A FORMALIZED DOMAINAL ROLE THEORY*

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ABSTRACT

The problem of determining the nature and number of semantic roles dates back to the mid-1960's as the work of Charles Fillmore does evidence. The sole objective pursued in the present paper is to enunciate a theory of semantic roles that purports to resolve the aforementioned problem. The proposed solution resides in the definition of eighteen semantic roles in line with the second of three axioms. The first axiom states that there are two entity types: thing and human. The second states that situations are divided twofold: thing and human, whereby a situation type may be absolute, essive, relative, contactive, or causative. The third states that there are sixteen semantic domain types: thing, quantitative numerical, spatial, material, temporal, biotic, botanical, animal, human, perceptual, emotional, cognitive, psychomotor, communicative, and ratiocinative. With θ, $\varkappa$, δ, *as role category (i.e. entity or situation), and domain respectively, the meaning of a sentence constituent is defined as* $\theta\,\varkappa\,(\delta)$. *Finally, through essivization,*

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relativization, contactivization and causativization of the five semantic role patterns (i.e. absolute, essive, relative, contactive, and causative) the formalizing power of the theory is immensely enhanced.

1. PRESENTING THE PROBLEM

In order to state the problem to be tackled in this paper, I propose to make contact with four texts on English Language and linguistics. The intended contact pertains to their treatment of role theory.

In their influential grammar of the English language Quirk et al (1985: 741) duly remind us that

> analysis of participant roles has not achieved a general consensus, nor has it fully explored all distinctions … [their] description must therefore be considered tentative.

On the other hand, Brown and Miller (1991: 308) justify their description of role theory by "its offering a degree of both generality and particularity [although] it has no easily defended validity … [and] there seems to be no alternative in the current state of knowledge."

While Fromkin et al (2003: 192) prefix their list of roles with a reassurance to the effect that "the list is not complete", Larson and Segal's (1995: 489) considered stance on the nature and number of semantic roles is the most pessimistic, for they write:

> The upshot is that we regard the question of which thematic roles there are and how they are defined as empirical ones, to be resolved in the usual way: by investigations that construct specific theories making detailed and

specific predictions. Preliminary theories of this kind have been proposed; however, it is likely that resolving thematic roles precisely will require a great deal of investigation, involving domains beyond linguistics. It is worth remembering that fully 22 centuries elapsed between the first suggestion of the atomic theory of matter, in which all substances were factored into earth, water, air, and fire, and the elaboration of atomic theory by John Dalton, in which a more complete and satisfactory set of atomic constituents was proposed. Finding elementary constituents can evidently be a long-term project.

Admittedly, the development of atomic theory was tortuous; but we need not resign ourselves to a similar state-of-affairs with regard to role theory. The objective I am poised to pursue in this paper is to bring the problem of determination of semantic roles closer to its solution by propounding a domainal role theory.

The theory has typically four components, namely, undefined concepts, underived principles, defined concepts, and derived principles.

2. THE FORMALIZED DOMAINAL ROLE THEORY

2.1 Undefined Concepts

Although intuitable, the concepts of semantic entity, semantic situation, semantic domain, and semantic role are undefined within the theory. In what follows, let β , β' , β'' and θ stand for entity, situation, domain and role respectively.

2.2 Underived Principles

There are two entity types: thing r and human h. There are two situation types: thing r′ and human h′, whereby a situation type is absolute, essive, relative,

contactive, or causative. There are sixteen domain types: thing r″, quantitative q″ , numerical n″, spatial l″, animal z″, human h″, perceptual e″, emotional f″, cognitive c″, psychomotor v″, communicative s″ , and ratiocinative p″. Restated symbolically,

2.1.1 Axiom 1: $\beta = r, h$

2.1.2 Axiom 2: $\beta' = r', h'$

2.1.3 Axiom 3: $\beta'' = r'', q'', n'', l'', m'', t''\ o'', b'', z'', h'', e'', f'', c'', v'', s'', p''$

2.3 Defined Concepts

The definitions which follow are based on undefined concepts and underived principles.

