAUSATION (*Causing an event or change of state in another participant*) and MOVEMENT (*Movement relative to the position of another participant*), but not VOLITION (*Volitional involvement in the event or state*) nor SENTIENCE. They also have a Proto-Patient property, in that they are causally affected by another participant (i.e. the Agent).

Since they exhibit two Proto-Agent properties, CAUSATION and MOVEMENT, they occupy an intermediate position between Agents and Patients in the hierarchy in (1) above, which makes them more likely to appear in subject position than typical Patients. In particular, the CAUSATION property appears to be crucial, as only intermediary Instruments participate in the Instrument-Subject Alternation (ISA), the construction in which the constituent that semantically is the Instrument is realized as the subject of the verb, whilst the Agent is omitted, as in (3).[5]

(3) a. The boy broke the glass with the rock
b. The rock broke the glass

Unsurprisingly, this property of intermediary Instruments is attested across several languages (Van Hooste 2018), including Italian, which

2 Fillmore 1968; Schlesinger 1989; Jackendoff 1990; Croft 1991; Talmy 2000; Koenig et al. 2003; 2008.

3 Marantz 1984; Ono 1992; Schütze 1995; Schlesinger 1995; Koenig et al. 2003; 2008.

4 For instance, *the key* in *The boy enters the room with the key* is a necessary precondition for the boy to enter the room, but it does not itself cause the action; no causal chain is established. This type of Instrument is referred to as *enabling*. Similarly, *helping* Instruments – such as *the spoon* in *The boy eats the ice-cream with the spoon* – merely facilitate the event denoted by the verb. The act of eating could be carried out by the boy even in the absence of the spoon, making the Instrument a merely helping entity.

5 Enabling Instruments do not participate in the Instrument-Subject Alternation (*The boy enters the room with the key / * The key enters the room),* nor do helping ones (*The boy eats the ice-cream with the spoon / * The spoon eats the ice-cream*).

is the target language of the present study. An example of ISA in Italian is provided in (4), where Instruments are typically expressed as prepositional phrases (PPs) headed by the preposition *con* 'with' (4a), but may also appear as subjects when the Agent is omitted (4b).

(4) a. Il bambino ha rotto il vetro con la pietra
'The boy broke the glass with the rock'
b. La pietra ha rotto il vetro
'The rock broke the glass'

While the Proto-Agent causation property is a necessary condition for an Instrument to participate in the ISA, the absence of volition is a blocking factor for ISA with certain predicates. Consider the contrast between (5b) and (6b).

(5) a. Gianni ha assassinato Carlo con il veleno
'Gianni murdered Carlo with poison'
b. *Il veleno ha assassinato Carlo
'*Poison murdered Carlo'
(6) a. Gianni ha ucciso Carlo con il veleno
'Gianni killed Carlo with poison'
b. Il veleno ha ucciso Carlo
'Poison killed Carlo'

The predicate *assassinare* 'to murder' entails that its subject acts volitionally (5a), but the same does not hold for the predicate *uccidere* 'to kill' (6a); the fact that the Instrument does not share this Proto-Agent property prevents it from occurring as subject of the former (hence the ungrammaticality of (5b)), but not of the latter (6b).

3 Semantic Properties are Inferred from Syntactic Roles: Psycholinguistic Studies on PRH

Building on the extensive body of evidence showing that speakers – both adults and children – are able to "make inferences about the semantic properties of nouns solely based" (Kako 2006, 3) on their syntactic position,[6] and on Dowty's (1991) claim that subjects display more Proto-Agent properties whilst objects more Proto-Patient ones, Kako (2006, 6) designed a set of five experiments aimed at "assessing the psychological validity of Dowty's hypothesis". In other words, he expected that speakers would perceive subjects as being more similar

6 Cf. Johnson 1967; Clark, Begun, 1971; Gleitman et al. 1996; Fisher 1996, a.o.

to Agents than to Patients, whereas the opposite pattern would hold for objects, relative to Proto-Agent and Proto-Patient properties.

To this end, he adapted Dowty's (1991) proto-role properties [tab. 1] into ten questions designed to be accessible to individuals without any formal linguistic training. The complete list of questions is reported in Table 2.

Table 2 Questions used by Kako (2006) in his experiment, implementing Dowty's (1991) Proto-Agent and Proto-Patient properties, and their shorthand label

Proto Role	Questions	Shorthand label
Proto-Agent	***How likely is it that the [subject]…***	
	… chose to be involved in [verbing]?	Chose
	… was aware of being involved in [verbing]?	Aware
	… caused a change in the [object]?	Caused change
	… caused the [object] to do something?	Caused do
	… moved?	Moved
	… existed before [verbing] took place?	Existed
Proto-Patient	How likely is it that the [patient]…	
	… was changed in some way as a result of [verbing]?	Changed
	… was created as a result of [verbing]?	Created
	… was stationary?	Stationary

In all of the experiments, participants were presented with a series of sentences and asked to rate how likely a given noun phrase (subject or object) was to have the properties listed in Table 2 on a 7-point Likert scale.

