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*CORRESPONDENCE
Khadija Farkad,
khadijafarkad@gmail.com

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Distributivity as a Bridge Between Verb and Noun Domains in Standard Arabic

Khadija Farkad[1*], Jamaa Ouchouid [2]

[12] Cadi Ayyad University, Marrakech 40000, Morocco

Abstract

The interactions between the verbal and nominal domains exhibit recurrent structural patterns that make it possible to establish systematic correlations across categories. Events are mapped onto temporal intervals by means of a trace function, while their participants are integrated into the event structure through thematic-role assignment. Making these mappings explicit allows the analysis to constrain the space of possible interpretations, ruling out unattested outcomes while preserving the compositional derivation of complex predicates. The empirical investigation is based on six morphologically related verb forms in Standard Arabic, organized into three pairs that share the same lexical root but differ in their morphological realization, thereby enabling a controlled comparison in which lexical content is held constant and only morphosyntactic variation is tested. Methodologically, the study combines aspectual diagnostics, such as compatibility with temporal adverbials and the distinction between cumulative and quantized readings, with syntactic tests on argument realization, in order to determine how morphological variation affects both argument structure and event composition. The results show, first, that telicity does not systematically correlate with the definiteness or boundedness of the internal argument; second, that alternations within each morphological pair allow identical nominal complements to yield both telic and atelic readings; and third, that distributive interpretations consistently shift event structure toward atelicity by preventing the formation of a single bounded event, even in the presence of quantized objects.

KEYWORDS
distributivity; aspectual interpretation; telicity; thematic roles

Introduction

Studies on interactions between event and noun quantification have highlighted a range of natural language phenomena, including telicity, distributivity, and measurement. A number of influential accounts—such as Quine (1960), Link (1989), Bach (1986), Dowty (1991), Verkuyl (1972, 1989, 1991, 2005), and Tenny (1995)—have provided detailed analyses of these domains, often focusing on one dimension at a time or privileging a particular explanatory factor. While these approaches have yielded important generalizations, they do not always converge on a unified set of constraints governing the interaction between verbal and nominal quantification, nor do they systematically account for the cross-domain correspondences that emerge when these phenomena co-occur. Champollion's Strata theory (2016, 2017) addresses this issue by proposing a unified framework. His central observation is that existing theories successfully describe contrasts such as

a. atelic vs. telic predicates (John ran for five minutes vs. ∗John ran to the store for five minutes)

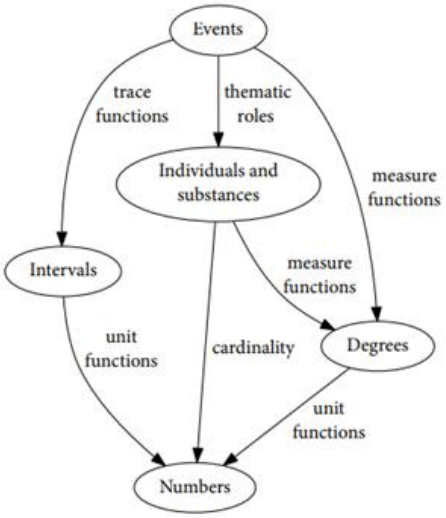

Figure 1. Mapping functions

b. mass vs. count nominal measurement (thirty liters of water vs. ∗thirty pounds of book)

c. distributive vs. collective readings (The boys each walked vs. ∗The boys each met),

Yet they stop short of providing explicit constraints on how these patterns systematically interact or fail to interact across domains. Against this background, the present study addresses the following questions: (i) to what extent can telicity be derived from the interaction between verbal morphology and nominal quantification, (ii) what role distributivity plays in mediating this interaction, and (iii) how these factors can be constrained within a compositional system that maps between event and nominal domains. Standard Arabic provides a particularly suitable testing ground for these questions due to its rich and productive system of derivational morphology. The analysis focuses on six such forms, organized into three morphologically correlated pairs, which make it possible to isolate the contribution of morphological structure while holding lexical meaning constant. Building on prior accounts, such as Verkuyl's and Tenny's compositional approaches to aspect, Bach's cumulative/distributive distinction and for-adverbial diagnostics, Krifka's homomorphic mapping, and Link's lattice-theoretic treatment of plurality, this argues that, while these frameworks capture important aspects of the data, they do not fully predict the observed variation in Standard Arabic, thereby motivating a more explicit integration of distributivity into the mapping between nominal and verbal quantification.

The functions are used to formulate constraints on the generalizations in this analysis. As mentioned above, the devised theories do not provide constraints on the unwanted outcome. Using a model-theoretic approach, Strata theory provides three constraints which all share the property of distributivity. However, this analysis only focuses on trace function linking events to intervals and thematic roles as 'a function mapping events to individuals and substances'.

Champolion, (85: 2017) breaks down the predicate as follows:

Constraint on Shares of adverbial-each sentences

A sentence with adverbial each whose Share is S, whose Map is M, and which is used to describe an event e is acceptable only if S has stratified distributive reference with respect to M and e (formally: SDRM(S)(e)).

Three boys each laughed.

a. Key: Three boys

b. Map: agent

c. Share: laugh

SDRagent(laugh)(e)⇔ e ∈ ∗λe (laugh(e)∧ Atom(∗agent(e)))

(The event e can be divided into one or more laughing events ("strata") whose agent is an atom.)

Constraint on Shares of temporal for-adverbials:

A temporal for-adverbial whose Share is S and which is used to describe an event e is acceptable only if S has stratified subinterval reference with respect to e (formally: SSR(S)(e)).

John and Mary waltzed for an hour.

a. Key: an hour

b. Map: runtime

c. Share: waltz

SSR(waltz)(e) ⇔ e ∈ ∗λe (waltz(e) ∧ τ(e))

(The event e can be divided into waltzing events whose runtime is properly included in its own.)

