A FORMALIZED DOMAINAL ROLE THEORY

By

© K.B. Kiingi

Makerere University

&

Kampala International University

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 sixteen semantic roles in line with two axioms. The first axiom states that there are four and only four situation types, namely absolute, relative, contactive, and causative situation types. The second axiom defines meaning of a sentence constituent as $\theta\,\varkappa(\delta)$*, where* θ*,* $\varkappa$*, and* δ*, is a semantic role, semantic category (i.e. entity or situation), and semantic domain respectively. Finally, through relativization, contactivization and causativization of the four semantic role patterns (i.e. absolute, 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. First, semantic roles, entities, situations and domains are undefined concepts. Second, as underived principles, it is, on the one hand, axiomatized that there are four and only four situation types; on the other hand, meaning is axiomatically captured in terms of semantic role, category and domain. Third, the theory rests on five definitions of :
(i) sixteen role types, (ii) unit of meaning, (iii) four basic role patterns, (iv) rules of well-formedness of semantic formulae, and (v) semantic equation. Fourth, further semantic role patterns are derived from the basic ones.

2. THE FORMALIZED DOMAINAL ROLE THEORY

2.1 Undefined Concepts

The lowercase letters ⌜q, n, l, t, m, b, z, h, e, f, v, c, o, a, s, p⌝ symbolize sixteen semantic entity types: quantity, number, space, time, matter, plant, animal, human, percept, emotion, body part, cognition, observation, value, psychomotor, and proposition respectively. Correspondingly, with β as an entity type, β' and β'' are quantitative, numerical , spatial, temporal, material, plant, animal, human, perceptual, emotional, physiological, cognitive, observational, axiological, psychomotor, and propositional situation and domain types respectively.

2.2 Underived Principles

2.1.1 Axiom 1

There are four and only four situation types: absolute, relative, contactive, and causative.

2.1.2 Axiom 2

If θ is a semantic role, $\varkappa$ is a semantic category, and δ is a semantic domain, then θ $\varkappa$(δ) is a unit of meaning of a sentence constituent.

2.3 Defined Concepts

2.3.1 Role Types

Role types are definable in line with the Axiom 1 in Sec 2.2.1.

In an absolute situation types,

B = df change bearer

Z = df nonchange bearer

In a relative situation type, B and Z are defined as above. Furthermore,

R = df reference

D = df direction

J = df comitative

S = df source

M = df mediate

G = df goal

Q = df measure

W = df whole

I = df identifier

K = df set

In a contactive situation type,

T = df contactor

A = df contacted

Finally, in a causative situation type,

C = df causer

E = df effected

2.3.2 Basic Role Patterns

Again in harmony with Axiom 1, four basic role patterns are discernible:

[Σ] where Σ = B, Z in an absolute situation type.

[ΣΔ] where Σ = B, Z and Δ = R, D, J, S, M, G, Q, W, I, K in a relative situation type.

[TA] in a contactive situation type.

[CE] in a causative situation type.

2.3.3 Formation Rules

A semantic formula (for a semantic situation) is well-formed if and only if it is reducible to one of the following:

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

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

Formation Rule 3: $[T\varkappa_1(\delta_1)A\varkappa_2(\delta_2)]$

Formation Rule 4 : $[C\varkappa_1(\delta_1)E\varkappa_2(\delta_2)]$

2.3.4 Derived Principles (Derived Role Patterns)

Through relativization , contactivization and causativization of the four basic patterns (cf. Sec. 2.3.2 Basic Role Patterns) further role patterns are obtainable as shown below.

			(1)	[Σ]				
			(2)	[ΣΔ]				
			(3)	[TA]				
			(4)	[CE]				
<1>	(5)	[Δ[Σ]]	<1>	(5)	[TA[Σ]]	<1>	(5)	[CE[Σ]]
<2>	(6)	[Δ[ΣΔ]]	<2>	(6)	[TA[ΣΔ]]	<2>	(6)	[CE[ΣΔ]]
<3>	(7)	[Δ[TA]]	<3>	(7)	[TA[TA]]	<3>	(7)	[CE[TA]]
<4>	(8)	[Δ[CE]]	<4>	(8)	[TA[CE]]	<4>	(8)	[CE[CE]]

2.4 Semantic Equation

If σ is a situation type,

$$\sigma = [Z\varkappa_1(\sigma') + \ldots + Z\varkappa_\nu(\sigma')$$

is a semantic equation. In other words, the formula of a category participating in a situation is $Z\,\varkappa\,(\sigma')$.

3. FORMALIZING SENTENCES IN THE THEORY

With the formal language of domainal role theory in place, I now analyse 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)).