The structure of the sentences (stimuli) differs across the experiments. In Experiment 1, the stimuli contain actual English verbs, all transitive, whilst subjects and objects are nonce words. The aim is to ascertain that Proto-Agent and Proto-Patient properties are inferred from the subject/object syntactic position thanks to the entailments of the predicate. To determine whether the inferences are consistent across different classes of verbs, the semantics of verbs is systematically varied across the stimuli in Experiment 2. In Experiment 3, both predicates and subject-object pairs are nonce words, in order to eliminate entirely any semantic factor, and determine that speakers make inferences only based on syntactic positions. Experiment 5 is specifically designed to determine whether the inferences are made based on verbs or on subject/object syntactic positions. In Experiments 1 to 3, verbs were either transitive or non-existent: in the first case, transitivity could have helped the inferences about the object; in the second case, nonce words could have been interpreted as being transitive, again fostering the inferences about

the object. Therefore, in Experiment 5 stimuli only contain actual English intransitive verbs used transitively. This way, the inferences about the properties of the object could only be based on the object syntactic position, without any additional cue coming from the verb. Finally, in Experiment 4, participants were asked to evaluate subject and object nouns on grammatically irrelevant properties such as, for instance, *How likely is it that the [subject] is bigger than a shoe/can be photographed/can make noise?*

The results are consistent across the experiments and overall confirm the psychological validity of Dowty's PRH. First, subjects are significantly perceived as more Agent-like than objects, whereas objects are significantly perceived as more Patient-like than subjects with respect Dowty's (1991) properties [tab. 2]. Crucially, grammatically irrelevant properties (Experiment 4) do not distinguish between subjects and objects. That is, they do not receive different ratings with respect to these properties. Second, the inferences speakers make about subjects and objects are based on their syntactic positions.

Kako's (2006) methodology has been used for a larger-scale study by Reisinger and colleagues (2015), who conducted two experiments. Experiment 1 conceptually replicated both the methodology and the findings of Kako (2006). In their second experiment, Reisinger and colleagues (2015) sought to determine if their initial results could be replicated on a larger scale using corpus data. They utilized data from PropBank (Palmer et al. 2005), which annotates predicate/argument structures in the English portion of the Penn Treebank (Marcus et al. 1993). Human annotators were presented with sentences, with predicates and arguments highlighted, and asked the same questions as in the first experiment. The results of this larger-scale experiment were overall consistent with both Kako's (2006) findings and their first experiment: Proto-Agent properties predicted subjecthood, and Proto-Patient properties predicted objecthood. The results reported by Reisinger and colleagues (2015) diverge from those of Kako (2006) only with respect to specific individual properties. We elaborate on this point in Section 4.2.

4 Exploring the Boundaries of Prototypes: Our Experiment

4.1 Aim of the Study and Research Questions

The works reviewed in the previous section, which consistently support the psychological validity of PRH, serve as the starting point for the present study. While these studies have shown that subjects

are generally perceived as more Agent-like and objects as more Patient-like, and that semantic inferences regarding proto-roles are derived from syntactic position, no previous work has investigated the inferences made about a proto-role when its typical syntactic position is occupied by a non-prototypical element.

Specifically, given that semantic inferences are position-sensitive, this study aims to compare the inferences speakers draw when the subject position is filled by a prototypical Agent, i.e. one that exhibits all the Proto-Agent properties, with those they draw when the subject position is occupied by a non-prototypical Agent, i.e. one that exhibits only a subset of such properties.

The Instrument role is particularly well-suited for this investigation. As previously noted, it possesses two Proto-Agent properties (CAUSATION and MOVEMENT) yet lacks SENTIENCE and VOLITION. Moreover, although existing literature often emphasizes a strong conceptual link between the Instrument and Agent roles (e.g. Schlesinger 1989; DeLancey 1991; Rissman et al. 2015), the fact that Instruments also display one Proto-Patient property (BEING CAUSALLY AFFECTED) is frequently overlooked. Not only does the Instrument occupy an intermediate position between Agent and Patient in Dowty's (1991) hierarchy of traditional roles (see (1)), but it can also appear in two distinct syntactic positions, as either a prepositional phrase headed by *con* 'with' or a noun phrase being the subject of the sentence (via ISA).

These properties make the Instrument role an ideal test case for addressing our two research questions, which are:

RQ1: Are different properties attributed to Instruments occurring as subjects compared to subjects expressing prototypical Agents?

RQ2: Does the Instrument role align more closely with the Proto-Agent or the Proto-Patient, depending on its syntactic realization (PP *versus* subject DP)?

RQ1 specifically investigates the defining properties of the Agent role, aiming to explore the boundaries of this prototype. RQ1 and RQ2, taken together, shed light on the respective contributions of syntax and semantics to the inferences made by speakers. In particular, if Italian speakers attribute the same properties to both prototypical and non-prototypical Agents occurring in subject position (RQ1), this suggests that their semantic inferences are driven solely by syntactic structure. The same conclusion would follow if the properties attributed to Instruments realized as prepositional phrases (PPs) differ entirely from those attributed to Instruments realized as subjects (RQ2). Conversely, if a common set of properties characterizes only prototypical Agent subjects (RQ1), or both instrumental PPs and instrumental subject DPs (RQ2), this would indicate that semantic content also plays a role in shaping speakers' inferences.

4.2 Materials

To answer our research questions, we created an online questionnaire containing 39 minimal pairs of sentences. Each pair contains a sentence in which the Instrument is realized via a *con*-PP 'with-PP' (7a) and a sentence in which it is the subject DP, under ISA (7b). All sentences have an animate human subject, a transitive verb, and an inanimate object.

The syntactic structure of each minimal pair is given in (7).

(7) a. X ha V-to Y con Z
'X V-ed Y with Z'

b. Z ha V-to Y
'Z V-ed Y'

Following the approach by Kako (2006), our participants are asked to evaluate how much a constituent in the sentence exhibits each of the properties. Departing slightly from Kako's method, however, we instructed participants to provide their judgments using a continuous scale.