2.3.1 Role Types

A semantic category $\varkappa$ is either an entity β or situation β'.

2.3.2 Role types are defined in line with Axiom 2. In an absolute situation type,

B = df change bearer

Z = df nonchange bearer

In an essive situation, B and Z are defined as above; additionally,

W = df whole

I = df identifier

K = df member

U = df augmentative

L = df diminutive

In a relative situation type, B and Z are again defined as above, additionally,

R = df reference

D = df direction

J = df comitative

S = df source

M = df mediate

G = df goal

Q = df measure (range)

In a contactive situation type,

T = df contactor

A = df contacted

In a causative situation type,

C = df causer

E = df effected

2.3.3 The meaning of a sentence constituent is defined as $\theta\varkappa(\delta)$; in words, category $\varkappa$ in domain δ plays role θ.

2.3.4 A semantic formula is well-formed if and only if it accords with one of the following rules:

Formation Rule 1: $[\Sigma\varkappa(\delta)]$

Formation Rule 2: $[\Sigma\varkappa_1(\delta_1)\Delta\varkappa_2(\delta_2)]$

Formation Rule 3: $[\Sigma\varkappa_1(\delta_1)\Lambda\varkappa_2(\delta_2)]$

Formation Rule 4: $[T\varkappa_1(\delta_1)A\varkappa_2(\delta_2)]$

Formation Rule 5: $[C\varkappa_1(\delta_1)E\varkappa_2(\delta_2)]$

2.3.5 If σ is a situation type, θ_1 and θ_2 are roles, $\varkappa_1$ and $\varkappa_2$ are categories, and δ_1 and δ_2 are domains, then if

$$[\theta_1\varkappa_1(\delta_1)\ \theta_2\varkappa_2(\delta_2)] = \sigma$$

then

$$[\theta_1\varkappa_1(\delta_1)\ \theta_2\varkappa_2(\delta_2)] = Z\varkappa_1(\sigma') + Z\varkappa_2(\sigma')$$

is a semantic equation.

2.4 Derived Principles

Stripping the semantic formulae in Sec 2.3.4 of the $\varkappa(\delta)$ – parts results in the following semantic role patterns:

[Σ] , [ΣΔ] , [ΣΛ] , [TA] , [CE]

Further role patterns can be generated through sequential essivization, relativization, contactivization, and causativization. Five role-pattern generating cycles suggest themselves.

First Cycle

	Essivization	Relativization	Contactivization	Causativization
[Σ]	[Σ]Δ	[Σ]Λ	TA[Σ]	CE[Σ]
[ΣΔ]	[ΣΔ]Δ	[ΣΔ]Λ	TA[ΣΔ]	CE[ΣΔ]
[ΣΛ]	[ΣΛ]Δ	[ΣΛ]Λ	TA[ΣΛ]	CE[ΣΛ]
[TA]	[TA]Δ	[TA]Λ	TA[TA]	CE[TA]
[CE]	[CE]Δ	[CE]Λ	TA[CE]	CE[CE]

Second Cycle

	Essivization	Relativization	Contactivization	Causativization
[Σ]Δ	[[Σ]Δ]Δ	[[Σ]Δ]Λ	TA[[Σ]Δ]	CE[[Σ]Δ]
[ΣΔ]Δ	[[ΣΔ]Δ]Δ	[[ΣΔ]Δ]Λ	TA[[ΣΔ]Δ]	CE[[ΣΔ]Δ]
[ΣΛ]Δ	[[ΣΛ]Δ]Δ	[[ΣΛ]Δ]Λ	TA[[ΣΛ]Δ]	CE[[ΣΛ]Δ]
[TA]Δ	[[TA]Δ]Δ	[[TA]Δ]Λ	TA[[TA]Δ]	CE[[TA]Δ
[CE]Δ	[[CE]Δ]Δ	[[CE]Δ]Λ	TA[[CE]Δ]	CE[[CE]Δ]