A unit of meaning is formalizable as:

$\theta\beta^{+}(\beta'')$ where β^{+} is a semantic object such that $\beta^{+} = \beta , \beta'$

or

$\theta\varkappa(\delta)$ where $\varkappa$ is a semantic category such that $\varkappa = \beta^{+}$, σ and $\delta = \beta'' , \sigma'$.

I shall, more simply, write $\theta\beta^{+}$ instead of $\theta\beta^{+}(\beta'')$ unless the domain is different from β''. A word about general modes of reading semantic formulae is in order. Consequently,

(1a)	$[Z\varkappa(\delta)]$	$\varkappa$ in δ persists.
(1b)	$[B\varkappa(\delta)]$	$\varkappa$ in δ persists.
(2a)	$[Z\varkappa_1(\delta_1)\ \Delta\varkappa_2(\delta_2)]$	$\varkappa_1$ in δ_1 persists in - Δ - relation – to $\varkappa_2$ in δ_2.
(2b)	$[B\varkappa_1(\delta_1)\ \Delta\varkappa_2(\delta_2)]$	$\varkappa_1$ in δ_1 changes in- Δ - relation – to $\varkappa_2$ in δ_2.
(3)	$[T\varkappa_1(\delta_1)\ A\varkappa_2(\delta_2)]$	$\varkappa_1$ in δ_1 comes into (is in) contact with $\varkappa_2$ in δ_2.
(4)	$[C\varkappa_1(\delta_1)E\varkappa_2(\delta_2)]$	$\varkappa_1$ in δ_1 causes (the emergence of) $\varkappa_2$ in δ_2.

(1a)	She is happy.
(1b)	h in f'' is a member of f' .
(1c)	Zh(f'')Kf'

(2a) He turned traitor.
(2b) h in a″ becomes a member of a′.
(2c) Bh(a″)Ka′

(3a) The Sahara is hot.
(3b) l is a member of m′
(3c) Zl Km′

(4a) Last night was warm.
(4b) t is a member of m′
(4c) ZtKm′

(5a) The show was interesting.
(5b) h′ is a member of a′.
(5c) ZhKa′

(6a) It is windy.
(6b) m'_1 is a member of m'_2.
(6c) Zm′Km'_2

(7a) He was at school.
(7b) h persists with reference to l.
(7c) ZhRl

(8a) She got into the car.
(8b) h in s″ changes with reference to m.
(8c) Bh(s″)Rm

(9a) He is lying on the floor.
(9b) h in v″ persists with reference to l.
(9c) Zh(v″)Rl

(10a) The meeting is at eight.
(10b) h′ persists with reference to t.
(10c) Zh′Rt

(11a) He was working.
(11b) h changes.
(11c) Bh

(12a) She is standing.
(12b) h in s'' persists.
(12c) Zh(s'')

(13a) The curtains disappeared.
(13b) m changes.
(13c) Bm

(14a) The wind is blowing.
(14b) m' changes
(14c) Bm'

(15a) It is raining.
(15b) m' changes.
(15c) Bm'

(16a) He threw the ball.
(16b) h in s'' causes [m to change].
(16c) Ch(s'')E[Bm]

(17a) Lightning struck the house.
(17b) m' comes into contact with m.
(17c) Tm'Am

(18a) He is holding a knife.
(18b) h in s'' is in contact with m.
(18b) Th(s'')Am

(19a) The stone broke the window.
(19b) m_2 causes [m_1 to change].
(19c) Cm_2 E[Bm_1]

(20a) She has a car.
(20b) h is in contact with m.
(20c) ThAm

(21a) We paid the bus driver.
i.e. We paid (money) to the bus driver.
(21b) h_2 in s" causes [h_1 in s" to come in contact with m'].
(21c) Ch_2(s")E[Th_1(s")Am']

(22a) The will benefits us all.
(22b) h in a" is in contact with p.
(22c) Th(a")Ap

(23a) They climbed the mountain.
(23b) h in s" is in contact with l.
(23c) Th(s")Al

(24a) The bus seats thirty.
(24b) h in v" persists with reference to l.
(24c) Zh(v")Rl

(25a) They fought a clean fight.
(25b) h in s" causes [the emergence of h' in a"].
(25c) Ch(s")Eh'(a")

(26a) I wrote a letter.
(26b) h in s" causes [the emergence of m].
(26c) Ch(s")Em

(27a) They had an argument.
(27b) h in p" causes [the emergence of p].
(27c) Ch(p")Ep

(28a) He nodded his head.
(28b) h in s" causes [h in v" to change].
(28c) Ch(s")E[Bh(v")]