The verbs used in the sentences were selected from *Il Nuovo Vocabolario di Base della Lingua Italiana* (De Mauro 2016). This source was chosen to ensure that verbs are high-frequency in Italian, so that all participants would know their meaning. All verbs that do not allow an intermediary Instrument were discarded, as non-intermediary ones cannot undergo ISA. Some of the selected verbs are, for example, *abbattere* 'to cut down', *bloccare* 'to block', *rompere* 'to break', *travolgere* 'to run over something', *curare* 'to cure', *fondere* 'to melt', *accecare* 'to blind', *accendere* 'to turn on', *allagare* 'to flood', *ammaccare* 'to dent'.

Before conducting the actual experiment, all sentences of the type illustrated in (7b) were evaluated in a pilot study by 10 native Italian speakers with no background in linguistics. The aim of the pilot was to assess the acceptability and naturalness of these sentences in Italian. Participants rated each sentence using a 6-point pseudo-Likert scale, selecting from the following options: *completamente inaccettabile* 'totally unacceptable', *inacettabile* 'unacceptable', *leggermente inaccettabile* 'slightly unacceptable', *leggermente accettabile* 'slightly acceptable', *accettabile* 'acceptable', *completamente accettabile* 'completely acceptable'. Sentences that were not rated as acceptable by at least 60% of the participants were discarded. Three examples of minimal pairs that were maintained are reported in (8). The complete list of minimal pairs is provided in the Appendix.

(8) a. Il pescatore ha catturato il pesce con una rete
'The fisherman caught the fish with a net'

a'. La rete ha catturato il pesce
'The net caught the fish'

b. L'automobilista ha travolto il cartello con l'auto
'The driver ran over the sign with the car'

B'. L'auto ha travolto il cartello
'The car ran over the sign'

c. Il meccanico ha ammaccato l'auto con una chiave inglese
'The mechanic dented the car with a wrench'

C'. La chiave inglese ha ammaccato l'auto
'The wrench dented the car'

The minimal pairs like those illustrated in (8) were used to evaluate all the elements under investigation, i.e. the Agent-subject, the Patient, the prepositional-Instrument and the subject-Instrument. Our study indeed comprised two conditions: the Agent-Instrument condition and the Patient-Instrument condition. In the Agent-Instrument condition, in the first sentence, e.g. (8a), the Agent-subject constituent is underlined (i.e. *il pescatore* 'the fisherman)'. In the second sentence, e.g. (8a'), the underlined constituent is the Instrument-subject (i.e. *la rete* 'the net'). In this condition, participants were asked to evaluate the prototypical Agent-subject (underlined constituent) in the first sentence and the Instrument-subject (underlined constituent) in the second sentence, with respect to each of the five properties. In the Patient-Instrument condition, in the first sentence, e.g. (8a), the underlined constituent is the prepositional-Instrument (i.e. *con la rete* 'with the net'), whilst in the second, e.g. (8a'), the prototypical Patient is the underlined constituent (i.e. *il pesce* 'the fish'). In this condition, participants were asked to evaluate the prepositional-Instrument (underlined constituent) in the first sentence and the Patient (underlined constituent) in the second sentence, with respect to each of the five properties. Furthermore, to avoid making a task excessively long and/or demanding, we further divided the list of stimuli of each condition into two balanced lists, resulting in two lists for the Agent-Instrument condition, and two for the Patient-Instrument condition.

Let us now turn to the questions we asked the participants, which are adapted from Kako (2006) and based on Dowty's (1991) Proto-Agent and Proto-Patient properties. The questions, Kako's (2006) shorthand labels and the corresponding Dowty's (1991) properties are reported in Table 3.

Table 3 Questions used for our study, along with our shorthand labels (and the corresponding Kako's (2006) labels in parentheses), and their associated Dowty's (1991) properties

Question		Short-hand label	Property
1.	Quanto [parola target] ha scelto di essere coinvolta nell'evento di [verbo della frase]? 'How much [target word] chose to be involved in the event of [verb of the sentence]?'	Volition (Kako: CHOSE)	Volitional Involvement
2.	Quanto [parola target] è consapevole di star partecipando all'evento di [verbo della frase]? 'How much [target word] is aware of participating in the event of [verb of the sentence]?'	Sentience (Kako: AWARE)	Sentience
3.	Quanto [parola target] provoca un cambiamento in [paziente della frase]? 'How much [target word] provokes a change in [patient of the sentence]?'	Causes a Change (Kako: CAUSED CHANGE)	Caused A Change
4.	Quanto [parola target] viene cambiata dall'azione dell'evento di [verbo della frase]? 'How much [target word] is changed by the action of the event of [verb of the sentence]?'	Was changed (Kako: CHANGED)	Undergoes A Change Of State
5.	Quanto l'esistenza di [parola target] dipende dall'evento di verbo della frase? 'How much does the existence of [target word] depends on the event of verb of the sentence?'	Existed (Kako: EXISTED)	Independent Existence

The questions (1-3) target Proto-Agent properties, the fourth is based on the negation of a proto-Agent property, hence targeting a Proto-Patient one, the fifth addresses a property that can be applied to both Proto-Agent and Proto-Patient.

Following Kako (2006), we excluded the INCREMENTAL THEME property (cf. Table 1) because conceptually it would only apply to a subset of the verbs used in our experiment and would be relevant solely to the Agent-Instrument condition. Nevertheless, the concept of incremental theme is implicitly captured by the properties CAUSED A CHANGE and UNDERGOES A CHANGE OF STATE. Additionally, we omitted Dowty's (1991) property CAUSALLY AFFECTED as it is already encompassed by our fourth question (short-hand label: CHANGED). Since the question pertains to

how much an entity is altered by another, the notion of being causally affected is inherent.

