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Contents

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Editorial

I am delighted to introduce the **12th edition of the ITB Journal**, the academic journal of the Institute of Technology Blanchardstown. In this issue of the journal we have the usual diverse, but interesting, mix of papers.

The first three papers are to do with the science of linguistic theory. The first paper explores elements of the reflexive and reciprocal constructions in Modern Greek within the theory of Role and reference Grammar, while the second paper provides, within the theory of cognitive linguistics, a cross-linguistic comparison involving a case study of Irish and Italian prepositions. The third lingustic paper looks at metaphorical semantics in Italian and Irish. The final and fourth paper is from a different science, that of engineering, and is concerned with an analysis of response of flexible pavements using finite element methods

Once again, we hope that you enjoy the papers in this issue of the ITB Journal.

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Reflexive and Reciprocal Constructions in Modern Greek*

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Abstract

This paper examines the various constructions that convey reflexivity and reciprocity in Modern Greek. Modern Greek reflexive and reciprocal constructions are characterized by a considerable degree of overlap between them, in the sense that they are structurally parallel to each other. More concretely, both reflexives and reciprocals in the language can be lexicalized through the addition of the non-active suffix -mai to a transitive verb; moreover, reflexivity and reciprocity can be syntactically realized by means of an active transitive verb followed by a pronominal that is referentially bound to an antecedent. Lastly, pronoun incorporation to a –mai verb constitutes another way of expressing reflexivity and reciprocity in the language, while in certain cases reflexivity/ reciprocity is inherently encoded in the semantics of individual verb predicates. The analysis is implemented within Role-and-Reference Grammar; the richness of the data, however, dictates the need for the enrichment of the framework. Specifically, the traditional Role-and-Reference Grammar organization structure is extended through the postulation of additional steps to the semantics-to-syntax derivational process and through the introduction of a feature-based analysis at the semantic level of representation. What is aimed in this way is a more thorough and effective analysis of the constructions under examination.

1. MG Reflexives and Reciprocals: Description

Reflexive and reciprocal constructions are closely correlated in Modern Greek (henceforth MG). At a semantic level, the surface subject of both reflexives and reciprocals in MG encodes not only agentivity, but also affectedness by itself (in the case of reflexives) or by a partner (in the case of reciprocals), which is, in essence, a crosslinguistic property of reflexive and reciprocal subjects (Shibatani 1985, pp.840-841).

Apart from the semantic correlation between reflexives and reciprocals in MG, it should be noted that there is also a considerable degree of syntactic overlap between them. Taking into account that a variety of structures can give rise to a reflexive or a reciprocal reading in MG, it will be illustrated that reflexive structures parallel reciprocal structures in their formation; besides, it is worth noting that reflexivity and reciprocity can be expressed under certain circumstances through the use of the same structure, thus giving rise to a potentially ambiguous interpretation. The discussion will firstly turn to an examination of MG reflexives.

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1.1 MG Reflexives

As Papangeli (2004, p.44) remarks, "at least three constructions in Greek give rise to reflexive reading…". In the majority of cases, MG reflexives are, following VanValin & LaPolla's (1997, p.393) terminology, lexical in nature; they are namely morphologically marked by the addition of the non-active[1] suffix *–mai*[2] to a transitive verb, thus leading to its detransitivization (1a, 1b, 1c, 1d, 1e). An alternative way of expressing reflexivity involves the prefixation of the reflexive pronoun *afto-* ('self') to a verb that already carries the suffix *–mai* (Mackridge 1987, p.88) (1f, 1g). Furthermore, a reflexive reading can also arise in MG when an active[3] transitive verb is followed by the full anaphoric pronoun *o eaftos mu* ('myself') in accusative case[4] that stands in a coreference relation with its antecedent (Tzartzanos 1946, p.239). Sentences *1h* and *1i* exemplify this structure, which is referred to as a 'coreference reflexive' or a 'plain reflexive' construction by VanValin & LaPolla (1997, p.396):

[1] Following Embick (2004), Alexiadou & Anagnostopoulou (2004) and Tsimpli (in press-b), the term 'non-active' morphology will be used in the present paper to refer to *-mai*, since it is more compatible with the various structures in which this suffix occurs in MG. *–mai* occurs namely in passives, anticausatives, middles, reflexives and reciprocals in the language.

[2] *-mai* is a 1st person singular present-tense suffix; the full paradigm of the MG non-active present-tense verbal suffix is provided below:

PERSON		
	SINGULAR	PLURAL
1ST	*-mai*	*-maste*
2ND	*-sai*	*-ste*
3RD	*-tai*	*-ndai*

[3] MG active present-tense verbal suffixes are shown in the following table:

PERSON		
	SINGULAR	PLURAL
1ST	*-o*	*-me*
2ND	*-eis/ -as*	*-te*
3RD	*-ei*	*-ne*

[4] The full paradigm of the anaphoric pronoun in accusative case is as follows:

PERSON		
	SINGULAR	PLURAL
1ST	ton eafto mu	ton eafto mas
2ND	ton eafto su	ton eafto sas
3RD	ton eafto *tu/ tis/ tu**	ton eafto tus

* *masculine/ feminine/ neuter*

(1)[5] a. Kitaxtike ston kathrefti.
look-3sg.past.non-act to the-acc.masc.sg. mirror
'S/he looked at herself/himself in the mirror.' (Mackridge 1987, p.88)

b. O athlitis proponeitai.
the-nom.masc.sg. athlete train-3sg.pres.non-act.
'The athlete trains himself.' (Tsopanakis 1994, p.356)

c. I nifi dithike
the-nom.fem.sg. bride dress-3sg.past.non-act.
'The bride got dressed.' (Tsimpli in press-a, p.12)

d. Xtenizomai sto kommotirio tis
comb-1sg.pres.non-act. at the-acc.neut.sg. hairdresser's the-gen.fem.sg.
geitonias.
neighbourhood
'I have my hair done at the hairdresser's in the neighbourhood."
(Tsimpli in press-a, p.13)

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[5] From a semantic perspective, MG reflexives can be either direct or indirect. Direct reflexives (see *1a*, *1b*, *1c*, *1f*, *1g*, *1h*, *1i*) are characterized by the volitionality as well as the direct affectedness of the chief participant (Kemmer 1993, p.205), while indirect reflexives denote an action where the agent and the beneficiary are coreferential but distinct entities (Kemmer 1993, p.74). With specific reference to MG indirect reflexives, they express, according to traditional grammarians (cf. Tzartzanos 1946, Tsopanakis 1994), situations where the subject is thought to do something for himself/ herself, or to something that s/he owns, through the mediation of a third participant (Tzartzanos 1946, p.240). Indirect reflexivity is syntactically expressed in the majority of cases through the use of *–mai* verbs (see *1d*, *1e*). It should be noted, however, that in certain contexts, even morphologically active verbs can have an indirect reflexive interpretation, as illustrated in the following examples:

a. Pigha sto kureio ki ekopsa ta
go-1sg.past.act. to the-acc.neut.sg. barber and cut-1sg.past.act. the-acc.neut.pl.
mallia mu.
hair my
'I had my hair cut at the barber.' (Tzartzanos 1946, p.245)

b. Ravo ena kostumi.
saw-1sg.pres.act. a-acc.neut. custome
'I have a costume made.' (Tsopanakis 1994, p.356)

e. Egrafomai sto panepistimio.
enroll-1sg.pres.non-act. in the-acc.neut.sg. university
'I am enrolled in the university.' (Tzartzanos 1946, p.240)

f. Aftokatastrefomai.
self destroy-1sg.pres.non-act
'I destroy myself.' (Theophanopoulou-Kontou, 1997, p.117)

g. Aftodhiafimizomai.
self advertise-1sg.pres.non-act
'I advertise myself.' (Theophanopoulou-Kontou, 1997, p.117)

h. Dino ton eafto mu.
dress-1sg.pres.act. the-acc.masc.sg self my
'I get dressed.' (Tzartzanos 1946, p.239)

i. Gimnazeis ton eafto su.
train-2sg.pres.act. the-acc.masc.sg. self your
'You train yourself.' (Tzartzanos 1946, p.239)