(29a) He declared her the winner.
(29b) h_2 in p" causes [h_1 to become identical with h_0].
(29c) Ch_2 (p")E[Bh_1Ih_0]

(30a) The sun turned it yellow.
(30b) m_2 causes [m_1 to become a member of m'].
(30c) Cm_2 E[Bm_1 Km']

(31a) The revolver made him afraid.
(31b) m_2 causes [h in f" to become a member of f'].
(31c) Cm_2 E[Bh(f") Kf']

(32a) I found it strange.
(32b) h in a" comes into contact with [$\varkappa$ in δ becoming a member of c'].
(32c) Th(a")A[Z$\varkappa$(δ)Kc']

(33a) He placed it on the shelf.
(33b) h in s" causes [m to change to l].
(33c) Ch(s")E[Bm Gl]

(34a) The storm drove the ship ashore.
(34b) m' causes [m to change to l].
(34c) Cm'E[BmGl]

(35a) A car knocked it.
(35b) m_1 comes into contact with m_2 .
(35c) Tm_1 Am_2

(36a) I prefer them on toast.
(36b) h in a" comes into contact with [m_1 coming into contact with m_2].
(36c) Th(a")A[Tm_1Am_2]

(37a) I bought her a gift.
(37b) [h_1 in s" comes into contact with m] with reference to h_2.
(37c) [Th_1(s") Am]Rh_2

(38a) She gave the door a kick.
(38b) h in s" causes [m to come into contact with s].
(38c) Ch(s")E [Tm As]

(39a) She knitted me a sweater.
(39b) [h_1 in s" makes m] with reference to h_2 .
(39c) [Ch_1 (s")Em]Rh_2

(40a) She was singing.
(40b) h in a" changes.
(40c) Bh(a")

(41a) The string broke.
(41b) m changes.
(41c) Bm

(42a) John sharpened the knife.
(42b) h in s" causes [m to change].
(42c) Ch(s")E[Bm]

(43a) The dog is digging a hole.
(43b) z in s" makes l.
(43c) Cz(s")El

(44a) Harold ran a mile.
(44b) h in s" changes through l measurably.
(44c) Bh(s")Ql

(45a) Susan went to Denmark.
(45b) h in s" changes from l.
(45c) Bh(s") Gl

(46a) Yasuko is arriving from Kyoto.
(46b) h in s" changes from l.
(46c) Bh(s") Sl

(47a) Helen traveled via Samarkand.
(47b) h in s″ changes via l.
(47c) Bh(s″) Ml

(48a) She gave the book to Bill.
(48b) h_2 in s″ causes [h_1 to come into contact with m].
(48c) Ch_2 (s″)E[Th_1 (s″)Am]

(49a) I got the cassette from David.
(49b) h_2 in s″ comes into contact with [m which previously h_2 in s″ causes [h_1(s″) to lose contact with]].
(49c) Th_2 (s″)A[Ch_2(s″)E[$T^{-1}h_1$ (s″)Am]]

(50a) I contacted Jane via her sister.
(50b) [h_1 in p″ comes into contact with h_2] through h_3 .
(50c) [Th_1 (p″)Ah_2]Mh_3

(51a) The painting cost £5,000.
(51b) m persists through m′ measurably.
(51c) Zm Q m′

(52a) Miranda knew all the answers.
(52b) h in c″ is in contact with c.
(52c) Th(c″) Ac

(53a) Harriet owns a cat.
(53b) h is in contact with z.
(53c) ThAz

(54a) Celia is cold/sad.
(54b) h in f″ is a member of f′.
(54c) Zh(f″)Kf′

(55a) The child is sleeping.
(55b) h in v″ persists.
(55c) Zh(v″)

(56a) The town is dirty,
(56b) l is a member of a′.
(56c) ZlKa′

(57a) Fiona is the convener.
(57b) h is identical to h_0 .
(57c) ZhIh_0
(58a) Joyce ran.
(58b) h in v″ changes.
(58c) Bh(v″)

(59a) Mary found the puppy.
(59b) h in e″ comes into contact with z.
(59c) Th(e″)Az

(60a) It_rains in Spain.
(60b) [m′ changes] with reference to l.
(60c) [Bm′]Rl

(61a) He put the cat on the porch.
(61b) h in s″ causes [z to change to l].
(61c) Ch(s″)E[Bz Gl]

(62a) He flew from Iowa to Idaho.
(62b) h in s″ changes from l_1 to l_2 .
(62c) [Bh(s″)Sl_1] Gl_2