We merged Kako's (2006) properties Caused Do and Caused Change because, in the second condition of our experiment (Patient-Instrument condition), the property Caused Do would not apply independently (as a patient in a transitive sentence would not cause another entity to perform an action). However, the Caused Change property was useful for analysing the instrument role in subject position.

Furthermore, we removed the properties Moved, Stationary, and Created as our sentences always imply movement, and the Instrument could not have been created either before or as a result of the action described by the verb, given the causal nature of the sentences. We also revised the property Existence since Kako's (2006) version referred to the entity's existence prior to the action expressed by the verb. Our fifth question, instead, focuses on the entity's existence in relation to the verb of the sentence.

Finally, the third question (*Quanto la parola sottolineata provoca un cambiamento nel paziente della frase?* 'How much does the underlined word cause a change in the patient of the sentence?') was modified to *Quanto la parola sottolineata provoca un cambiamento nella frase?* 'How much does the underlined word cause a change in the sentence?' in the Patient-Instrument condition. Since in this context the Patient itself is the underlined word being analyzed, the question would have otherwise been nonsensical. For example, in the case of sentence (8f), the question would have been **Quanto l'auto provoca un cambiamento nell'auto?* '*How much does the car cause a change in the car?'. By having modified the question, the resulting one is the acceptable *Quanto l'auto provoca un cambiamento nella frase?* 'How much does the car cause a change in the sentence?'.

4.3 Participants and Procedure

Our experimental sample consisted of 93 native Italian-speaking participants (49 F, 44 M).

The experiment was conducted online, using Gorilla Experiment Builder[7] (Anwyl-Irvine et al. 2018) to create and host our experiment. Participants were recruited sharing the experiment link on social networks and with acquaintances. Participants had no time limit for completing the task and did not receive any compensation.

Before starting the experiment, each prospective participant read and accepted an informed consent, in compliance with the

7 https://www.gorilla.sc/.

regulation (EU) 2016/679. After having accepted the consent form, they completed a demographic questionnaire, where we collected information on their age, gender, education level, and first language.

Concerning gender, 53% of participants were female (no. = 49), and 47% were male (no. = 44).

The age ranges of participants is reported in Table 4, while Table 5 summarizes the educational background of the sample.

Table 4 Age ranges of participants (Participants' age was collected via a multiple-choice question, in which participants had to select the age range that applied to them)

Age Range			
18-25	26-50	More than 50	Total
16.13% (no. = 15)	30.11% (no. = 28)	53.76% (no. = 50)	100% (no. = 93)

Table 5 Educational background of participants (Data about participants' educational background were collected via a multiple-choice question, in which participants had to select the educational qualification that applied to them)

Educational Qualification					
Middle School Diploma	High School Diploma	Bachelor's Degree	Master's /Old System Degree	Phd	Total
3.23% (no. = 3)	44% (no. = 41)	12% (no. = 11)	18.67% (no. = 17)	4% (no. = 4)	100% (no. = 93)

After completing the demographic questionnaire, participants were automatically directed from the online platform to one of the four experimental lists. 24 participants saw the first list of sentences for the Agent-Instrument condition, and 23 participants saw the second list of sentences for the same condition. For the Patient-Instrument condition, 22 participants saw the first list of sentences, while 25 participants saw the second list of sentences.

Each participant was presented with a minimal pair each time. They had to answer five questions [tab. 3] with respect to one constituent (e.g. Agent-subject) and the same five questions for the other constituent (e.g. Instrument-subject), for a total of 10 questions. Answers were provided by moving the slider placed under each question. If a participant believed that the underlined constituent did not exhibit the specified property at all, they were to move the slider towards *per nulla* 'not at all' (that correspond to 0). Conversely, if they thought that the syntagm fully embodied the given property, they were to move the slider towards *completamente* 'completely' (that corresponds to 100). They could place the slider at any point along the continuum between these two extremes. Figure 1 illustrates the layout of the questionnaire as viewed by participants.

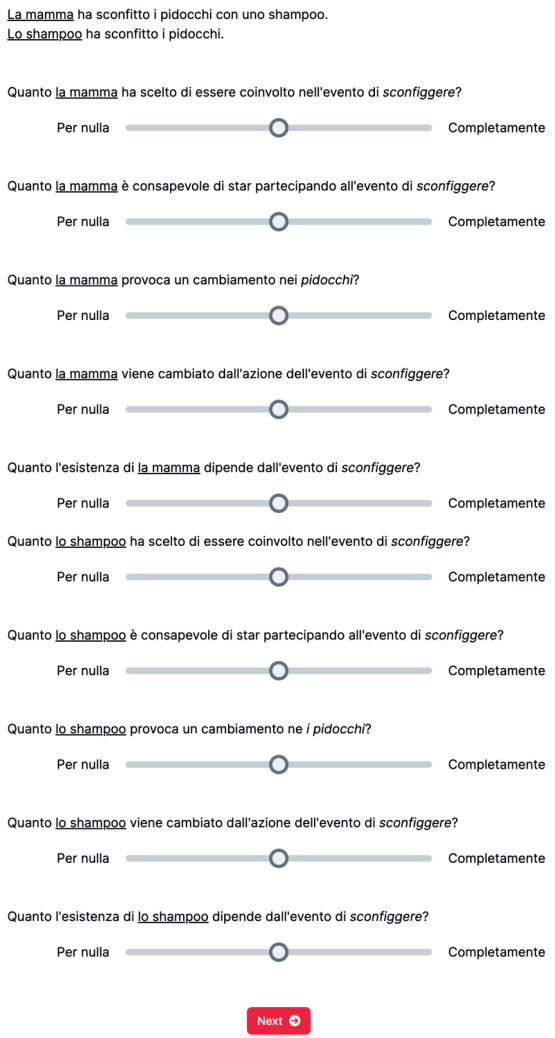

Figure 1 Screenshot of the layout of our questionnaire, as implemented on Gorilla Experiment Builder