It is worth noting that the coreference reflexive of some verbs is used only for emphatic purposes (Tzartzanos 1946, p.244, Papangeli 2004, p.45) (2a, 2b), while the same construction constitutes the unique means of expressing reflexivity with deponent verbs[6] (2c). An emphatic reflexive interpretation can also be attained through the use of a non-active verb followed by the adjunct adjectival phrase *monos/ monaxos mu* ('by myself') predicating the subject (Tzartzanos 1946, p.244) (2d, 2e, 2f). Lastly, it should be mentioned that certain morphologically active verbs, like *girizo* ('to turn around'), *allazo* ('to change') and *gerno* ('to lean'), can acquire a reflexive meaning without being followed by an anaphoric pronoun (Tzartzanos 1946, p.245):

[6] Deponent verbs are verbs that are retrieved from the lexicon with the suffix *–mai*. The presence of *–mai*, however, is not associated with an affected surface subject; on the contrary, the surface subject of deponents is fully agentive in nature.

(2) a. Dhe gnorizeis ton eafto su.
not know-3sg.pres.act. the-acc.masc.sg. self your
'You don't know yourself.' (Tzartzanos 1946, p.244)

b. Edho o kosmos xanetai ki
here the-nom.masc.sg. world fall apart-3sg.pres.non-act. and
o Giannis plenei ton eafto tu.
the-nom.masc.sg. John wash-3sg.pres.act. the-acc.masc.sg. self his
'The world is falling apart and John is washing himself.'
(Papangeli 2004, p.46)

c. Lipamai ton eafto mu.
pity-1sg.pres.non-act. the-acc.masc.sg. self my
'I pity myself.' (Tzartzanos 1946, p.244)

d. Dhilitiriastike monos tu.
poison-3sg.past.non-act. own his
'He poisoned himself.' (Tzartzanos 1946, p.244)

e. Ligho eleipse na prodhotho monaxi mu.
little miss-3sg.past.act. to give away-1sg.subj.non-act. own my
'I have nearly given myself away.' (Tzartzanos 1946, p.244)

f. Skotothike moni tis.
kill-3sg.past.non-act. own her
'She killed herself.' (Mackridge 1987, p.88)

A final point that should be made concerns situations where a *–mai* verb is used instead of its active counterpart, although the latter could equally well convey a reflexive meaning. Following Theophanopoulou-Kontou (1999, p.152), the preference of *–mai* over the active morphology *–o* reflects a higher degree of subject affectedness, which triggers the characterization of such *–mai* forms as 'pseudoreflexives'. The verb *skorpizo/ skorpizomai* ('to spread') constitutes an example of this *–o*/ *-mai* alternation, where the latter verb form encodes greater subject affectedness than the former.

On the whole, it has become evident through the discussion in this section that the notion of 'reflexives' in MG includes a variety of structures associated with special semantics.

1.2 MG Reciprocals

MG reciprocals are structurally similar to reflexives; specifically, reciprocity is generally expressed by plural *–mai* verbs ((3))[7]. In addition, it should be noted that MG also has two overt markers of reciprocal semantics (Tzartzanos 1946, p.246), which correspond to what Kemmer (1993, p.103) refers to as 'light' and 'heavy' reciprocal markers. That is, the ancient reciprocal pronoun *allilo-* ('each other') can be incorporated to a non-active plural verb ((4)), or, alternatively, a singular or plural transitive verb is used in combination with the 'heavy' reciprocal marker *o enas ton allo*[8] (lit. 'the one the other') ((5)). For emphatic purposes, a structure consisting of a *–mai* verb followed by the adjunct prepositional phrase *metaksi mas*/ *sas*/ *tus* ('between (among) us/ you/ them') is used ((6)). Lastly, it is worth noting that some morphologically active verbs have an inherently reciprocal meaning (Tzartzanos 1946, p.246), as illustrated in examples *7a*, *7b* and *7c* below:

(3) a. Agaliazondai.
hug-3pl.pres.non-act.
'They hug each other.' (Tzartzanos 1946, p.241)

b. Tilefoniundai.
call-3pl.pres.non-act.
'They call each other.' (Papangeli 2004, p. 100)

c. Antamonomaste.
meet up-1pl.pres.non-act
'We meet up.' (Tzartzanos 1946, p.241)

d. Koitaxtikame sta matia.
look-1pl.past.non-act. into the-acc.neut.pl. eyes
'We looked into each other's eyes.' (Mackridge 1987, p.88)

[7] Singular non-active verbs may also convey reciprocal meaning when they take a collective noun as subject:
(ii) To zevghari filithike.
the-nom.neut.sg. couple kiss-3sg.past.non-act.
'The couple kissed.' (Mackridge 1987, pp.88-89)

[8] *O enas ton allo* is used with masculine subjects. Feminine and neuter subjects require the reciprocal pronouns *i mia tin alli* and *to ena to allo* respectively.

(4) a. **Allilo**ipostirizondai.
each other support-3pl.pres.non-act.
'They support each other.' (Tzartzanos 1946, p.246)

b. **Allilo**peirazomaste.
each other tease-3pl.pres.non-act.
'We tease each other.' (Mackridge 1987, p.89)

(5) a. Koitakse o enas ton allo kai
look-3sg.past.act. the-nom.masc.sg. one the-acc.masc.sg. other and
xamoghelasan.
smile-3pl.past.act.
'They looked at each other and smiled.' (Tzartzanos 1946, p.246)

b. Plisiazun o enas ton allo.
approach-3pl.pres.act. the-nom.masc.sg. one the-acc.masc.sg. other
'They are approaching one another.' (Mackridge 1987, p.89)

c. Dhe milane o enas **me ton allo**[9].
not talk-3pl.pres.act. the-nom.masc.sg. one with the-acc.masc.sg. other
'They don't talk to each other.' (Mackridge 1987, p.89)

(6) Ta adherfakia aghapiondane metaksi tus.
the-nom.neut.pl. siblings love-3pl.past.non-act among them
'The siblings loved one another.' (Tzartzanos 1946, p.246)

(7) a. Ine kairos pu xorisan.
be-3sg.pres. time that break up-3pl.past.act.
'They broke up with each other a long time ago.'
(Tzartzanos 1946, p.246)

b. Antamosame.
meet up-1pl.past.act.
'We met up.' (Mirambel 1988, p.132)

c. Dhosame xeria.
give-1pl.past.act. hands
'We shook hands.' (Tzartzanos 1946, p.247)

[9] Some verbs require that the reciprocal marker contain a prepositional phrase headed by an argument-marking preposition compatible with each individual verb.

To sum up, reciprocity can be expressed in MG in various ways, each of which is used to encode different semantic underpinnings.

On the basis of the data presented in 1.1 and 1.2, it can be concluded that reflexives and reciprocals are closely related in MG. That is, reflexivity and reciprocity are manifested syntactically in parallel ways. Besides, their correlation is best reflected in the fact that both notions can be expressed through the use of the same non-active verbal morphology. Taking into account that reciprocals are by default plural, it follows that "…Greek displays ambiguities when reflexive verbs are used with plural subjects" (Papangeli 2004, p.164). Examples of sentences that can have either a reflexive or a reciprocal reading are provided in (8) below:

(8) a. Oi kopeles xtenizondai.
the-nom.fem.pl. girls comb-3pl.pres.non-act.
'The girls are combing *their*/ *each other's* hair.'

(Tsimpli in press-a, p.13)

b. Ta pedhia vrexondan me ta lastixa.
the-nom.neut.pl. children throw water-3pl.past.non-act. with the-acc.neut.pl. hoses
'The children were throwing water *to themselves*/ *to each other* with the hoses.'