Third Cycle

	Essivization	Relativization	Contactivization	Causativization
[Σ]Λ	[[Σ]Λ]Δ	[[Σ]Λ]Λ	TA[[Σ]Λ]	CE[[Σ]Λ]
[ΣΔ]Λ	[[ΣΔ]Λ]Δ	[[ΣΔ]Λ]Λ	TA[[Δ]Λ]	CE[[ΣΔ]Λ]
[ΣΛ]Λ	[[ΣΛ]Λ]Δ	[[ΣΛ]Λ]Λ	TA[[ΣΛ]Λ]	CE[[ΣΛ]Λ]
[TA]Λ	[[TA]Λ]Δ	[[TA]Λ]Λ	TA[[TA]Λ]	CE[[TA]Λ]
[CE]Λ	[[CE]Λ]Δ	[[CE]Λ]Λ	TA[[CE]Λ]	CE[[CE]Λ]

Fourth Cycle

	Essivization	Relativization	Contactivization	Causativization
TA[Σ]	[TA[Σ]]Δ	[TA[Σ]]Λ	TA[TA[Σ]]	CE[TA[Σ]]
TA[ΣΔ]	[TA[ΣΔ]]Δ	[TA[ΣΔ]]Λ	TA[TA[ΣΔ]]	CE[TA[ΣΔ]]
TA[ΣΛ]	[TA[ΣΛ]]Δ	[TA[ΣΛ]]Λ	TA[TA[ΣΛ]]	CE[TA[ΣΛ]]
TA[TA]	[TA[TA]]Δ	[TA[TA]]Λ	TA[TA[TA]]	CE[TA[TA]]
TA[CE]	[[TA[CE]]Δ	[TA[CE]]Λ	TA[TA[CE]]	CE[TA[CE]]

Fifth Cycle

	Essivization	Relativization	Contactivization	Causativization
CE[Σ]	[CE[Σ]]Δ	[CE[Σ]]Λ	TA[CE[Σ]]	CE[CE[Σ]]
CE[ΣΔ]	[CE[ΣΔ]]Δ	[CE[ΣΔ]]Λ	TA[CE[ΣΔ]]	CE[CE[ΣΔ]]
CE[ΣΛ]	[CE[ΣΛ]]Δ	[CE[ΣΛ]]Λ	TA[CE[ΣΛ]]	CE[CE[ΣΛ]]
CE[TA]	[CE[TA]]Δ	[CE[TA]]Λ	TA[CE[TA]]	CE[CE[TA]]
CE[CE]	[CE[CE]]Δ	[CE[CE]]Λ	TA[CE[CE]]	CE[CE[CE]]

3. FORMALIZING SENTENCES IN THE THEORY

In formalizing natural language, it should be borne in mind that meaning depends on semantic role, category and domain , as is defined in Sec 2.3.3. For instance, in the role pattern [TA] contact is generically involved; for T$\varkappa(\delta)$ the pattern can spawn the following formulae for the predicates indicated:

(1)	$Tr_1(m'')Ar_2(m'')'$	**(collide with)**
(2)	Th(e")Ar(m")	**(see)'**
(3)	Th(c")Ar(s")	**(remember)**
(4)	Th(f")Ar(m")	**(like)**
(5)	Th(v")Ar(m")	**(hit)**
(6)	$Th_1(s'')Ah_2(e'')$	**(call)**
(7)	Th(p")Ar(s")	**(endorse)**

I now analyze and formalize 74 sentences, sixty-six of which are taken from Quirk et al(1985:754) sentences (1) –(39)), Brown and Miller (1991:309) (sentences (40)-(57)), and Fromkin et al (2003: 192-3) (sentences (58)-(66)).