The example sentences shown in Figure 1 are: (a) *La mamma ha sconfitto i pidocchi con uno shampoo* 'The mother defeated the lice with a shampoo' and (b) *Lo shampoo ha sconfitto i pidocchi* 'The shampoo defeated the lice'. The questions that follow, each accompanied by a slider, pertain to the subjects of sentences (a) and (b), namely *la mamma* 'the mother' and *lo shampoo* 'the shampoo', respectively.

4.4 Results

Table 6 reports the ratings (mean ± SD) for each constituent under investigation (Agent-subject, Instrument-subject, prepositional-Instrument, and Patient) received with respect to each property [tab. 3] on a 1-100 scale.

Table 6 Mean (±SD) rating received by each constituent with respect to each property (on a 1-100 scale)

	Agent-subject	**Instrument-subject**	**Prepositional-Instrument**	**Patient**
Volition	80.96 (±15.72)	9.17 (±17.88)	10.43 (±19.73)	14.91 (±19.60)
Sentience	84.58 (±15.87)	8.66 (±16.75)	12.07 (±21.03)	20.78 (±19.28)
Causes A Change	84.97 (±9.52)	81.53 (±17.24)	67.44 (±29.05)	54.90 (±33.27)
Was Changed	35.77 (±21.25)	25.55 (±19.30)	30.15 (±21.45)	70.27 (±20.34)
Existed	42.92 (±22.59)	46.68 (±25.30)	48.85 (±26.21)	46.97 (±29.07)

Agent-subjects receive the highest ratings with respect to the proto-Agent properties (Volition, Sentience, and Causes A Change), while Patients receive the highest rating for the proto-Patient property, i.e. Was Changed.

The lowest ratings for Volition and Sentience are received by Instrument-subjects, which, on the other hand, receive the second highest ratings for the property Causes A Change. A similar pattern holds for prepositional-Instruments, which are perceived as being scarcely volitional and sentient, but receive a higher rating for the property Causes A Change. Agent-subjects, Instrument-subjects and prepositional-Instruments are similarly perceived as not being really changed by the action denoted by the verb. Patients receive low ratings for the proto-Agent properties Volition and Sentience, yet slightly higher than Instruments (both subjects and prepositional), but lower ratings for the property Causes a Change. All constituents receive similar ratings for the property Existed.

The collected data were analyzed using a linear mixed-effects model. All analyses were carried out using the *lme4* (Bates et al. 2015) and *emmeans* (Lenth 2023) packages in the R computing environment (R Core Team 2023). Constituent and property are treated as fixed effects, while items (i.e. minimal pairs of sentences) and participants are treated as random effects. In this analysis, whose model formula is reported below, the dependent variable (score) is modelled as a function of (denoted by "~"): (a) constituent and property (fixed effects), and their interaction (denoted by "*");

and (b) random intercepts/effects for both participant and pair (to account for repeated measures).

lmer(score ~ constituent * property + (1 | participant) + (1 | pair))

This analysis revealed significant main effects of both constituent ($p < .001$) and property ($p < .001$) on the ratings; furthermore, significant interactions are found between the fixed effects. In particular, concerning Patients, the properties Was Changed and Existed were the most strongly endorsed properties ($\beta = 109.49$ and 75.15, $p < .001$), i.e. Patients receive significantly higher ratings with respect to these properties. Regarding prepositional-Instruments and Instrument-subjects, Causes a Change was highly endorsed ($\beta = 54.22$ and 76.21, $p_s < .001$), as were Was changed and Existed (all $p_s < .001$), compared to Sentience and Volition.

The estimated marginal means (EMMs) calculated from the model, visually displayed in Figure 1, were used to conduct post hoc pairwise comparisons with Tukey correction, allowing for precise comparisons between each constituent-property pair.

Post hoc pairwise comparisons reveal that Agent-subjects are perceived as significantly more volitional than Instrument-subjects ($p < .001$), prepositional-Instruments ($p < .001$) and Patients ($p < .001$). The same holds for the Sentience property, with respect to which Agent-subjects are rated significantly higher than Instrument-subjects ($p < .001$), prepositional-Instruments ($p < .001$) and Patients ($p < .001$).

The third proto-Agent property, Causes A Change, yields different results: with respect to it, Instrument-subjects receive significantly higher ratings than prepositional-Instruments ($p < .001$). Instruments – in both syntactic positions – receive significantly higher ratings than Patients ($p < .001$). On the contrary, only prepositional-Instruments receive significantly lower ratings than Agent-subjects ($p < .001$), while Instrument-subjects do not differ from Agent-subjects with respect to this property ($p = .89$).

Turning to the only proto-Patient property, i.e. Was Changed, Patients receive significantly higher ratings than Agent-subjects ($p < .001$), Instrument-subjects ($p < .001$), and prepositional-Instruments ($p < .001$).

Finally, all constituents receive similar ratings for the property Existed, for which no significant difference is found through pairwise comparisons.