(Champolion, 2017, p. 89)

The constraints are built on the premises of the Operational definition: Distributive predicate

Table 1. Arabic Verb Forms (II–XV): Templates and Core Meanings

Form	CV template	Meaning
Form Ⅱ	C1aC2C2aC3a	Causative, intensive
Form Ⅲ	C1aaC2aC3a	Associative, reciprocal, repeated, attempted
Form Ⅳ	CaC1C2aC3a	Causative
Form Ⅴ	taC1aC2C2aC3a	Reflexive, gradual progress in an activity or state, acquisition or imitation of a quality
Form Ⅵ	taC1aaC2C2aC3a	Reciprocal, gradual or continuous increase in a quality
Form Ⅶ	inC1aC2aC3a	Reflexive, resultative, passive, or Medio passive
Form Ⅷ	iC1taC2aC3a	Reflexive or medio passive, resultative, reciprocal
Form Ⅸ	iC1C2aC3C3a	Acquisition of a color or a physical trait
Form Ⅹ	istaC1C2aC3a	Requestative or estimative
Form Ⅺ	iC1C2aaC3C3-a	The acquisition or existence of a color or physical trait

Form XII	iC1C2awC2C3a	Indicates color or physical quality
Form XIII	iC1C2awwaC3a	Denotes color or quality but may also denote an action
Form XIV	iC1C2anC3aC3a	Indicates color or physical quality
Form XV	iC1C2anC3aa	

A distributive predicate is a predicate for which (11a) and (11b) are acceptable and entail each other when it is substituted for PRED.

((Filip, 2011)) a. Three people PRED.

b. Three people each PRED.

(Champolion, 2017, p. 75)

The main focus of the discussion is on stratified distributive reference captured by the use of each-adverbial constructions and stratified subinterval reference made evident by means of for-adverbials.

Form II shortened FII

FaʕʕaI, the second consonant gemination predicate.

This form is otherwise known as "multiplicity" and mubaalaɣah "exaggeration (i.e. augmentative), defined by Fassi Fehri as having properties of reduplication, temporal repetition, and plural action on/by many (Fassi Fehri, 1993, 2004). All these properties can be illustrated in the following sentences:

(1) darrasa l-junuud-a

teach.Gem.3ms Def-soldiers-Acc

'he taught the soldiers'

(2) darrasa kulla jundiy-in ʕala ħida

teach.Gem.3ms each soldier-Gen apart

'he taught each soldier'

SDRtheme(درّس)(e)⇔e ∈ ∗λe (درّس(e) ∧ Atom(∗theme(e)))

(The event e can be divided into one or more teaching events ("strata") whose theme is an atom.)

a. Key: the soldiers

b. Map: theme

c. Share: teach

The theme soldiers maps the share teaching to the key soldiers. The reduplication and plural action on many properties are clearly captured through the model.

In order to render the temporal repetition property, the SSR can be implemented.

(3) darrasa l-junuud-a li sanawaat

teach.Gem.3ms Def-soldiers-Acc for years

'he taught the soldiers for years'

SSR(درّس)(e) ⇔ e ∈ ∗λe (درّس(e) ∧ سنوات (e))

(The event e can be divided into teaching events whose runtime is properly included in its own.)

a. Key: for years

b. Map: runtime

c. Share: teach

The runtime maps the share teaching to the key for years capturing the temporal repetition property.

Form III shortened FIII

FaaʕaIa, the mutuality predicate.

Fassi Fehri (2004) claims that both participants are actors of the action. This claim does not reify the intelligible connections that hold the constituents of the construction together due to the ambiguous use of the word 'actors'. If actor is used here to mean agent, the following sentence shows that both arguments cannot be construed as agents.

(4) naafasaI-mutasaabiq-u l-maghribiy-u l-mutasaabiq-a

compete.3ms Def-contestant-Nom Def-moroccan-Nom Def-contestant-Acc

l-balghariy-a

Def-bulgarian-Acc

'The Moroccan contestant competed against the Bulgarian contestant'

A proper explanation would be that the predicate is distributive over theme and agent. The predicates holds when the contestant both competes and is competed against.

SDRtheme(نافس)(e) ⇔ e ∈ ∗λe (نافس(e) ∧ Atom(∗theme(e)))

SDRagent(نافس)(e) ⇔ e ∈ ∗λe (نافس(e) ∧ Atom(∗agent(e)))

1. a. Key: the Bulgarian contestant
   b. Map: agent
   c. Share: compete
2. a. Key: the Moroccan contestant
   b. Map: theme
   c. Share: compete

The agent Moroccan contestant maps the share competing to the key Bulgarian contestant. The opposite also holds.

Form IV shortened FIV

ʔafʕala, the glottal prefixed predicate.

It may or may not distribute over more than one argument. Fassi Fehri (2012) attributes this to the root of the verb. The property of this form raises questions about its transitive behavior which in its own creates predicaments regarding the distribution over other arguments. This form does not seem to be compatible with for-adverbials despite of its intransive nature over some roots. Stenteces (5) and (6) illustrate it:

(5) 'aqsama r-rijaal-u li sanawaat

swear3ms Def-men-Nom for years

'the men swore for years'

SDRagent(أقسم)(e) ⇔ e ∈ ∗λe (أقسم(e) ∧ Atom(∗agent(e)))

a. Key: the man

b. Map: agent

c. Share: swear

The agent maps the share swear to every man in the sum. It is maintained that the agent is an atom that gets mapped to one of the strata into which the event is divided.

The reciprocity property can easily be made clear through the implementation of with-constructions.

(6) tanaafasa l-‘awlaad-u
compete.3mp Def-boys-Nom
‘the boys competed’

(7) tanaafasa Muhammad-un maʕa Aly-in
compete.3mp Muhammad-Nom with Ali-Gen
‘Muhammad competed with Ali’

(8) tanaafasa Muhammad-un wa Aly-un
compete.3mp Muhammad-Nom and Ali-Acc
‘Muhammad and Ali competed’

Fassi Elfehri posits that “both participants are understood as "subjects" of the "same" event” (Fassi Elfehri, 2012, p. 39).

The meaning postulate for (1) and (3) can be suggested as follows.

SDRagent(تنافس)(e) ⇔ e ∈ ∗λe (تنافس(e) ∧ Atom(∗agent(e)))

a. Key: the children/ Ahmed and Ali

b. Map: agent

c. Share: compete

The agent maps the share compete to every child in the sum. It is maintained that the agent is an atom that gets mapped to one of the strata into which the event is divided.