(Papangeli 2004, p.73)

Hence, as illustrated in the above sentences, the verbal *–mai* suffix can be ambiguous between a reflexive and a reciprocal interpretation[10]. The discussion will now turn to a Role-and-Reference Grammar account of MG reflexive and reciprocal constructions.

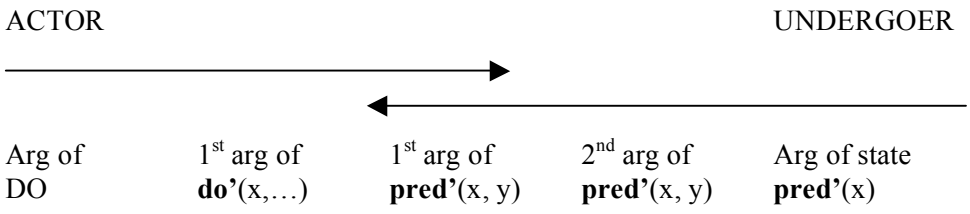
2. MG Reflexives and Reciprocals: Analysis

On the basis of the description of MG reflexives and reciprocals in the previous section as syntactically and semantically overlapping constructions, it is expected that their derivation within Role-and-Reference Grammar (henceforth RRG) will be accounted for in similar terms. The prediction is namely made that parallel MG reflexive and reciprocal structures are also derivationally similar.

Before turning to a closer examination of each of the constructions in question, a brief presentation of the traditional RRG machinery will be provided. RRG posits a single level of syntactic representation to which the semantic representation of a sentence is directly mapped

(VanValin & LaPolla 1997, p.21) by means of certain linking principles. Default linking, however, can be overridden in voice constructions, as dictated by the Privileged Syntactic Argument (henceforth PSA) modulation and the argument modulation features. Specifically, the PSA modulation voice allows a non-actor[11] argument to function as the syntactic pivot of the sentence; given the Actor-Undergoer hierarchy[12] presented in *Figure 1* below, it is usually the undergoer argument that is the primary topical participant in voice constructions, thus functioning as the syntactic pivot. The actor argument, on the other hand, appears in the clausal periphery or is entirely omitted, as postulated by the argument modulation voice (VanValin & LaPolla 1997, p.295).

***Figure 1*: The Actor- Undergoer Hierarchy**



(cf. VanValin 2004, p.12)

With more specific reference to reflexives and reciprocals, RRG bases its analysis of such constructions on the notion of o(bliqueness)-command, according to which an argument x o-commands another argument y in the argument structure list if x precedes y. More concretely, RRG posits the Obliqueness Condition within the Binding Domain which states that "an anaphor must be coindexed with a less oblique member of the same logical structure in the minimal S containing the verb" (cf. Nolan 2000, p.23). In addition, adopting Jackendoff's (1972) proposal that the antecedent must be higher than the reflexive/ reciprocal on the thematic relations hierarchy, the Role Hierarchy Condition on Reflexivization (and reciprocalization) is posited that is stated as follows:

Role Hierarchy Condition on Reflexivization:
The reflexive pronoun must not be higher on the following hierarchy than its antecedent:
Actor> Undergoer> Other

(VanValin 2001-b, p.7)

The analysis of MG reflexives and reciprocals presented below proceeds in accordance with the Obliqueness and the Role Hierarchy conditions; however, it should be

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[10] The disambiguation of sentences like *8a* and *8b* can be forced by the choice of adjuncts and contextual factors (Papangeli 2004, pp. 52, 97).

[11] Note that in ergative languages the undergoer constitutes the default syntactic pivot; thus, in voice constructions it is the actor that is promoted to the PSA position. Yet, MG being an accusative language, reference will be made throughout only to the alterations involved in languages of this type.

noted that this analysis is based on an extended version of the traditional RRG organization structure.

At the semantic level, it will be assumed that three steps are involved. Firstly, the retrieval from the lexicon takes place of the appropriate logical structure which contains abstract valency slots. At a next step, the construal of the specific event is achieved by means of full argument specification; and finally, the logical structure gets further modified by its adjustment to construction-specific operations of information packaging. *–mai* constructions, for instance, will be shown to involve argument deletion or obliqueness, thus resulting in single-argument logical structures, while plain reflexives and prototypical reciprocals will trigger argument coindexation. For reasons of convenience, these three steps at the level of semantic representation will be referred to as LS0, LS1 and LS2 respectively[13].

Once LS2 has been specified, it is then realized at the syntactic level. More concretely, at the next step upwards (S1), the linear sequence of the elements of the sentence is represented; yet, no further information will be assumed to be encoded at this step with respect to the sentential elements, their morphological properties being specified at the final overt S2 stage of the derivation. In other words, this two-step syntactic representation is assumed to provide all the information that in the traditional RRG account is conflated in the single morphosyntactic representation postulated.

As a final remark, it should be mentioned that, where necessary, a feature-decompositional approach will be adopted at LS0, in an attempt to represent formally the constraints pertaining to the predicate in each construction and to its arguments. In this way, a more fine-grained description of MG reflexive and reciprocal constructions will be attempted, thus enabling a more succinct capturing of their similarities and differences.

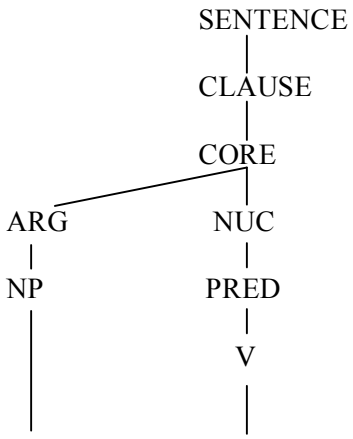
2.1 The Syntax of MG Reflexives

Focusing initially on *–mai* reflexives, (9 & 10) below illustrates the various steps underlying their derivation:

(9) O athlitis proponeitai.
the-nom.masc.sg. athlete train-3sg.pres.non-act
'The athlete trains himself.' (Tsopanakis 1994, p.356)

[12] RRG postulates two generalized semantic macroroles, Actor and Undergoer, the prototypes of which are the thematic relations of agent and patient respectively (VanValin & LaPolla 1997, p.143).
[13] This analysis constitutes, in essence, a more elaborated version of Vihman's (2004, p.iv) proposal that there are two levels of semantic representation "one in the lexicon, with abstract valency slots, and the other on a construction-specific level, with fully specified arguments".

(10)[14]



S1: [$_{CLAUSE}$ [$_{CORE}$ [$_{PSA}$ o athlitis], [$_{NUC}$ propono]]]

LS2: BECOME **proponimenos**'(o athlitis)

LS1: **do**'(o athlitis$_i$, [**propono**'([o athlitis]$_i$, o eaftos tu$_i$)])

LS0: **do**'(x_i [AGR [1]], [**propono**', (x_i, y_i [AGR [1]])])

This LS0 has two arguments in it, the leftmost one being the actor and the rightmost one the undergoer. At LS1 macrorole specification occurs, with *o athlitis* being mapped to actor and *o eaftos tu* to undergoer. Reflexivity arises in the sense that "…the second participant, the undergoer and object of the sentence, is pointing back reflexively to the first participant, the actor and its antecedent" (Nolan 2000, p.34). Besides, the reflexive reading is enforced by virtue of the fact that both arguments carry the same agreement features. Incidentally, it is worth noting that this reflexivity is well-formed, since both arguments are within the scope of predication of *propono*, and both the Obliqueness and the Role Hierarchy conditions are satisfied. However, M-transitivity[15] is reduced at LS2 from two macroroles to one by means of undergoer suppression. Thus, *o athlitis* surfaces at S1 in its default core-initial argument

[14] Following VanValin & LaPolla (1997, p.393), I will assume that reflexive elements "…appear in logical structure in the form that they will appear in the actually realized sentence, case marking aside". That is, the appropriate person, number and gender features will be present at LS1, while, similarly to other referring expressions, case marking specification will take place at S2.