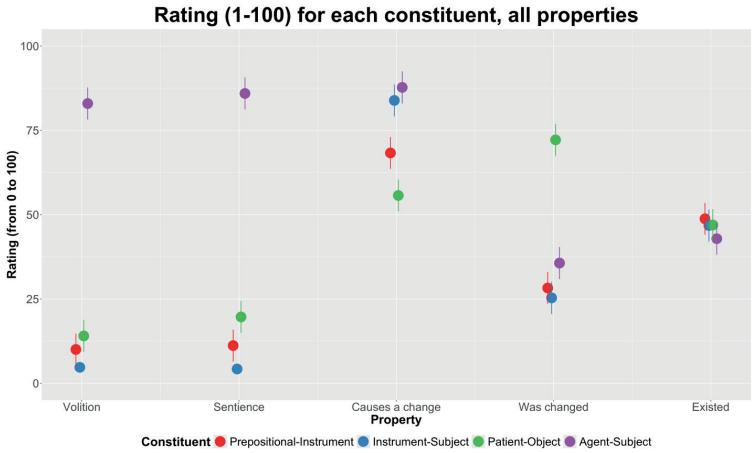

Figure 2 Estimated marginal means of ratings for all constituents with respect to all properties

4.5 Discussion

The data reveal distinct perception patterns for the different constituents. Agent-subjects are consistently perceived as more volitional and sentient than both Instrument constituents – regardless of syntactic position – and Patients. Instrument-subjects are perceived as stronger causes of the action compared to prepositional Instruments and Patients, and they align closely with Agent-subjects on this property. Conversely, Patients are perceived as being more affected by the action than all other constituents. Regarding this property, both types of Instruments – prepositional and subject – are perceived similarly to Agent-subjects. Finally, the property Existed does not differentiate among the constituents, as all are perceived similarly in this regard, and receive ratings around 50, meaning that their existence is perceived as neither being dependent nor independent from the action denoted by the verb. Notably, the property Existed was useful in distinguishing subjects from objects in Kako's (2006) study, but – crucially – not in that of Reisinger et al. (2015), who further subdivided the original property into three different ones: Existed before the event, Existed during the event, Existed after the event. As Dowty (1991) originally pointed out, this property is only relevant for differentiating subjects and objects within certain verb classes, specifically creation or destruction verbs, since only in these cases the object is brought into being or destroyed. For other predicates, both subjects and objects exist independently of

the predicate. Since in our verb sample no such classes of verbs are included, this may explain why this property is completely irrelevant in our analysis.

Overall, when considering only Agent-subjects and Patients, the data indicate that Agent-subjects exhibit the Proto-Agent properties – volition, sentience, and the ability to cause a change in other participants – to a greater extent. In contrast, Patients are primarily characterized by the Proto-Patient property investigated in this study, namely their being causally affected by the action denoted by the verb and, indirectly, by other participants. Furthermore, Patients are not perceived as exhibiting the characteristic proto-Agent properties, and vice versa. These findings are consistent with both Dowty's (1991) PRH and with the findings of previous studies on Proto-Roles (Kako 2006; Reisinger et al. 2015).

Let us now turn to our research questions, which specifically concern the comparison between proto-Agents and Instruments. Beginning with RQ1 (Are different properties attributed to Instruments occurring as subjects compared to subjects expressing prototypical Agents?), our results show that Instruments are not perceived as more volitional or more sentient when they occur in subject position. On the one hand, this finding reinforces the idea that Volition and Sentience are core properties of prototypical Agents, animate (often human) participants who act volitionally (cf. Jackendoff 1996).

Moreover, the results suggest that semantic role inferences are not solely determined by syntactic position. Indeed, whether Instruments are realized as subject noun phrases or as prepositional phrases, they remain inanimate and non-sentient tools, incapable of volitional action. This intrinsic lack of agency appears to constrain how speakers attribute Proto-Agent properties such as Volition and Sentience, regardless of syntactic configuration.

On the other hand, the third Proto-Agent property, namely Causes A Change, appears to be sensitive to the syntactic position occupied by Instruments: they are perceived as more effective "causers" when they occur as subjects than when they are realized as prepositional phrases. This finding leads us to our second research question (RQ2: Does the Instrument role align more closely with the Proto-Agent or the Proto-Patient, depending on its syntactic realization?).

The data indicate that Instruments consistently align more closely with the Proto-Patient in terms of Volition and Sentience, regardless of their syntactic position.[8] However, in terms of causality, they align

8 Instrument-subjects are indeed perceived as less volitional and sentient than prepositional-Instruments and Patients, although the difference in ratings is not statistically significant. We explain this finding as a byproduct of our experimental

with the Proto-Agent only when they appear in subject position. In other words, the perception of their ability to cause a change in other participants is modulated by syntax: Instruments are perceived as more agentive, or more like "causers", when they are syntactic subjects than when they are expressed as PPs.

Taken together, our results indicate that speakers do not rely solely on syntactic cues when making inferences about semantic roles, particularly when real lexical items are used (as opposed to nonce words, as in Kako's (2006) study).

Specifically, speakers' world knowledge – for example, the understanding that Instruments are typically tools – influences the semantic representation of instrumental lexical items. This, in turn, shapes how speakers evaluate constituents realizing the Instrument role, particularly with regard to the properties of Volition and Sentience. Put differently, we adopt a view that does not posit a strict dichotomy between lexico-semantic knowledge and world knowledge, as the two are deeply interconnected: the latter informs and shapes the former (cf. Schank 1975; Wilks 1975; Cappelli 2022). With respect to the issue at hand, speakers' world knowledge makes them aware that Instruments are typically tools manipulated by an Agent. This understanding is projected onto the semantic representation of instrumental lexical items, which are therefore perceived as non-volitional and non-sentient. As a result, the properties of Volition and Sentience appear to be grounded more in lexical semantics than in syntactic position. In other words, since tools are inherently non-volitional and non-sentient, these properties are not inferred solely from syntactic structure but emerge from the semantic nature of the role or referent itself.