Form Ⅶ shortened FⅦ

ʔinfaʕala

Ryding (2005) considers FⅦ “reflexive, resultative, passive, or mediopassive in meaning” (p. 555). This form is categorized as ergative or “unaccusative”, which would deem it, following Tenny’s (1989) analysis, to be compatible with for-adverbials due to the absence of an internal object that would activate the measuring out constraint resulting in telecity. However, the constructions below do not support this assumption.

(9) ‘inkasara-t z-zujaajaat-u li saaʕaat-in
broke-Fem Def-bottles-Acc For hours
‘the bottles broke for hours’

(10) ‘inkasara-t z-zujaajaat-u
broke-Fem Def-bottles-Acc
‘the bottles broke’

Form Ⅵ shortened FⅥ

Tafaaʕala, the reciprocal predicate.

SDRagent(انكسر)(e) ⇔ e ∈ ∗λe (انكسر(e) ∧ Atom(∗agent(e)))

Conceptual framework:

Distributivity

The parallels between mass reference, plural reference, lexical aspect and distributivity has been substance for extensive research. Many authors have analyzed the correspondence between these domains in attempts to use their properties “for drawing semantic generalizations across constituents” Champollion, (2010). Link (1983) and Bach, (1986) have trodden the same path, but diverged from modelling these correspondences through syntactic feature to “relating them to semantic properties of the denotations of the constituents in question” (Champollion, 2017, p. 71). The metaphysical stance those authors took led them to assume that mereological relations govern the parallels between these domains.

Link, (1983)

Within the mathematical framework of semilattice, Link’s analysis offers a comprehensive analysis of noun reference in his attempt to account for behavior of mass and plural nouns. In this endeavor, Link’s analysis defines ordering relations that are part and parcel of understanding the semantics of plural and mass nouns. These relations lay out a formalization of the part-whole relations.

Parthood Relation (≤):

“Sums are partially ordered through the intrinsic ordering relation (≤) on E which is expressed in the object language by the 2-place predicate ''. It is called the individual part relation (i-part relation, for short) and satisfies the biconditional” (Link, 1983, p. 306)

a∩b ↔ a∪b = b.

This relation implies the following properties

Reflexivity: For any element x, x≤x

Antisymmetry: If x≤y and y≤x then x=y

Transitivity: If x≤y and y≤z, then x≤z

This relation is used to model how individual parts relate to their wholes, whether in plural or mass terms.

Join Operation (∨)

The second ordering relation is called material part (m-part) relation and denoted by T. “objects which are m-parts of one another are materially equivalent in that they have the same portion of matter constituting them. If x is an i-part of y then a is a m-part of b” (Link, 1983, p. 308). This relation is defined by:

x ≤ y iff x∪y = y

Homomorphism

The two ordering relations are related by an order-preserving function; the semilattice homomorphism h. This identity function entails:

The i-part relation can be defined as follows

$X \leq_i y \Rightarrow h(x) \leq h(y) \quad \{x, y \in E \text{ and } x \neq 0\}$

The m-part relation can be defined as :

$X \leq_m y \quad \text{iff} \quad h(x) \leq h(y) \quad \{x, y \in E\{0\}\}$

Ordering of Plurals and Mass Terms

Link's analysis organizes both plural nouns and mass nouns into a hierarchy based on the parthood relation.

Plurals: Individual entities (atoms) are ordered based on their inclusion in larger plural sets. For example, a single dog d1 is part of the sum of individuals *P{a∪b∪c∪d).

The operator works “on 1-place predicates P, which generates all the individual sums of members of the extensions of P. Such a starred predicate now has the same cumulative reference property as a mass predicate, it is closed under sum formation” (Link, 1983, p. 306). “Distributive predicates working on plural terms have to be starred, all the other predicates must not be” (Link, 1983, p. 310).

Mass Terms: Masses are also ordered by parthood, where a portion of a substance is part of a larger mass. For example, a liter of water is part of a larger body of water.

$\text{Distr}(P) \leftrightarrow \Lambda\chi(P\chi \cap tx)$

Link observes that individual sums or plural objects respect levels of "linguistic comprehension" as shown by the examples below:

a. The cards on the table are numbered consecutively.

b. The decks of cards on the table are numbered consecutively.

Collections, contrastively, usually combine those levels. Sums and collections share a similarity, however, in that they both are just individuals, as concrete as the individuals which serve to define them, and of the same logical type as these (p. 305).

The formalizations below illustrate for distributive constructions.

1. a.Children built the raft.

   b.$\forall x(*Px \cap Qx)$

3. a. The children built the raft.

   b. $\forall y = (\sigma *xPx \cap Qy)$

Bach 1986

Bach’s paper suggests that events could be analyzed as physical objects in terms of their structure and composition. “I will start by considering events to be analogous to the singular and plural individuals and bounded processes ('bits of process') analogous to the portions of matter that make up the 'material extensions' of those individuals.” (Bach, 1986, p. 8). Parallel to Link’s analysis, lays out two ordering relations ≤e and ≤p. A new system is then outlined:

1. Ee: the set of events with join operations Ue and partial ordering ≤e (a complete atomic Boolean algebra);
2. Ae ≤ Ae: atomic events;
3. De ≤ Ae: bits of process with join Up and partial ordering ≤p (a complete join semilattice) (Bach, 1986, p. 8)

This approach allows for a formal analysis of events. It models how events are combined, related and temporally ordered. Model (1) formalizes how events combine, whereas (2) models the mereological relationship between sub-events and larger events.

Bach sets the ground to equating the subinterval property with mereological parthood.

Link 1991

The subinterval property defined by Bennet and Partee has the minimal part impediment. It seems to be too strong when the divisibility of some events is considered. The granularity parameter that Link introduces excludes temporal intervals below a certain threshold.