Note, however, that nominative is chosen as the default case in which nominals derive from the lexicon. On this ground, all nominals in this and the following diagrams will by convention appear at LS in nominative case.

Moreover, the predicate following BECOME at LS2 is the passive perfect participle of the LS1 verb predicate. Hence, *proponimenos* in the above diagram, for example, is the passive perfect participle of the LS1 verb predicate *propono*. Participial predicates will appear throughout in the default nominative masculine singular form.

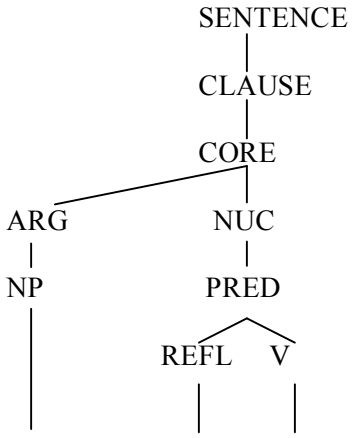
[15] "[T]ransitivity in RRG is defined in terms of the number of macroroles that a verb takes…" (VanValin 2004, p.12); RRG employs this term in order to distinguish between its semantically-based

position, while the reflexive interpretation remains intact through the addition at S2 of the non-active suffix to the verb, which "…has no function other than signalling that the actor and undergoer are the same participant" (VanValin & LaPolla 1997, p.395 for Lakhota)[16].

As for the derivation of *afto-* incorporation reflexives, it is represented in the following diagram:

(11) Aftokatastrefomai.
self destroy-1sg.pres.non-act
'I destroy myself.' (Theophanopoulou-Kontou, 1997, p.117)

(12)



S2: $\varnothing_i$ afto$_i$- katastrefomai$_i$

S1: [$_{CLAUSE}$ [$_{CORE}$ [$_{PSA}$ $\varnothing_i$], [$_{NUC}$ afto$_i$-, katastrefo]]]

LS2: BECOME afto$_i$- **katestrammenos**'($\varnothing_i$)

LS1: **do**'($\varnothing_i$, [**katastrefo**'($\varnothing_i$, afto$_i$-)])

LS0: **do**'(x_i [AGR [1]] , [**katastrefo**', (x_i, y_i [AGR [1]])])

Katastrefo is transitive in nature and, hence, LS0 has two arguments in it. The actor argument is specified at LS1 as Ø[17], while the reflexive clitic *afto-* takes the undergoer macrorole. Both macroroles are within the binding domain of the verb predicate and are thus linked together

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definition of transitivity and other theories' syntactic characterization of transitivity in terms of the number of syntactic arguments (S-transitivity) (cf. VanValin & LaPolla 1997, p.150).

[16] Emphatic reflexives (see *2d*, *2e*, *2f* in 1.1) will be assumed to involve the same linking procedures as those just described with respect to the derivation of (9 & 10) above. The only difference between the derivation of non-emphatic and emphatic *–mai* reflexives is that in the latter, as opposed to the former, an adjunct phrase headed by *monos* is inserted at LS2 which is coindexed with the subject of the sentence.

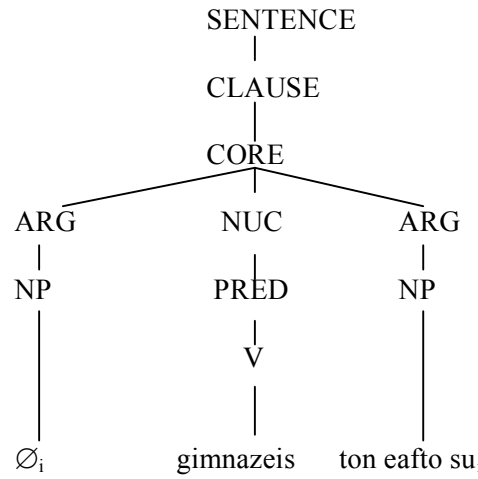
[17] Ø is used to symbolize a covertly realized (i.e. phonetically null) actor. Note that MG is a null subject language, where a phonetically null constituent is licensed in subject position by strong agreement features (cf. Chomsky 1995, p.77).

through a relation of reflexivity. Besides, the Obliqueness and the Role Hierarchy conditions are also satisfied, since the overtly null antecedent is less oblique and higher on the thematic hierarchy than the reflexive *afto-*. Furthermore, it is worth noting that actor and undergoer are identical in terms of phi-feature specification, which follows naturally from the reflexivity relation that holds between them. *Afto-* remains overtly present also at LS2; yet, as can be observed in (12), it does not occupy an argument position anymore, thus leaving the null actor as the single argument in the logical structure. As a result, a template with only one argument slot is selected, to which the null actor is mapped at S1. *Afto-*, on the other hand, is prefixed to the verb predicate; the latter gets at S2 the non-active suffix *–mai* attached to it, which encodes the reflexive interpretation at the syntactic level "…by interpreting the privileged syntactic argument as both actor and undergoer simultaneously…" (VanValin & LaPolla 1997, p.411). Of course, the presence of *afto-* enhances the reflexive reading of the sentence.

Turning to MG plain reflexives, the linking operations underlying their derivation are schematically represented in the following figure:

(13) Gimnazeis ton eafto su.
train-2sg.pres.act. the-acc.masc.sg. self your
'You train yourself.' (Tzartzanos 1946, p.239)

(14)



S1: [$_{CLAUSE}$ [$_{CORE}$ [$_{PSA}$∅$_i$], [$_{NUC}$ gimnazo], [$_{POST\text{-}NUC}$ o eaftos su$_i$]]]

LS2: **do**'(∅$_i$, [**gimnazo**'(∅$_i$, o eaftos su$_i$)])

LS1: **do**'(∅$_i$, [**gimnazo**'(∅$_i$, o eaftos su$_i$)])

LS0: **do**'(x_i [AGR [1]] , [**gimnazo**', (x_i, y_i [AGR [1]])])

At LS0 both an actor and an undergoer exist for the verb predicate *gimnazo*, which are specified at LS1 as Ø and *o eaftos su* respectively. The reflexive marker *o eaftos su* encodes, in turn, that both arguments share the same reference, thus giving rise to a relation of reflexivity between them. Moving to LS2, the undergoer is still overtly recorded; consequently, Ø and *o eaftos su* are linked to their default positions at S1, the former becoming the PSA and the latter surfacing in the immediately post-nuclear core argument slot. Finally, at S2 accusative case is assigned to the reflexive marker and active morphology is attached to the verb, thus resulting in (13) above.

Lastly, as mentioned in 1.1, reflexivity is occasionally expressed by active intransitive verbs. In such cases, reflexivity is not the result of any syntactic operations; on the contrary, it constitutes an inherent feature of the lexical semantics of individual predicates. Therefore, no special linking algorithm is at work in this case[18].

2.2 The Syntax of MG Reciprocals

As will be illustrated in the following discussion, reciprocal constructions are analogous to reflexive ones in terms of logical structure and syntactic representation, and of the underlying linking operations.

Firstly, as regards reciprocal constructions that are built around *–mai* predicates, their derivation proceeds as follows:

(15) Agaliazondai.
hug-3pl.pres.non-act.
'They hug each other.' (Tzartzanos 1946, p.241)

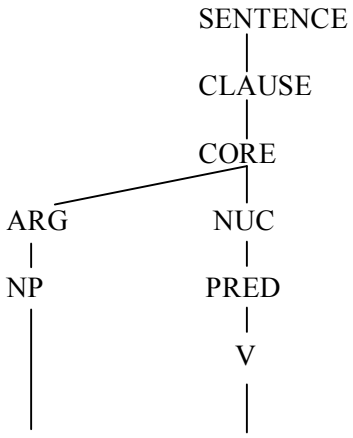
[18] As regards indirect reflexives, their derivation will be treated as being the same as that of their direct counterparts.