By contrast, the property of causality appears to be more sensitive to syntactic structure: Instruments are perceived as more likely to cause change when they occur in subject position than when they are realized as prepositional phrases.

In conclusion, our findings suggest that semantic and syntactic information interact dynamically in shaping speakers' role-related inferences. Importantly, some Proto-Role properties, such as Volition and Sentience, are more strongly tied to lexical semantics, while others, like causality, are more influenced by syntactic realization. We can finally turn to the main question, which is *what makes an Agent an Agent*?: our results show that there are two distinct kinds of Proto-Agent properties. On the one hand, if Proto-Roles are understood as sets of entailments inferred from syntactic positions, causality

design: in the Agent-Instrument condition, Instrument-subjects are explicitly compared to prototypical Agents. This, in our opinion, causes the low ratings they receive in terms of Volition and Sentience.

emerges as the most relevant Agent-defining property (consistently with Reisinger et al.'s (2015) findings). Indeed, it remains applicable to non-prototypical Agents that occur in subject position with transitive predicates (such as Instrument-subjects in our case, but also natural forces in similar constructions), it can be inherited by such subjects when the Agent is syntactically implicit, and it appears to be determined primarily by syntax.

In contrast, Volition and Sentience are only true of prototypical Agents – namely, humans who act volitionally. These properties depend more heavily on the (interaction of the) lexical semantics of the sentence elements, they cannot be inherited by non-prototypical Agents occurring as subjects and they are not inferred from syntactic position.

5 Conclusions

In this study, we built on Dowty's (1991) Proto-Role Hypothesis and on previous experimental investigations supporting its psychological plausibility (Kako 2006; Reisinger et al. 2015) to examine the inferences Italian speakers make about the roles of Agents, Patients, and Instruments. Specifically, starting from the assumption that semantic role inferences are influenced by syntactic position, we leveraged the distinctive behavior of Instruments, which can surface both as subjects and as PPs, to identify the defining properties of prototypical Agents and to disentangle the respective contributions of semantics and syntax in shaping speaker judgments.

To this end, we selected five properties from Dowty's (1991) inventory of Proto-Agent and Proto-Patient entailments and created 39 minimal sentence pairs, each featuring an Instrument both as a PP and in subject position. A total of 93 native Italian speakers were then asked to rate, on a 1-100 continuous scale, the degree to which Agent-subjects, Instrument-subjects, prepositional-Instruments, and Patients exhibited each of the five properties.

The results revealed that Volition and Sentience are core properties of prototypical Agents (i.e. Agent-subjects). Consistent with Dowty's PRH, Patients were perceived as non-volitional, non-sentient, and non-causing, but as highly causally affected by the verb's action.

Importantly, the property Causes a Change was attributed to both Agent-subjects and Instrument-subjects, but not to prepositional-Instruments, indicating that only Instruments in subject position align with Agents in this respect. In contrast, Instruments consistently aligned more closely with Patients regarding Volition and Sentience, regardless of syntactic position.

In conclusion, these findings show that while some properties, such as causality, are sensitive to syntactic realization, others, namely

Volition and Sentience, are more tightly linked to lexical semantics and world knowledge. This suggests that semantic role attribution emerges from an interaction between syntax and semantics, with different proto-role properties showing differing degrees of sensitivity to syntactic cues.

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Appendix

Complete list of experimental stimuli and their English translation.

1. Il boscaiolo ha abbattuto l'albero con l'ascia. / L'ascia ha abbattuto l'albero.
   'The lumberjack cut down the tree with the axe'. / 'The axe cut down the tree'.

2. Il bambino ha rotto il vaso con la palla. / La palla ha rotto il vaso.
   'The boy broke the vase with the ball'. / 'The ball broke the vase'.

3. L'automobilista ha travolto il cartello con l'auto. / L'auto ha travolto il cartello.
   'The driver ran over the sign with the car'. / 'The car ran over the sign'.

4. Il fabbro ha fuso il metallo con il fuoco. / Il fuoco ha fuso il metallo.
   'The blacksmith melted the metal with fire'. / 'The fire melted the metal'.

5. Il bambino ha bagnato l'orsacchiotto con l'acqua. / L'acqua ha bagnato l'orsacchiotto.
   'The child soaked the teddy bear with water'. / 'The water soaked the teddy bear'.

6. L'operaio ha bucato il muro con il trapano. / Il trapano ha bucato il muro.
   'The worker pierced the wall with the drill'. / 'The drill pierced the wall'.

7. La donna ha bruciato la lettera con una candela. / La candela ha bruciato la lettera.
   'The woman burnt the letter with a candle'. / 'The candle burnt the letter'.

8. Il pescatore ha catturato il pesce con una rete. / La rete ha catturato il pesce.
   'The fisherman caught the fish with a net'. / 'The net caught the fish'.

9. Il carpentiere ha colpito il chiodo con un martello. / Il martello ha colpito il chiodo.
   'The carpenter hit the nail with a hammer'. / 'The hammer hit the nail'.
   L'investigatore ha contaminato la scena con un capello. / Un capello ha contaminato la scena.
   'The detective contaminated the scene with a hair'. / 'A hair contaminated the scene'.