(1) She is happy.
Zh(h") Kh'(f")

(2) He turned traitor.
Bh(h")Kh'(f")

(3) The Sahara is hot.
Zr(l")Kr'(m")

(4) Last night was warm.
Zr(t")Kr'(m")

(5) The show was interesting.
Zh'(h")Kr'(f")

(6) It is windy.
Zr′$_1$ (m″)Kr′$_2$(m″)

(7) He was at school.
Zh(h″)Rr(l″∩ l″)

(8) She got into the car.
Bh(v″)Gr(l″)

(9) He is lying on the floor.
Zh(v″)Rr(l″)

(10) The meeting is at eight.
Zh′(h″)R(t″)

(11) He was working.
Ch(h″)

(12) She is standing.
Zh(v″)

(13) The curtains disappeared.
Br(l″)

(14) The wind is blowing.
Br′(m″)

(15) It is raining.
Br′(m″)

(16) He threw the ball.
Ch(v″)E[Br(l″)]

(17) Lightning struck the house.
Tr′(m″)Ar(l″)

(18) He is holding a knife.
Ch(v″)E[Zr(l″)]

(19) The stone broke the window.
Cr_1 (m")E[Br_2(m")]

(20) She has a car.
Th(h")Ar(f")

(21) We paid the bus driver.
i.e. We paid (money) to the bus driver.
Ch_1(v")E[Th_2(v")]

(22) The will benefits us all.
Zr(s")Rh(f")

(23) They climbed the mountain.
Bh(v")Qr(l")

(24) The bus seats thirty.
Cr(m")E[Zh(h")R(l")]

(25) They fought a clean fight.
Ch(v")E[Bh'(h")Kr'(f")]

(26) I wrote a letter.
Ch(v")Er(s")

(27) They had an argument.
Ch(n"$\cap$ s")Eh'(s")

(28) He nodded his head
Ch(v")E[Bh(o")]

(29) He declared her the winner.
Ch_1(s")E[Bh_2(h")Kh'(f")]

(30) The sun turned it yellow.
Cr_1 (m")E[Br_2 (r")Kr'(m")]

(31) The revolver made him afraid.
Cr(m")E[Bh(h")Kh'(h")']

(32) I found it strange.
Th(p")A[Z$\varkappa$(δ)Kβ'(f")]

(33) He placed it on the shelf.
Ch(v")E[Br$_1$(m")Gr$_2$(l")]

(34) The storm drove the ship ashore
Cr'(m")E[Br$_1$(m)Gr$_2$ (l")]

(35) A car knocked it.
Tr$_1$ (m")Ar$_2$(m")

(36) I prefer them on toast.
Th(f"$\cap$ p")A[Zr$_1$(m")Rr$_2$(l")]

(37) I bought her a gift.
[Th$_1$(v") A[Zr(m")Rh$_2$(f")]

(38) She gave the door a kick.
Ch(v")E [Th(o")Ah'(v")]

(39) She knitted me a sweater.
[Ch$_1$(v")E[Br(m")Rh$_2$(f")]

(40) She was singing.
Ch(s")

(41) The string broke.
Br(m")

(42) John sharpened the knife.
Ch(v")E[Br(m")]

(43) The dog is digging a hole.
Cr$_1$(z")Er$_2$(l")

(44) Harold ran a mile.
Bh(v")Qr(l")

(45) Susan went to Denmark.
Bh(v") Gr(l")

(46) Yasuko is arriving from Kyoto.
Bh(v") Sr(l")

(47) Helen traveled via Samarkand.
Bh(v") Mr(l")

(48) She gave the book to Bill.
Ch_1 (v")E[Th_2 (v")Ar(s")]

(49) I got the cassette from David.
Ch_1 (v")E[Ch_2(v")E[Th_1(v")Ar(m")]]

(50) I contacted Jane via her sister.
[Th_1 (s")Ah_2(e")]Mh_3 (s")

(51) The painting cost £5,000.
Zr_1(m") Qr_2(f")'

(52) Miranda knew all the answers.
Th(c") Ar(s")

(53) Harriet owns a cat.
Th(h")Ar(z")

(54) (a) Celia is cold/sad.
Zh(h")Kh'(f")

(54) (b) Zh(h")Kh"(e")

(55) The child is sleeping.
Zh(e")

(56) The town is dirty.