With reference to *-mai* indirect reflexives (see *1d*, *1e* in 1.1), on the one hand, their derivation involves identical linking operations to those involved in the derivation of direct reflexives. The only difference between them lies in LS0 specification; in the case namely of indirect reflexives, the actor argument will be assumed to carry a [-AGENCY] feature that is non-present at LS0 in (10). In other words, what is encoded in this way is that the direct reflexive actor carries a greater degree of agentivity than the indirect reflexive actor.

–o indirect reflexives (see *a*, *b* in footnote 5), on the other hand, constitute typical transitive constructions. In this respect, they resemble - in linking terms - the plain reflexive in (13 & 14); yet, the undergoer in indirect reflexives is not a reflexive marker and the actor argument bears the [-AGENCY] specification, which are the two properties that distinguish *–o* indirect from plain reflexives.

On the whole then, indirect reflexives are formally differentiated from direct ones by virtue of the LS0 [-AGENCY] feature that is present in the former but not in the latter.

(16)



S2: ∅ agaliazondai

S1: [$_{CLAUSE}$ [$_{CORE}$ [$_{PSA}$∅], [$_{NUC}$ agaliazo]]]

LS2: BECOME **agaliasmenos**'(∅)

LS1: **do**'(∅$_i$, [**agaliazo**'(∅$_i$, [o enas ton allo]$_i$)])

LS0: **do**'(x_i [AGR 2 [1 PER a, GEND b]], [**agaliazo**' [AGR 1 [NUM pl]] (x_i, y_i [AGR 2])])

Agaliazo is a transitive verb that takes two arguments at LS0, the actor x and the undergoer y. At the next derivational step, x is filled by Ø and y by the reciprocal marker *o enas ton allo*, both of which carry the same agreement specification. It is worth noting that the two macroroles are plural in number, thus agreeing with *agaliazo* that is necessarily marked as plural. In other words, plural agreement marking constitutes an obligatory requirement for the formation of reciprocal constructions. Reciprocity is well formed given that Ø is less oblique and higher on the thematic hierarchy than *o enas ton allo*[19]. Moving to LS2, the reciprocal marker gets suppressed; hence, a template with the single PSA slot is selected from the syntactic inventory, to which Ø is mapped at S1. The undergoer *o enas ton allo* is therefore covertly manifest in the syntax through the attachment at S2 of the non-active morphology to *agaliazo*, which serves to signal that "…any of the initiators of the action, the actors, can also be considered as the endpoint of the action, the undergoers" (Nolan 2000, p.36). Hence arises the reciprocity of (15) above[20].

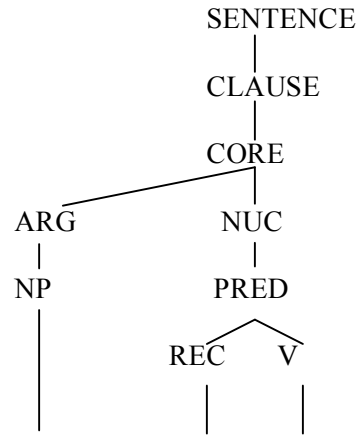
[19] Similarly to reflexives, the well-formedness of reciprocal constructions will be judged on the basis of the Obliqueness and the Role Hierarchy conditions.

[20] The same analysis can be applied to emphatic reciprocals (see (6) in 1.2). Their difference lies at LS2, where in emphatic reciprocals, as opposed to non-emphatic ones, an adjunct *metaksi* phrase is

With reference to *allilo-* incorporation reciprocals, their derivation is diagrammed in the following figure:

(17) Allilopeirazomaste.
each other tease-3pl.pres.non-act.
'We tease each other.' (Mackridge 1987, p.89)

(18)



S2: $\varnothing_i$ allilo$_i$- peirazomaste$_i$
S1: [$_{CLAUSE}$ [$_{CORE}$ [$_{PSA}$ $\varnothing_i$], [$_{NUC}$ allilo$_i$-, peirazo]]]

LS2: BECOME allilo$_i$- **peiraghmenos**'($\varnothing_i$)

LS1: **do**'($\varnothing_i$, [**peirazo**'($\varnothing_i$, allilo$_i$-)])

LS0: **do**'(x_i [AGR 2 [1 PER a, GEND b]], [**peirazo**' [AGR 1 [NUM pl]] (x_i, y_i [AGR 2])])

This LS0, similarly to the LS0 in (16) above, has two arguments in it, and the verb predicate carries plural agreement marking. x and y are specified at LS1 as Ø and the reciprocal clitic *allilo-* respectively. Given the anaphoric status of *allilo-*[21] and that both Ø and *allilo-* are in the scope of predication of *peirazo*, it follows that *allilo-* is bound by Ø. Thus, both arguments carry the same agreement features, while the Obliqueness and the Role Hierarchy conditions are also satisfied. At LS2 a single-argument logical structure is derived, since *allilo-* is no longer in an argument position. Consequently, the null actor is mapped at S1 to PSA, the reciprocal clitic being prefixed to *peirazo*. Non-active morphology is added to the verb at S2

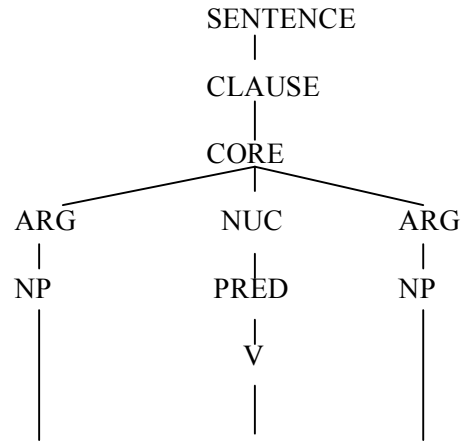
inserted, which is linked to the first conjunct of the logical structure by means of coindexation. This adjunct phrase is then mapped in syntax to a clause peripheral position and attributes an emphatic interpretation to the reciprocity conveyed.

and thus the reciprocal interpretation is encoded at the syntactic level; besides, the presence of *allilo-* also contributes to the reciprocity conveyed.

Turning now to *–o* reciprocals that are followed by the heavy reciprocal marker *o enas ton allo*, (19 & 20) below is illustrative of their underlying semantic representation and of the linking operations deriving their surface syntactic form:

(19) Plisiazun o enas ton allo
approach-3pl.pres.act. the-nom.masc.sg. one the-acc.masc.sg. other
'They are approaching one another.' (Mackridge 1987, p.89)

(20)



S1: [CLAUSE [CORE [PSA∅i], [NUC plisiazo], [POST-NUC [o enas ton allo]i]]]

LS2: **do**'(∅i, [**plisiazo**'(∅i, [o enas ton allo]i)])

LS1: **do**'(∅i, [**plisiazo**'(∅i, [o enas ton allo]i)])

LS0: **do**'(xi [AGR 2 [1 PER a GEND b]], [**plisiazo**' [AGR 1 [NUM pl]] (xi, yi [AGR 2])])

Given the transitivity of *plisiazo*, which bears plural agreement specification, two arguments are present at LS0. At LS1, Ø is mapped to the actor x and *o enas ton allo* to the undergoer y argument. In virtue of the reciprocal coreference it signals, *o enas ton allo* necessarily agrees with Ø in terms of case and phi-features. Besides, reciprocity is well formed since the Ø antecedent precedes the reciprocal marker in the argument structure list and is higher than it on the thematic hierarchy, thus satisfying the Obliqueness and the Role Hierarchy conditions respectively. Moving to LS2, *o enas ton allo* still occupies the undergoer position and,

[21] Following the generative tradition, RRG treats both reflexives and reciprocals as anaphoric in nature.

therefore, a template with two argument slots is selected. Ø and *o enas ton allo* are then mapped respectively to their default core-initial and core-final positions at S1, while the necessary morphological features are added at S2.

Finally, reciprocity constitutes an inherent property of certain morphologically active verbs (see (7) in 1.2); in such cases, however, it is purely lexical in nature and not the result of special linking operations.