10. Il muratore ha coperto il buco con lo stucco. / Lo stucco ha coperto il buco.
    'The bricklayer covered the hole with putty'. / 'The putty covered the hole'.

11. Il dentista ha estratto il dente con le pinze. / Le pinze hanno estratto il dente.
    'The dentist extracted the tooth with pliers'. / 'The pliers extracted the tooth'.

12. Il medico ha guarito la ferita con delle bende. / Le bende hanno guarito la ferita.
    'The doctor healed the wound with bandages'. / 'The bandages healed the wound'.

13. Il chirurgo ha inciso la pelle con il bisturi. / Il bisturi ha inciso la pelle.
    'The surgeon cut the skin with a scalpel'. / 'The scalpel cut the skin'.

14. Il tecnico ha interrotto la corrente con l'interruttore. / L'interruttore ha interrotto la corrente.
    'The technician cut the power with the switch'. / 'The switch cut the power'.

15. Il grafico ha modificato l'immagine con il computer. / Il computer ha modificato l'immagine.
'The graphic artist changed the picture with the computer'. / 'The computer changed the picture'.

16. Il magazziniere ha mosso le scatole con il montacarichi. / Il montacarichi ha mosso le scatole.
'The warehouse worker moved the boxes with the freight elevator'. / 'The freight elevator moved the boxes'.

17. Il custode ha rimosso la neve con la pala. / La pala ha rimosso la neve.
'The caretaker removed the snow with the shovel'. / 'The shovel removed the snow'.

18. La mamma ha sconfitto i pidocchi con uno shampoo. / Lo shampoo ha sconfitto i pidocchi.
'The mother has defeated the lice with shampoo'. / 'The shampoo has defeated the lice'.

19. Il carpentiere ha sollevato la trave con una fune. / La fune ha sollevato la trave.
'The carpenter lifted the beam with a rope'. / 'The rope lifted the beam'.

20. Il pompiere ha spento l'incendio con l'estintore. / L'estintore ha spento l'incendio.
'The fireman put out the fire with the fire extinguisher'. / 'The fire extinguisher put out the fire'.

21. Il bambino ha sporcato il vestito con la penna. / La penna ha sporcato il vestito.
'The child soiled her dress with the pen'. / 'The pen soiled her dress'.

22. Il traslocatore ha spostato il mobile con un carrello. / Il carrello ha spostato il mobile.
'The mover moved the furniture with a cart'. / 'The cart moved the furniture'.

23. Il cuoco ha tagliato la verdura con il coltello. / Il coltello ha tagliato la verdura.
'The cook cut the vegetables with the knife'. / 'The knife cut the vegetables'.

24. L'autista ha trainato l'auto con il camion. / Il camion ha trainato il rimorchio.
'The driver towed the car with the truck. / The truck towed the trailer'.

25. L'uomo ha tamponato il furgone con l'auto. / L'auto ha tamponato il furgone.
'The man rear-ended the truck with the car. / The car rear-ended the truck'.

26. Il conducente ha urtato il guardrail con l'auto. / L'auto ha urtato il guardrail.
'The driver hit the guardrail with the car'. / 'The car hit the guardrail'.

27. L'agricoltore ha voltato la terra con la vanga. / La vanga ha voltato la terra.
'The farmer turned the soil with the spade'. / 'The spade turned the soil'.

28. L'arredatrice ha staccato la carta da parati con il vaporizzatore./ Il vaporizzatore ha staccato la carta da parati.
'The decorator peeled off the wallpaper with the steamer'. / 'The steamer peeled off the wallpaper'.

29. Il muratore ha scavato una buca con l'escavatrice. / L'escavatrice ha scavato una buca.
'The bricklayer dug a hole with the excavator'. / 'The excavator dug a hole'.

30. Il ricercatore ha ritrovato il tesoro con il metal detector. / Il metal detector ha ritrovato il tesoro.
    'The searcher found the treasure with the metal detector'. / 'The metal detector found the treasure'.

31. Il conducente ha rallentato l'auto con il freno. / Il freno ha rallentato l'auto.
    'The driver slowed down the car with the brake. / The brake slowed down the car'.

32. Il ragazzo ha provocato un incendio con un accendino. / L'accendino ha provocato un incendio.
    'The boy started a fire with a lighter'. / 'The lighter started a fire'.

33. Il tecnico ha girato i bulloni con la chiave. / La chiave ha girato i bulloni.
    'The technician turned the bolts with the spanner'. / 'The spanner turned the bolts'.

34. Il contadino ha disperso i semi con il seminatore. / Il seminatore ha disperso i semi.
    'The farmer scattered the seeds with the sower'. / 'The sower scattered the seeds'.

35. Il piromane ha devastato il bosco con un lanciafiamme. / Il lanciafiamme ha devastato il bosco.
    'The arsonist devastated the forest with a flamethrower'. / 'The flamethrower devastated the forest'.

36. Il manifestante ha ostacolato la strada con uno striscione. / Lo striscione ha ostacolato la strada.
    'The protester obstructed the road with a banner'. / 'The banner obstructed the road'.

37. L'alunno ha ritagliato la carta con le forbici. / Le forbici hanno ritagliato la carta.
    'The pupil cut out the paper with scissors'. / 'The scissors cut out the paper'.

38. Lo scultore ha scolpito il marmo con lo scalpello. / Lo scalpello ha scolpito il marmo.
    'The sculptor carved the marble with the chisel'. / 'The chisel carved the marble'.