SUBLink(P) def =

$\forall e, t[P(e) \wedge t \leq \tau(e) \wedge |t| \geq \gamma(e) \rightarrow \exists e' (e' \leq e \wedge P(e') \wedge \tau(e') = t)]$

(A predicate P has the Link-style subinterval property iff for any e of which it holds, every part of the runtime of e whose length is at least γ(e) is the runtime of a part of e of which P holds as well.)

The granularity of e (γe) “expresses the observation that some time stretches might be too small to be a trace of the event e; thus γ(e) fixes the minimal length that a time stretch must have to serve as a trace for e” (Link, 1991, p. 217). This parameter may have addressed the minimal part problem, but it does not fully account for it. The following section will shed the light on Champollion’s (2017) modification to the notion of granularity.

Verb forms

Verb forms have been the subject of many semantic (Danks, 2011), morphological (Hudson 1986), morpho-syntactic (Bahloul 2008) accounts. The scope of this section focuses on the lexical formation of the six verb patterns, namely forms Ⅱ Ⅲ Ⅳ Ⅴ Ⅵ Ⅶ, due to the lexical correspondence observed between each pair Ⅱ-Ⅴ, Ⅲ-Ⅵ, and Ⅳ-Ⅶ. This section will summarize Wright’s (1892) and Ryding’s (2005) lexical accounts.

Wright 1892 and Ryding, (2005) list fifteen forms of verbs in Arabic. Wright 1892

Ryding (2005) and William Wright (1892) agree that Form II expresses intensiveness, though Ryding also attributes causation, a view rejected by Fassi Fehri. He questions how reduplication, if marking verbal plurality, can yield both intensive and causative meanings (2003, p. 158). Others, such as Ford, (2009) and Al Kaabi & Ntelitheos, (2019) maintain both readings. Form II corresponds to Form V, where the morpheme -ta (Wright’s reflexive marker) yields an effective or reflexive meaning. Since reflexivity does not account for gradual development, acquisition, or imitation, Form V is better analyzed as effective. Ryding and Wright also treat Form III as reciprocal, but Fassi Fehri disputes this, arguing it is not inherently symmetrical. Rather, it may express joint participation of subject and object (2012, p. 321). Although the long vowel aa suggests plurality or participation, reciprocity is not primarily encoded by the verb itself (2012, p. 324). By contrast, Form VI is consistently analyzed as reciprocal(Watson, 2002).

Forms Ⅳ and Ⅶ are not traditionally considered parallels (Alshdaifat, 2021), Ryding & Watson (2014), Ibrahim, (2020). In the literature, form Ⅳ is considered causative, whereas form Ⅶ is maintained to be resultative and passive or medio-passive. It is usually translated into English using middle formations. The syntactic absence of an object gives rise to unaccusativity deeming this form as passive. The Oxford Learner's Dictionary uses a middle formation sentence to illustrate for the entry inchoative "of verbs) expressing a change of state that happens on its own. Opened in 'the door opened' is an example of an inchoative verb. This form is taken to correspond with form Ⅳ because it denotes a change of a state that happens on its own accord. The causation property is absent in this case.

The compositional nature of telicity

Tenny argues that only the direct internal argument can "measure out" an event, i.e., determine its temporal endpoint (1994, pp. 10–11). This reflects a broader correspondence between syntax and semantics, also assumed by Kratzer, (1996), Pylkkänen, (2002), Hale & Keyser, (1993), and Jackendoff, (1987), and later adopted by Müller & Wechsler, (2014). In this view, telicity depends on the countability of the internal argument: count nouns yield telic events, while mass nouns yield atelic ones (Tenny, 1995). No comparable effect is found for external arguments. Tenny formulates three constraints: only direct internal arguments can measure out events; only one such measurement is possible per event; and any change undergone must contribute to delimitation (1994, p. 11). Similarly, Krifka, along with Verkuyl, (1972, 1999), Filip, and Rothstein, (2008), links argument structure to aspect: quantized arguments produce telic predicates, while cumulative ones yield atelic readings (e.g., drink wine vs. drink a glass of wine).

To avoid iteration effects, Tenny further restricts internal arguments to mass nouns and distinguishes measuring out from mere delimitation. Telicity is tied to affectedness, defined as an argument's undergoing change (Tenny, 1989, p. 8). Only internal arguments of change-of-state or motion verbs, bearing roles such as theme or patient, can measure out events, though this aspectual potential may remain latent and selectively realized (Tenny, 1989).

Proto-Roles and Telicity- Dowty (1991)

Proto-Role Theory

Thematic roles are semantic relations that represent different ways in which entities participate in events (Parsons 1990, Dowty 1991). In this sense, the recurring question of how entities participate in events can be treated within the framework of thematic roles. The generalizations in thematic roles have been predicated in different fields, according to Dowty. However, previous accounts, in his view, either assign thematic roles to constituents that can be eliminated or are too strict and lack flexibility. Therefore, the theory of thematic roles needs to allow room for nuances based on the perspective of the context.

Conceivably, his approach must allow thematic roles that are not characterized by a single essential property, but rather a cluster concept, which also allows for broader categorizations. His rather flexible alternative, later adopted by other scholars (Kako, 2006), (Reisinger, 2015), White, (2017) engulfs two broad clusters of properties called Proto-Agent and Proto-patient. They enclose a set of properties that have a tendency of co-occurring with agents and patients in events.

Proto-Agent Properties

It is typically associated with the initiator or the doer that performs an action. Some of the properties it comprehends are:

Volitional involvement in the event or state: the entity acts intentionally or with volition

- Sentience/sentence (or perception): the sensory experience.
- Causation: the entity causes an event or change of state in another participant.
- Movement: it initiate movement relative to the position of another participant.
- Independent Existence: it exists independently of the event named by the verb.
- Proto-Patient Properties:
- These properties are characteristics usually associated with the affected entity of an action.
- Undergoes change of state: the event results in a change of state to the entity in question.
- Incremental Theme: the entity is progressively affected by the event.

Causally affected by another participant: the actions of another participant affect the entity.

Stationary relative to movement of another participant: the entity is stationary while another entity moves.

Although Dowty's Proto-Roles are broader than the rigid thematic roles, the Proto-Patient property remains narrower than the traditional Patient role, which encompasses predicates in which the relation between the verb and the object is non-homomorphic such as stroke (a cat) or stir (a soup).