3. Summary and Conclusions

On the whole, the discussion in this paper has shown that parallel reflexive and reciprocal constructions can be accounted for in similar terms within Role-and-Reference Grammar. All *–mai* reflexives and reciprocals were marked by argument reduction at LS2, *-mai*[22] and emphatic ones involving undergoer suppression and pronoun incorporation ones undergoer prefixation to the verb predicate. In *–o* reflexives and reciprocals, on the other hand, that are followed by *ton eafto mu* and *o enas ton allo* respectively, "…the [undergoer] is not understood and covert…but overt and explicitly represented…within the syntax" (Nolan 2000, p.50). Lastly, reflexivity and reciprocity sometimes constitute an inherent part of the semantics of some verbs.

In general, lexical cases aside, all reflexive and reciprocal constructions were found to be well accounted for in terms of the Obliqueness condition within the binding domain, the Role Hierarchy condition and the principles of the Role-and-Reference Grammar framework implicit in the analysis throughout. Of course, this analysis was based on an enriched version of the Role-and-Reference Grammar machinery; that is, the traditional Role-and-Reference Grammar organization structure was extended to include three stages (LS0, LS1, LS2) at the semantic and two stages (S1, S2) at the syntactic level of representation, while a feature-decompositional approach was implemented at the LS level. In this way, a more succinct description and comparison/ contrast of Modern Greek reflexive and reciprocal constructions was aimed at and apparently attained.

[22] Here in the restricted sense of reflexives and reciprocals that involve neither an emphatic adjunct phrase nor an incorporated pronoun.

References

Alexiadou, A. and E. Anagnostopoulou, 2004: "Voice Morphology in the Causative-Inchoative Alternation: Evidence for a Non-Unified Structural Analysis of Unaccusatives", in A. Alexiadou, E. Anagnostopoulou and M. Everaert (eds), *The Unaccusativity Puzzle: Explorations of the Syntax-Lexicon Interface*, pp.114-136. Oxford: Oxford University Press.

Chomsky, N., 1995: *The Minimalist Program*. Cambridge, Massachusetts: MIT Press.

Embick, D., 2004: "Unaccusative Syntax and Verbal Alternations", in A. Alexiadou, E. Anagnostopoulou and M. Everaert (eds), *The Unaccusativity Puzzle: Explorations of the Syntax-Lexicon Interface*, pp.137-158. Oxford: Oxford University Press.

Jackendoff, R. S., 1972: *Semantic interpretation in generative grammar*. Cambridge, Massachusetts: MIT Press.

Kemmer, S., 1993: *The Middle Voice*. Typological Studies in Language 23. Amsterdam/ Philadelphia: John Benjamins.

Mackridge, P., 1987: *The Modern Greek Language*. Oxford: Oxford University Press.

Mirambel, A., 1988: *I Nea Elliniki Ghlossa: Perighrafi kai Analisi*. S. Karatzas (transl). Second Edition. Thessaloniki: Manolis Triantafyllidis Foundation.

Nolan, B., 2000: "Reflexive and Reciprocal Constructions in Modern Irish", *ITB Journal* 2, pp.21-58.

Papangeli, D., 2004: *The Morphosyntax of Argument Realization: Greek Argument Structure and the Lexicon-Syntax Interface*. LOT Dissertation Series 86, Utrecht University.

Shibatani, M., 1985: "Passives and Related Constructions: A Prototype Analysis", *Language* 61, pp.821-848.

Theophanopoulou-Kontou, D., 1997: "Ta Mesa Ametavata Rimata tis Neas Ellinikis kai i Mesopathitiki Kataliksi" ("Middle Intransitive Verbs in Modern Greek and the Mediopassive Suffix"), in A. Moser (ed), *Proceedings of the 3rd International Conference on the Greek Language*, pp.114-122. Athens 1999: Ellinika Grammata.

Theophanopoulou-Kontou, D., 1999: "Dhomes tis Neoellinikis me Prooptiki tu Dhekti kai i Katanomi *–o/ -mai*: ta Antimetavivastika kai Pathitika" ("Patient-Oriented Constructions in Modern Greek and the *–o/ -me* Alternation: Anticausatives and Passives"), *Studies in Greek Linguistics: Proceedings of the 20th Annual Meeting of the Department of Linguistics, Aristotle University of Thessaloniki*, pp.146-157. Thessaloniki 2000.

Tsimpli, I. M., (in press-a): "I Foni stin Elliniki: Perighrafi tu Sistimatos kai Meleti tis Anaptiksis tu stin Elliniki os Mitriki kai Dhefteri/ Kseni Ghlossa" ("Voice in Greek: A Description of the System and a Study of its Development in Greek as Native and Second/ Foreign Language"), in S. Moschonas (ed), *Sintaksi*. Athens: Patakis Publishers.

Tsimpli, I. M., (in press-b): "The Acquisition of Voice and Transitivity Alternations in Greek as Native and Second Language", in S. Unsworth, T. Parodi, A. Sorace and M. Young - Scholten (eds), *Paths of Development in L1 and L2 Acquisition*. John Benjamins.

Tsopanakis, A. G., 1994: *Neoelliniki Grammatiki*. Thessaloniki: Kiriakidis Publishers.

Tzartzanos, A., 1946: *Neoelliniki Sintaksis (tis Koinis Dhimotikis)*. Vol.1. Second Edition. Athens: Orghanismos Ekdhoseos Dhidhaktikon Vivlion.

VanValin, R. and R. LaPolla, 1997: *Syntax: Structure, Meaning and Function*. Cambridge: Cambridge University Press.

VanValin, R., 2001-b: "Minimalism and Explanation", [electronic resource, available on the RRG website: linguistics.buffalo.edu/research/rrg.html].

VanValin, R., 2004: "Lexical Representation, Co-composition, and Linking Syntax and Semantics", [electronic resource, available on the RRG website: linguistics.buffalo.edu/research/rrg.html].

Vihman, V. A., 2004: *Valency Reduction in Estonian*. PhD Dissertation, University of Edinburgh.

Cross-linguistic comparisons: A case study involving Irish and Italian prepositions

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Abstract

Cross-linguistic comparison of unrelated or distantly related languages is often hindered by the lack of a one-to-one correspondence between the formal repertoires of the different languages. This article presents an example of such a situation, where the comparison of the Irish and Italian prepositional inventories is made impossible, on a formal basis, by the different sizes of the two sets of forms and the different semantic segmentation of the spatial-content continuum, i.e., the fact that one and the same form can express different concepts in a way that is cross-linguistically not always valid, and – conversely – that one and the same concept may be expressed by more than one linguistic form in a language and by just one in the other. A possible way of tackling this problem for the case at hand, based on a conceptual rather than formal comparison, is subsequently expounded. The aims of the comparison in point, that is, finding patterns of metaphorical sense extensions in the domain of Irish and Italian prepositions, are also explained.

1 Introduction

When comparing two or more languages with respect to a certain aspect of their grammar, one may find that the comparison is made difficult by the lack of a one-to-one correspondence between the elements of the grammatical system to be examined. This can be easily observed in the case of closed-class linguistic forms such as prepositions. In this article, which accounts for part of the analysis carried out in my MPhil dissertation (Frenda 2005), an example is presented of a situation where such difficulty arose, and the method is presented whereby I tried to solve the problem posed by the apparent incomparability of two systems.

Frenda (2005) is a comparative analysis of Irish and Italian aimed at accounting for the widespread polysemy that characterizes prepositions in terms of the theory of metaphorical semantics as defined and supported by George Lakoff. The fundamental idea with that research study is that the meaning of prepositions is primarily spatial and that metaphor works as a pervasive conceptual mechanism linking the different meanings of one and the same preposition in a motivated and principled way.

These ideas, brought forward by a number of works in the domain of cognitive linguistics (see section 2 below for an account), were to be tested against two different Indo-European languages, Irish and Italian. In order for this to be done, it was necessary to find a common ground for comparing the two systems.