Zr(l″∩ h″)Kr′(m″)

(57) Fiona is the convener.
Zh(h″)Ih′(h″)

(58) Joyce ran.
Bh(v″)

(59) Mary found the puppy.
Th(e″)Ar(z″)

(60) It_rains in Spain.
[Br′(m″)Rr(l″)

(61) He put the cat on the porch.
Ch(v″)E[Br_1(z″) Gr_2(l″)]

(62) He flew from Iowa to Idaho.
[Bh(h″)Sr_1(l″)] Gr_2(l″)

(63) Jo cuts hair with a razor.
Ch(v″)E[Cr_1(m″)E[Br_2 (o″)]]

(64) Helen heard Robert playing the piano.
Th_1(e″)A[Th_2(h″)Ar](m″)]

(65) The wind damaged the roof.
Cr′(m″)E [Br(l″)]

(66) The tail of the dog wagged furiously.
Br(o″)Qr′(f″)

(67) Our home faces the beach.
Zr_1 (l″∩ h″)Dr_2(l″)

(68) Our house is far way from the beach.
Zr_1(l″)Rr_2(l″)

(69) The man went to the beach with his wife.
$[Bh_1(v'')Jh_2(v'')]Gr(l'')$

(70) The man causes his son to leave the room.
$Ch_1(h'')E[Bh_2(v'')Sr(l'')]$

(71) Uganda is a part of East Africa.
$Zr_1(l'')Wr_2(l'')$

(72) 7 is greater than 6.
$Zr_1(n'')Lr_2(n'')$

(73) 6 is less than 7.
$Zr_2(n'')Ur_1(n'')$

(74) The city of Kampala is geographically part of Buganda.
$Ch(h'')Rr(h'')$

On examining how role patterns in Sec 2.4 are attested in the corpus which has just been formalized, we see that following the table emerges.

Table: Attestation of Role Patterns

[Σ] 12-15, 41, 55, 58	[Σ]Δ	[Σ]Λ	TA[Σ]	CE[Σ] 16,18-19,28 42,65
[ΣΔ] 1-6, 54, 56-57 71-73	[ΣΔ]Δ	[ΣΔ]Λ	TA[ΣΔ] 32	CE[ΣΔ] 25, 29-31
[ΣΛ] 7-10, 22-23 44-47, 51,60, 66-68	[ΣΛ]Δ	[ΣΛ]Λ 62,69	TA[ΣΛ] 36-37	CE[ΣΛ] 24, 33-34, 39, 61, 70
[TA] 17,20,35, 52-53,59	[TA]Δ	[TA]Λ 50	TA[TA] 64	CE[TA] 38,48
[CE] 26-27,43	[CE]Δ	[CE]Λ	TA[CE]	CE[CE]

It is evident that the role patterns in grey-shaded boxes are not attested.

The "truncated" role patterns are attested as follows:

(1) [C] : 11,40
(2) [CΛ] : 74
(3) [CE[T]: 21

In the fifth cycle of role patterns CE[CE[TA]] and CE[CE[Σ]] are attested by sentences 49 and 63 respectively.

4 CONCLUSION

In order to conclude the paper, I wish to contend that what purports to constitute a solution to the problem of determining semantic roles consists in the evidenced formalizing power of the new formal analytical language which incorporates roles as predicates and ontological categories as individual variables. Furthermore, Larson and Segal's yearning for a breakthrough in role theory seems, with all due restraint, to have been accorded full attention.

References

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