Strata theory

The common point between all of these accounts is distributivity. It seems to touch down on various concepts. It has been considered as property of quantifiers, a connecting bridge between constituents, and a property of predicates and constructions.

Champollion (2010, 2017) outlines three types of distributivity, namely quantificational distributivity, relational distributivity and predicative distributivity. Since this paper focuses on distributivity between two constituents, we will only discuss his analysis of predicative distributivity and for-adverbials.

Distributive constructions

Champollion starts out by suggesting stratified distributive reference as a higher-order property. "All distributive predicates can then be modelled as having stratified distributive reference" (Champollion, 2017). The generalization provided by SDR is a tool that abstracts away from the compositional fashion of each predicate, whether a predicate is transitive, intransitive, distributes over its agent position or patient position.

The following are meaning postulates proposed by

Champollion (2017, pp. 80-81). (See Figure 1).

Stratified distributive reference (universal version)

SDRθ (P) def = ∀e [P(e) → e ∈ ∗λe (P(e) ∧ Atom(θ(e)))]

(An event predicate P has stratified distributive reference with respect to a thematic role θ iff every event e to which P applies can be exhaustively divided into one or more sub-events ("strata") to which P also applies and whose θ is an atom.)

Meaning postulate: see is distributive on its theme position

SDRtheme(∗see) ⇔ ∀e [see(e) → e ∈ ∗λe (∗see(e) ∧ Atom(theme(e)))]

Meaning postulate: see is distributive on its agent position

SDRagent(∗see) ⇔ ∀e [see(e) → e ∈ ∗λe (∗see(e) ∧ Atom(agent(e)))] (See Table 1).

For-adverbials

Dowty (1972) demonstrates that the entailment properties of atelic predicates in relation to various phenomena, such as tense, the progressive, and aspectualizers, can be initially understood by using the concept of the subinterval property. Champollion objects that "It is well known that the subinterval property is too strong. For example, waltz is an atelic predicate, but a subinterval that is so short that it contains less than three steps makes it hard to determine whether these steps qualify as waltzing (Dowty 1972)" (Champollion, 2017, p. 87).

Champollion suggests a definition that involves a weaker sub-interval property.

Definition: Stratified subinterval reference

SSR(P)(e) def = e ∈ ∗λe' (P(e) ∧ τ(e') < τ(e))

(An event predicate P has stratified subinterval reference with respect to an event e iff e can be exhaustively divided into parts ("strata") that are each in P and whose runtimes are properly included in the runtime of e.) (p. 87).

Methods

The literature reviewed in this paper converges on three widely discussed generalizations: (1) a predicate is typically analyzed as telic when its argument is quantized and atelic when its argument is non-quantized; (2) gradual change affecting an object correlates with telicity; and (3) a mapping function mediates the correspondence between the verbal and nominal domains. These proposals have shaped much of the research on aspectual composition, yet their predictions do not always align with the empirical behavior of morphologically related verbs in Standard Arabic. The present study therefore examines six verb forms organized into three morphologically correlated pairs derived from the same lexical roots. The selection of these forms follows two criteria: first, each pair contrasts a distinct morphological configuration while preserving the lexical meaning of the root; second, the verbs allow controlled testing with the same nominal complements and temporal modifiers, which makes it possible to observe how aspectual interpretations vary under otherwise comparable conditions.

Consider the following constructions:

(11) *'inkasara-t z-zujaajaat-u li saaʕaat-in
broke-3f Def-bottles-Nom For hours
'the bottles broke for hours'

(12) *takassara-t z-zujaajaat-u li saaʕaat-in
smashed-3f Def-bottles-Nom For hours
'the bottles smashed for hours'

(13) kassara z-zujaajaat-u li saaʕaat-in
Broke.Gem.3ms Def-bottles-Acc For hours
'he smashed the bottles for hours'

The non-quantized argument in (11) and (12) already challenges the generalization in (1), since the predicates remain incompatible with for-adverbials despite the plural nominal. By contrast, the causative geminated form in (13) allows a different distribution of the event over the internal argument. Building on these contrasts, the analysis proceeds in three steps. First, each verb form is tested with identical nominal complements and temporal adverbials in order to determine whether the predicate yields a bounded event reading, a temporally extended reading, or a distributive interpretation across participants. Second, the argument structure of each form is examined, with particular attention to how proto-agent and proto-patient properties are assigned to the internal argument, following Dowty's (1991) entailment-based diagnostics. Third, the resulting event structures are classified according to whether they exhibit Stratified Distributive Reference (SDR) or Stratified Subinterval Reference (SSR).

A verb that assigns a higher number of proto-patient entailments—especially those involving measurable change in the affected argument—is analyzed as yielding SDR, whereby the event decomposes into multiple subevents whose proto-patients correspond to atomic individuals:

SDR_{proto-patient}((P)(e)) ⇔ e ∈ ∗λe (P(e) ∧ Atom(∗proto-patient(e))).

By contrast, a verb that assigns stronger proto-agent properties is analyzed as yielding SSR, in which an event e can be partitioned into subevents whose runtime is properly included within the runtime of the larger event:

SSR(P)(e) ⇔ e ∈ ∗λe (P(e) ∧ τ(e′) < τ(e)).

The validity of the analysis is evaluated through the convergence of these diagnostics across the six verb forms: consistent correlations between morphological structure, proto-role entailments, and aspectual behavior provide empirical support for the classification. In this way, the study refines Champollion's (2017) model by integrating Dowty's (1991) observation that arguments may bear proto-roles to varying degrees, showing that the distribution of these entailments plays a decisive role in determining how noun quantification and verb quantification interact in Standard Arabic.