(63a) Jo cuts hair with a razor.
(63b) h in s″ causes [m_2 to cause [m_1 to change]].
(63c) C_2h(s″)E[C_1m_2 E[Bm_1]]

(64a) Helen heard Robert playing the piano.
(64b) h_2 in e″ is in contact with [[h_1 in s″ being in contact with m] in h″].
(64c) Th_2(e″)A[[Th_1(s″)Am](h″)]

(65a) The wind damaged the roof.
(65b) m'_2 causes [m_1 to change].
(65c) $Cm_2'E$ [Bm_1]

(66a) The tail of the dog wagged furiously.
i.e. The tail of the dog wagged in a furious way.
(66b) [z in v" changes] through f' measurably.
(66c) [Bz(v")]Qf'

(67a) Our home faces the beach.
(67b) l_1 persists towards l_2 .
(67c) Z l_1 Dl_2

(68a) Our house is far way from the beach.
(68b) l_1 persists with reference to l_2 .
(68c) Z l_1 R l_2

(69a) The man went to the beach with his wife.
(69b) [h_1 in s" changes to l] with h_2 in s".
(69c) [Bh_1(s")Gl]Jh_2(s")

(70a) The man causes his son to leave the room.
(70b) h_2 causes [h_1 in v" to change from l].
(70c) Ch_2E[Bh_1(v")Sl]

(71a) The man lets his son leave the room.
(71b) h_2 lets [h_1 is v" change from l].
(71c) C^{-1} h_2E[Bh_1(v")Sl]

(72a) The man tries to have his son leave the room.
(72b) h_2 is in contact with [h_2 causing [h_1 (v") to change froml]].
(72c) Th_2A[Ch_2E[Bh_1 (v") Sl]

(73a) The man fails to have his son leave the room.
(73b) h_2 is in contact with [h_2 causing [h_1(v") to not change from l]].
(73c) Th_2A[Ch_2E[$B^{-1}h_1$ (v")Sl]]

(74a) The city of Kampala is geographically part of Buganda.
(74b) l_1 is part of l_2.
(74c) Zl_1Wl_2

4. SEMANTIC EQUATIONS

Assessing the theory I have presented in this paper, Section 2.4 is what promises to afford us the ability to, so to speak, chemicalize language, for we can set up equations analogous to chemical ones. Let a few examples follow.

(75) h_1 kissed h_2.

Th_1Ah_2	=	$Zh_1(Th_1Ah_2)'$	**kisser**
		+ $Zh_2(Th_1Ah_2)'$	**kissee**

(76) h_1 pays m to h_2.

$Ch_1E[Th_2Am]$	=	$Zh_1(Ch_1E[Th_2Am])'$	**payer**
		+$Zh_2(Ch_1E[Th_2Am])'$	**payee**
		+$Zm(Ch_1E[Th_2Am])'$	**payment**

(77) h_1 teaches $\varkappa$ to h_2.

$Ch_1E[Th_2A\varkappa]$	=	$Zh_1(Ch_1E[Th_2A\varkappa])'$	**teacher**
		+ $Zh_2(Ch_1E[Th_2A\varkappa])'$	**learner**
		+ $Z\varkappa(Ch_1E[Th_2A\varkappa])'$	**teaching**

(78) h bakes m in l.

[Ch(s")Em]Rl	=	Zh([Ch(s")Em]Rl)'	**bakery worker**
		+ Zm([Ch(s")Em]Rl)'	**bakery product**
		+ Zl([Ch(s")Em]Rl)'	**bakery**

5. ERISTIC RECAPITULATION

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. To

facilitate the anticipated critical assessment of the theory I have enunciated in this paper, let it be recapitulated sequentially:

Basis of the move in the theory building		Move in the theory building
1	(1)	undefined concepts
2	(2)	Axiom 1
3	(3)	Axiom 2
2	(4)	role types
2, 4	(5)	basic role patterns
3, 5	(6)	formation rules
5	(7)	derived role patterns
5,6, 7	(8)	semantic equation
8	(9)	semantic product formula

References

Brown, Keith and Jim Miller (1991) *Syntax: A Linguistic Introduction to Sentence Structure*, 2nd edn, London and New York: Routledge.

Fromkin, Victoria, Robert Rodman and Nina Hyams (2003) *An Introduction to Language*, 7th edn; Boston, Massachusetts: Wadsworth Thomson.

Larson, Richard and Gabriel Segal (1995) *Knowledge of Meaning*; Cambridge, MA: MIT Press.

©Dr K.B. Kiingi,

Makerere University

P.O Box 7062 Kampala

Uganda

E-mail Address: kbalubuliza@arts.mak.ac.ug