Table 2. Verb Forms, CV Templates, and Terminology

Verb form	CV template	Terminology
Fa??aLa	$C_1VC_2C_3VC_4V$	Repetitive form
Faaʔ aLa	$C_1VVC_2VC_3V$	Mutual form
ʕaFʔ aLa	$C_1VC_2C_3VC_4V$	Causative form
TaFa??aLa	$C_1VC_2VC_3C_4VC_5V$	Effective form
TaFaaʔ aLa	$C_1VC_2VVC_3VC_4V$	Reciprocal form
ʕinFaʔ aLa	$VC_1C_2VC_3VC_4V$	Inchoative form

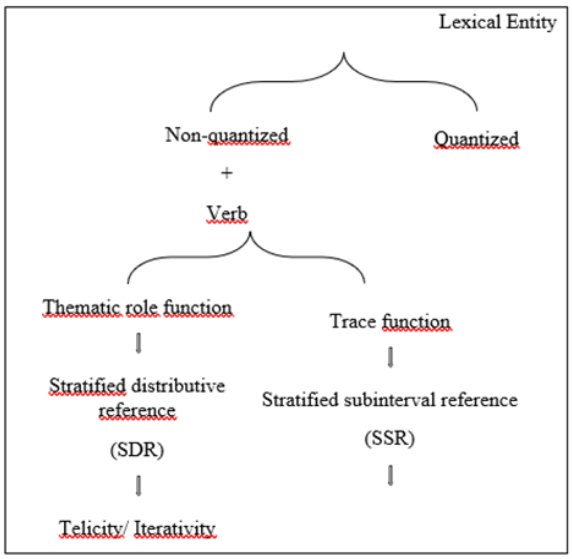

Figure 2. Interaction of Quantization, Thematic Roles, and Trace Functions in Event Structure

Derived trilateral patterns

A table outlining verb forms seems to be a salient staring points. The table is put together from literature on verb forms from Danks (2010), Wright (1892), Ryding (2005) and Hans Wehr's Dictionary of Modern Written Arabic (1976). The focus will mainly be on derived trilateral patterns. Arabic does not have an infinitive form. The verbs are referred to in the third person singular as it is the most commonly used paradigm. These verb forms are chosen to be investigated due to the theoretical correspondences assumed between each pair, Forms Ⅱ-Ⅴ, Forms Ⅲ-Ⅵ and forms Ⅳ-Ⅶ. (See Table 2).

Form Ⅱ

In his examination of verbal plurality in Semitic languages, Greenberg, (1991) identifies verbal plurality as potentially being rendered as 'temporal repetition', 'spatial dispersion', 'action by many' or 'action on many' (Swadesh 1946 in Greenberg 1991:577). Temporal repetition aligns with the predictions of the SSR model resulting in an atelic reading of the predicate.

(14) kassara z-zujaajaat-u li saaʕaat-in
Broke.Gem.3ms Def-bottles-Acc For hours
'he smashed the bottles for hours'

كسّر

kassara (+d. o.)

Break something into pieces
(temporal repetition)

SSR(كسّر)(e) ⇔ e ∈ ∗λe (كسّر(e) ∧ ساعات(e') < ساعات(e))

(15) qattala l-junuud-a li saaʕaat-in
kill.Gem.3ms Def-soldiers-Acc For hours
'he smashed the bottles for hours'

قتّل الجنود لساعات (+direct object)

qattala (+d. o.). (See figure 2)

kill many people (action on many)

SSR(قتّل)(e) ⇔ e ∈ ∗λe (قتّل (e) ∧ ساعات(e') < ساعات(e))

Fassi Fehri, (2012) this assumption in to assigning temporal repetition to 1(b) and distributive/action on many to 2(b). Dixon claims both gemination and 'consonant repetition' as morphological manifestations of causation (2000, p.34). However, Fassi Fehri stresses that 'if reduplication is a mark of verbal plurality, how can it be the source of both the "intensive" … and the "causative"…?' (2003, p. 158). In the same vein, Greenberg (1991) adds "[If . . .] the expression of distributive plurality in the verb has as its original sound symbolic meaning 'temporal repetition', then the transition to the meaning 'plural object' is not so difficult". He then adds that if one does something repeatedly ". . . it is highly likely to be action on separate objects, hence to involve a distributive plural" (p. 584). Therefore, we will adopt repetition form as a term referring to form Ⅱ. This repetition translates over temporal repetition and action on many making the predicate more prone to atelicity.

Form Ⅲ

Fassi Fehri (2012) calls this pattern participation form, whereas Benmamoun (2003a) uses the term reciprocal. This claim is rather interesting, because later on Benmamoun states that 'reciprocal formation cross-linguistically usually yields intransitive forms' (2003a, p.56). The following construction enhances the questionability of the reciprocity association with Form Ⅲ.

(16) naafasa l-mutasaabiq-u l-maghribiy-u l-mutasaabiq-a
compete.3ms Def-contestant-Nom Def-moroccan-Nom Def-contestant-Acc
l-balghariy-a
Def-bulgarian-Acc
'The Moroccan contestant competed against the Bulgarian contestant'

While this formation is transitive, its behavior complicates a straightforward reciprocity analysis, suggesting that a mutual or participation-based interpretation may better capture its semantic properties.

(17) qaatala l-muħaarib-un baʕdha-hom Li saaʕaat-in
fought.3ms Def.warriors-Nom each-Res For hours-Gen
'the warriors fought each other for hours'

SSR(قاتل)(e) ⇔ e ∈ ∗λe (قاتل (e) ∧ ساعات(e') < ساعات(e))

Danks (2010) draws an important distinction

Thus vowel lengthening represents semantic plurality in

both patterns III and VI; partitioning of participants in a transitive construction allows asymmetric differentiation in pattern III; and detransitivising by ta- prefixation removes the asymmetry and assembles the participants in one grammatical subject. Hence there appears to be a good semantic case for accepting verbal plurality as a property of both pattern III mutual verbs and pattern VI reciprocal verbs.(p. 213)

We will adopt Danks (2011) terminology and call form Ⅲ mutual.

Form Ⅳ

The glottal stop prefixed form (FIV) is considered causative. However, the transitivity property does not seem to be fully agreed on. Wright (1967) claims “if the verb is intransitive in the first form, it becomes transitive in the fourth, if transitive in the first, it becomes doubly transitive in the fourth” (P. 34), whereas Fassi Fehri (2003) attributes transitivity to the nature of the root of the verb. The form “may or may not result in transitivization” (P. 156). “If R is non-verbal, then the form ‘verbalizes’ it (without adicity increase), but if R is already ‘verbal’, then the outcome is transitivized” (Fassi Fehri, 2003, p. 156).

Let’s consider the following constructions in (16) and (17). The verb in (16) is derived from a non-verbal root. The verb in (17) is derived from a verbal root.

(18) ‘a-nbatal-ħaql-u li sanawaat-in
Caus-plant.3ms Def-field.Nom for years-Gen
‘the field grew plants for years’

(19) ‘a-xraj-tu l-‘awlaad-a
Caus.go out-1s Def-children-Acc
‘I made the children go out’

Fassi Fehri (2003) states that the morpheme “/’a/ can be taken as reduplicating ev/V, and hence pluralizing it” (p. 157). However, the plurality of the event in both examples is not rendered through the morpheme, but rather the for-adverbial in (16) and the plural object in (17). Let us consider the same examples without the for-adverbial and the plural object.

(20) ‘a-nbatal-ħaql-u
Caus-plant.3ms Def-field.Nom
‘The field grew plants’

The examples (18) and (17) can be both interpreted as something caused the event to take place. In (18), it is not quite explicit what brought the event about. “Despite the fact that /ʕ/ prefixation results in plurality, it cannot be interpreted as ‘intensive’, e.g. as denoting temporal repetition (Fassi Fehri, 2003, p. 157). Therefore, the form (FIV) can be concluded as causative and the morpheme /ʕ/ as distributive.

The model-theoretic bellow illustrates sentences (16) and (17).

(4b) SDRproto-patient ((أخرج)(e) ⇔ e ∈ ∗λe (أخرج(e) ∧ Atom(∗proto-patient(e)))

Form Ⅴ

Prefixing ta- to form II produces the form V: TaFaʔʔaLa. MacDonald (1963) refers to it as 'reflexive ta-' (P. 104). It derives a reflexive pattern from a repetitive form. Form Ⅴ is defined in Wright’s words as follows “it expresses the state into which the object of the action denoted by the second form is brought by that action, as its effect or result. In English it must often be rendered by the passive” (1896, p. 38). This form is rendered into middle formations rather than passive. The reflexive meaning does not always hold for this form. Verbs like tajarraʕa, tajawwala, taqSSa, taħaqqaqa testify to this statement. “The effective implies that an act is done to a person, or a state produced in him, whether it be caused by another or by himself” (Wright, 1896, p. 39). Sentences (19) and (2) illustrate for this statement.

(21) takasara-t z-zujaajaat-u
broke-Fem Def-bottles-Nom
‘the bottles broke’

(22) tajawwala l-‘awlaad-u
stroll.3ms Def-children-Nom
‘the children strolled’

The difference seems to reside in the compatibility of the two forms with for-adverbials.

(23) *takasara-t z-zujaajaat-u li saaʕaat-in
broke-Fem Def-bottles-Acc for hours-Gen
‘the bottles broke for hours’

(24) tajawwala l-‘awlaad-u li saaʕaat-in
stroll.3ms Def-children-Nom for hours-Gen
‘the children strolled for hours’

The ungrammaticality of (5c) shows that form Ⅴ can acquire both SSR and SDR. Hence, (5a) and (5b) can be represented as follows:

1. SSR(تجوّل(e) ⇔ e ∈ ∗λe (تجوّل (e) ∧ لساعات(e) < لساعات (e’))
2. SDRproto-patient ((تكسّر)(e) ⇔ e ∈ ∗λe (تكسّر(e) ∧ Atom(∗proto-patient(e)))

Form Ⅵ

Prefixing ta- to form Ⅲ produces the form Ⅵ: TaFaaʔaLa. The ‘reflexive –Ta’ derives a reciprocal pattern from a participatory one.

(25) taqaatala l-junuud-u
fought.3ms Def-soldiers-Nom
‘the soldiers fought with one another’

The sentence in (22) requires a grammatically or functionally plural subject. The for-adverbial test results in a grammatically correct construction, concluding that Form Ⅵ acquires SSR.

(26) taqaatala l-junuud-u li saaʕaat-in
fought.3ms Def-soldiers-Nom for hours-Gen
‘the soldiers fought with one another for hours’

(6a) SSR(تقاتل (e) ⇔ e ∈ ∗λe (تقاتل (e) ∧ لساعات(e) <لساعات(e’))

Form Ⅶ

Wright (1892) states that “the seventh form is formed from the first form by prefixing a ن, before which is added a

prosthetic ا to facilitate the pronunciation" (p. 42). Form Ⅶ has a reflexive signification without a reference to who brought about the event. This form is never assumed to be reciprocal. It embodies causation and reflexivity resulting in inchoative signification. Sentence (10) is repeated here for convenience.

(27) 'inkasara-t z-zujaajaat-u
broke-3f Def-bottles-Nom
'the bottles broke'

The for-adverbial test results in a grammatically incorrect construction, concluding that Form Ⅶ acquires SDR. Sentence (11) is repeated here for convenience.

(28) *'inkasara-t z-zujaajaat-u li saaʕaat-in
broke-3f Def-bottles-Nom For hours
'the bottles broke for hours'

(7a) SDRproto-patient ((انكسر)(e) ⇔ e ∈ ∗λe (انكسر(e) ∧ Atom(∗proto-patient(e)

Result and Discussion

The analysis of the six verb forms reveals systematic correlations between morphological structure, proto-role assignment, and aspectual interpretation, though these correlations are not uniform across all configurations. Table 1 summarizes the distribution of aspectual readings and distributivity functions. In what follows, each form is examined individually in order to distinguish the empirical data, the interpretive patterns, and the resulting generalizations.

Form Ⅱ (faʕʕala).

Empirically, predicates in this form are consistently compatible with for-adverbials and yield atelic readings, even when combined with arguments that would otherwise favor bounded interpretations. The gemination encodes temporal repetition, which distributes the event across subintervals of time, resulting in Stratified Subinterval Reference (SSR), where the runtime of the event is divisible into smaller intervals. Importantly, even predicates with an inherent endpoint lose their telicity under repetition, indicating that temporal distributivity can override argument-based quantization. Marginal cases arise when contextual factors enforce bounded readings, suggesting that repetition is a strong but not absolute constraint. Form Ⅱ induces atelicity through temporal distributivity (SSR), weakening the predictive role of argument quantization.

Form Ⅲ (faaʕala).

Form Ⅲ displays a dual behavior depending on verb class. With dynamic predicates, repetition over time yields SSR and atelicity, parallel to Form Ⅱ. With stative predicates, the eventuality spans a larger interval but is interrupted by state changes, producing a fragmented interpretation. While generally atelic, certain reciprocal contexts approach bounded readings, indicating an interaction between reciprocity and event closure. Form Ⅲ patterns with SSR, but its aspectual outcome remains sensitive to lexical aspect, revealing controlled variability.

Form Ⅳ (ʔafʕala).

This causative and transitive form assigns a higher number of proto-patient properties to its internal argument, including change of state and causal affectedness. When combined with plural arguments, the event distributes over atomic individuals, yielding Stratified Distributive Reference (SDR). The resulting interpretation is iterative rather than durative, and for-adverbials are degraded because the event is construed as a series of completed subevents. This shows that proto-patient entailments trigger participant-based partitioning of the event. Form Ⅳ encodes SDR via proto-patient entailments, producing iterative readings that resist temporal extension.

Table 3. Verb Forms, Distributivity Functions, and Aspectual Readings

Verb form	Distributivity function	Meaning	Aspectual reading
Form Ⅱ	SSR runtime	Repetitive	Atelic
Form Ⅲ	SSR runtime	Mutual	Atelic
Form Ⅳ	SDR proto-agent	Causative	Iterative
Form Ⅴ	SSR runtime	Gradual progress or change in an activity or state.	Atelic
	SDR proto-role	Effective	Iterative
Form Ⅵ	SSR runtime	Reciprocal	Atelic
Form Ⅶ	SDR proto-patient	Inchoative	Iterative

Table 4. Distribution of Proto-Agent and Proto-Patient Properties Across Verb Forms

Verb form	Form Ⅱ	Form Ⅲ	Form Ⅳ	Form Ⅴ	Form Ⅵ	Form Ⅶ
Proto-Agent Properties:						
Volitional involvement in the event or state	+	+	+	+	+	+
Sentience/sentence (or perception)	+	+		+	+	+
Causation			+		+	

Verb form	Form Ⅱ	Form Ⅲ	Form Ⅳ	Form Ⅴ	Form Ⅵ	Form Ⅶ
Movement	+	+	+		+	
Independent Existence	+			+	+	
Proto-Patient Properties:						
Undergoes change of state			+	+		+
Incremental Theme			+			
Causally affected by another participant		+	+			
Stationary relative to movement of another participant			+			
Dependent Existence			+			

Form Ⅴ (tafaʕʕala).

Form Ⅴ exhibits two distinct readings. When it encodes gradual change or the acquisition of a property, the event is temporally extended and compatible with for-adverbials, yielding SSR. In contrast, its effective reading distributes the event over participants, producing SDR and iterative interpretations. This alternation shows that morphological form alone does not fix distributivity type; rather, the distribution of proto-role entailments determines whether the event is partitioned temporally or across individuals. Form Ⅴ alternates between SSR and SDR, providing direct evidence for a flexible mapping between morphology, proto-roles, and aspect.

Form Ⅵ (tafaaʕala).

This reciprocal form allows for-adverbials and consistently yields atelic readings. The reciprocal structure distributes the event across participants while maintaining temporal extension, resulting in SSR. Although the event is participant-distributed, it is not decomposed into bounded subevents, which explains its compatibility with temporal extension. Form Ⅵ encodes participant-based distributivity without event segmentation, confirming SSR as compatible with reciprocity.

Form Ⅶ (infaʕala).

Form Ⅶ is inchoative and encodes a sudden change of state. It is incompatible with for-adverbials and yields iterative readings when plural arguments are present. The event distributes over atomic individuals, each undergoing a distinct change, which results in SDR. Despite its intransitive syntax, the argument bears strong proto-patient properties, showing that syntactic position does not determine distributivity type. Form Ⅶ patterns with SDR, demonstrating that proto-patient entailments, rather than argument structure alone, govern event partitioning

Taken together, these results show that distributivity splits into two mechanisms: Stratified Subinterval Reference (SSR), which partitions events temporally, and Stratified Distributive Reference (SDR), which partitions events across participants. This division follows from the distribution of proto-role entailments: predicates with stronger proto-patient properties (e.g., change of state, affectedness) favor SDR, whereas those with stronger proto-agent properties favor SSR. Crucially, this mapping is not reducible to argument structure or nominal quantization alone, as shown by intransitive forms that still yield SDR. These findings refine Champollion's (2017) model by relativizing distributivity to proto-roles, challenge compositional accounts that derive telicity from argument quantization, and extend Dowty's (1991) framework by demonstrating that the gradient distribution of proto-role entailments directly shapes event structure and aspectual interpretation. (See Table 3 and table 4).

Conclusion

This study has shown that the interaction between verbal morphology, proto-role assignment, and nominal reference in Standard Arabic cannot be adequately captured by accounts that reduce telicity to argument quantization or syntactic configuration. By examining six morphologically related verb forms, the analysis demonstrates that distributivity constitutes a central mechanism governing the mapping between noun quantification and event structure. The distinction between Stratified Subinterval Reference (SSR) and Stratified Distributive Reference (SDR) provides a more precise account of how events are partitioned, either temporally or across participants. Crucially, the results establish that proto-role entailments—rather than the mere presence of an internal argument—determine how this partitioning proceeds. In doing so, the study refines existing theories of aspectual composition, extends the empirical scope of distributivity-based approaches, and motivates a more articulated interface between morphology, argument structure, and event semantics.

Author contributions

The first author conceptualized and designed the study, conducted the literature review, developed the theoretical framework, analyzed the data, and wrote the manuscript. The second author revised the article critically for intellectual content and approved the final version for publication.

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