2 Prepositions and polysemy: The metaphorical semantics account

The distinction between closed- and open-class forms is functionally exploited by Talmy (2000), who explains it in terms of the opposition between non-lexical and lexical forms respectively. Open-class (lexical) forms are typically represented by nouns and verbs: it

is normally the case that in a spoken language their number is constantly accrued by loanwords and the formation of neologisms. Closed-class (non-lexical) forms, on the other hand, are defined as being not easily augmentable in number – in other words, closed-class repertoires are not subject to being updated by borrowings or neologisms (also cf. Frenda 2005:22). Prepositions are a handy example of closed-class forms: in a language, the restricted set of prepositions and prepositional forms is rather frozen and not open to the introduction of new members.

For instance, technological development may bring along a series of lexical entries (nouns) to describe new devices and applications (IT has been, for the past century, an inexhaustible source of neologisms and cases of resemanticization[23]). On the other hand, it is highly unlikely that a new preposition be introduced to express a new kind of relation brought about by technology: for instance, no new preposition has been invented and introduced to express the relation between SENDER OF AN E-MAIL and RECEIVER OF AN E-MAIL – to the contrary, prepositions holding for relations between SENDER and RECEIVER of ordinary mail, like *from* and *to* in English, have been successfully applied to the new context.

Frenda (2005) examines precisely this aspect of prepositions, i.e. their capacity of expressing different kinds of relations, or in other words, their inherently polysemous character. By this definition, not only is it meant that polysemy is a characteristic of prepositions, but also that, by virtue of their highly schematic nature, prepositions are typically fit to describe a number of more specific situations sharing the same kind of general schema (cf. for instance Talmy 2000:162–4) – hence the claim of their *inherent* polysemy.

The starting point of my discussion, there, was the assumption that the basic meaning of each preposition is a spatial one; that is, prepositions primarily describe a relation in space between entities, and typically two of them: a more prominent (figure) and a less prominent one (ground).[24] The fact that prepositions are commonly employed to express relations of a non-spatial kind is explained – according to Lakoff (1993) – by the notion of *metaphorical sense extension*. According to this view – which Lakoff terms a theory of *metaphorical semantics* – sense extension is made possible thanks to a process of metaphorical mapping of conceptual structure from one domain (the basic one, i.e. space) to a new, less concrete domain (e.g. time, emotions, etc.; cf. Lakoff and Johnson 1980). This process allows for the human mind to employ well established and immediately understood conceptual schemes in order to make sense of abstract scenarios by setting up analogies between the basic and the non-basic. In Lakoff's terms, this is exactly what is called a *metaphorical mapping* of

[23] Cf. neologisms like *e-mail*, *internet*, *webspace* etc., and the resemanticization of existing words like *mouse*, *provider*, *portal*, etc.

conceptual structure: a concrete, spatial-like relation is used to make sense of a more abstract one thanks to some analogies that can be established between the two. For instance, a process of chronological succession of events like history or a person's life can be readily represented as a material experience, e.g. a journey (Lakoff and Turner 1989:61ff.), i.e. a progression on a path: analogies holding between life as chronological succession of events and life as voyage include BIRTH = STARTING POINT, DEATH = END OF JOURNEY, etc.

3 Finding common grounds for cross-linguistic comparison

It is a long-established tenet of linguistic typology that cross-linguistic comparisons should be based on parameters of meaning/function rather than on formal, language-dependent ones (cf. Croft 1990:11–8, Stassen 1985:14f.). The reason why it should be so is easily explained: by merely comparing formal structures, one will unavoidably exclude from the comparison those languages where a given formal structure is not found. On the other hand, if pragmatic functions are first singled out, one can compare the different formal structures that different languages employ in order to fulfil those functions. For instance, if the expression of spatial relationships were the issue, basing a cross-linguistic comparison on prepositions will lead to excluding from the analysis languages where such relationships are expressed by postpositions. In other words, one ought to allow for the structures to be compared cross-linguistically to be not necessarily coincident from a formal point of view, and rather choose them on a semantic basis – i.e., on account of their fulfilling a common function.

In our case, we set to compare two languages with respect to a formal structure that is known to be exhibited by both, that is, prepositions, in order to proceed further with the analysis of their metaphorical sense extensions. Now, although both languages do feature the class of prepositions, it was found that there was no one-to-one correspondence between the two prepositional inventories, the Irish and the Italian one. In fact, as far as simple prepositions go,[25] it was found that the Irish and Italian inventories for such prepositions, as retrieved from school grammars rather than specialized academic works,[26] differed in both size (number of items contained) and quality (semantic content), as shown by Tables 1 and 2.

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[24] The terms "figure" and "ground" were first used in this sense by Gestalt psychologists (cf. the account given by Zelinsky-Wibbelt 1993b:9). In linguistic studies, Langacker's (1987) terms "trajector" (for *figure*) and "landmark" (for *ground*) are also used.

[25] The definition of *simple* prepositions (as opposed to *complex* prepositions or *prepositional locutions*: cf. Lehmann 1998) is based on parameters of morphological simplicity and traditional grammar description: see Frenda (2005:28f.).

[26] Such as Mac Congáil (2004:62) for Irish, Sensini (1992:240) for Italian.

Followed by the nominative case:	**gan** 'without', **idir** 'between', **seachas** 'other than'
Followed by the dative case:	**ag** 'at', **ar** 'on', **as** 'out of', **chuig** 'to', **de** 'of', **do** 'to', **faoi** 'under', **go** 'to', **i** 'in', **le** 'with', **ó** 'from', **roimh** 'before', **thar** 'past', **trí** 'through', **um** 'about'
Followed by the genitive case:	**chun** 'to', **dála** 'as', **fearacht** 'as', **timpeall** 'around', **trasna** 'across'

Table 1: Simple prepositions as included in the Irish corpus (Frenda 2005:29).

di 'of', **a** 'at, to', **da** 'from', **in** 'in', **con** 'with', **su** 'on', **per** 'though, for', **tra/fra**[27] 'between'

Table 2: Simple prepositions as included in the Italian corpus (Frenda 2005:30).

That is, as can be easily seen by comparing Tables 1 and 2, not only does Irish exhibit more prepositions, so that a one-to-one correspondence is made a priori impossible, but the case also is that there is deep semantic incomparability between the two sets if individual forms from one language are to be compared to individual forms from the other.

To begin with, one language might have simple prepositions to express concepts that the other language entrusts to more complex forms: for instance, Italian has no simple preposition to express 'other than' (Irish *seachas*), and must resort to the complex form *oltre a*. At the same time, one language can entrust one form with more than one meaning whereas the other language keeps the two meanings lexically separate by employing two different forms; the converse is also possible, i.e., two or more forms might be indifferently be utilized to convey the same meaning. For instance, Italian *a* means both 'at' and 'to', whereas in Irish no preposition is found which expresses these two meanings: in fact, 'at' is translated by Irish *ag*, and 'to' is rendered by a number of forms including *chun*, *chuig*, *do*. The last observation

[27] *Tra* and *fra* are traditionally considered variants of the same prepositions (although historically they have developed from two different Latin prepositions, i.e., *intra* 'within' and *infra* 'under', respectively). Synchronically, they have no difference whatever in meaning and their choice seems to be only determined by euphony, to avoid the repetition of the same consonant cluster (e.g., ***tra fr****atelli* 'between brothers' is preferred to ***fra fr****atelli*, ***fra Tr****eviso e Venezia* 'between Treviso and Venice' to ***tra Tr****eviso e Venezia*): cf. Cortelazzo and Zolli (1980: s.v. *fra*; 1988: s.v. *tra*); Sensini (1988: p.216).

shows, in turn, how more than one form can be used to express one and the same concept in Irish.[28]

In order to make a comparison between the two sets possible, the meanings of the various prepositions were recovered from grammars (see above) and dictionaries (mainly Ó Dónaill 1977 for Irish, Zingarelli 1949 and The Oxford-Paravia Concise for Italian). Subsequently, their basic spatial meanings (BSMs for short) were isolated and compared, to be used as a reference for the cross-linguistic comparison. A graphic representation of the comparative analysis is shown in Figure I:

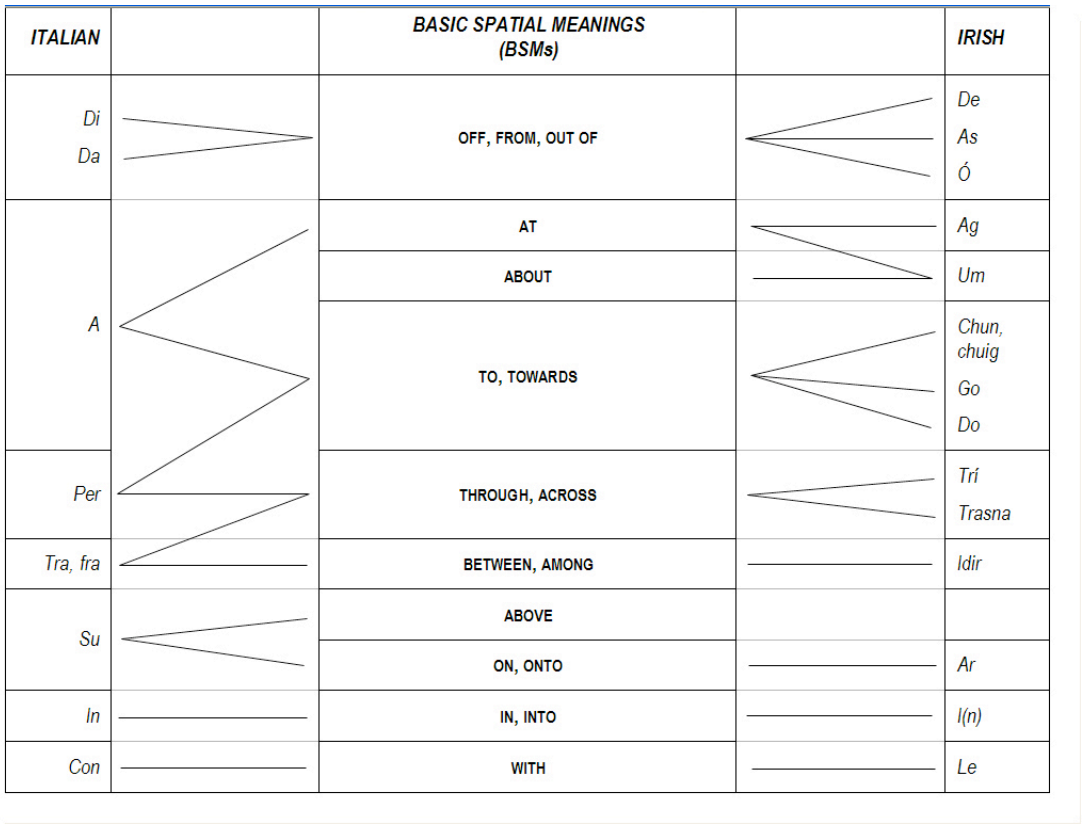

Figure I: Interrelationships between the basic spatial meanings of Italian (leftmost column) and Irish prepositions (rightmost column) (from Frenda 2005:33).

As can be seen in Figure I, eight of the Irish prepositions present in Table 1 (namely *dála*, *faoi*, *fearacht*, *gan*, *roimh*, *seachas*, *timpeall*, *thar*) were excluded from the comparison, as no semantic equivalents could be found for them among Italian prepositions. Only simple prepositions that had a comparable semantic core with one or more forms of the other language's repertoire were included.

[28] Besides, it might be the case that different forms express different shades of a concept that are thus kept formally distinct in a language but merged together in the other. This, at any rate, does not seem to be the case in Irish, were *chun/chuig*, *go* and *do* does not seem to differ on the basis of the selection of their objects (cf. Frenda 2005:40f.)

Therefore, what Figure I shows is an example of cross-linguistic comparison based on functional/semantic – rather than formal/lexical – criteria: a set of cross-linguistic correspondences between forms is set up through the medium of language-independent spatial concepts (our BSMs), which are not linguistic forms but abstract units of content. In other words, given a certain function, two or more linguistic forms from the two languages are associated on the basis of their common capability of being employed to carry out that function. For instance, Irish *de/as/ó* and Italian *di/da* can be associated in that all of them may be utilized to express SOURCE (i.e. the BSM FROM).

4 Conclusions

Cross-linguistic comparison on a formal basis may prove itself a difficult or impossible task, in that comparing language-specific structures will lead to excluding from the analysis those languages where a the same function is fulfilled by a formally different structure. To overcome this difficulty, one solution is to compare whatever kinds of linguistic forms are put into use by different languages in order to convey a certain semantic content.

Even when, like in our example, the same kind of linguistic structure does in fact exist in the two (or more) languages to be compared, it may be the case that their actual repertoires differ to various extents. Again, the same principle may be successfully applied and the two (or more) repertoires be compared via the correspondences that can be established on a semantic/functional basis between them.

References

Cortelazzo, M. and P. Zolli (1980) *Dizionario etimologico della lingua italiana. Vol. 2/D–H*. Bologna: Zanichelli

Croft, W. (1990) *Typology and universals*. Cambridge: Cambridge University Press

Ó Dónaill, N. (1977) *Foclóir Gaeilge-Bearla*. Dublin: Stationery Office

Frenda, A. S. (2005) *Metaphor and space: A cognitive-based analysis of Irish and Italian prepositions*. Unpublished MPhil dissertation. Trinity College Dublin

Lakoff, G. (1987) *Women, fire, and dangerous things: What categories reveal about the mind.* Chicago and London: The University of Chicago Press

— (1993) The Syntax of Metaphorical Semantic Roles. In *Semantics and the lexicon.* J. Pustejovsky (ed.) Dordrecht: Kluwer Academic Publishers: 27–36

Lakoff, G. and M. Turner (1989) *More than cool reason: A field guide to poetic metaphor.* Chicago and London: The University of Chicago Press

Lehmann, C. (1998) German abstract prepositional phrases. In *Clause combining and text structure.* I. Korzen and M. Herslund (eds.) Frederiksberg: Samfundslitteratur (Copenhagen Studies in Language, 22): 87–106. Available [online] from <http://www.uni-erfurt.de/sprachwissenschaft/personal/lehmann/CL_Publ/German_abstract_PPs.pdf> [18 October 2005]

Mac Congáil, N. (2004) *Irish grammar book.* Indreabhán, Conamara: Cló Iar-Chonnachta

The Oxford-Paravia Concise. Available [ondine] from <http://oxfordparavia.it> [18 October 2005]

Sensini, M. (1988) *La grammatica della lingua italiana: Guida alla conoscenza e all'uso dell'italiano scritto e parlato.* Milano: Arnoldo Mondadori Editore
— (1992) *Il sistema della lingua: Dalle parole al testo*. Milano: Arnoldo Mondadori Scuola

Stassen, L. (1985) *Comparison and universal grammar.* Oxford: Basil Blackwell

Talmy, L. (2000) *Toward a cognitive semantics. Vol. I*. Cambridge, MA: MIT Press

Zelinsky-Wibbelt, C. (ed.) (1993a) *The semantics of prepositions: From mental processing to natural language processing*. Berlin: Mouton de Gruyter.
(1993b) Introduction. In Zelinsky-Wibbelt (ed.): 1–24

Zingarelli, N. (ed.) (1949) *Vocabolario della lingua italiana. Settima edizione.* Bologna: Zanichelli

In italiano, as Gaeilge: A MATTER of metaphorical semantics

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Abstract

In the present article the linguistic expression of MATTER will be considered with regards to (a) the prepositions involved and (b) the basic spatial meanings (BSMs) of such prepositions. The analysis will concentrate on Italian and Irish. The motivations for the choice of the preposition(s) will be sought after in the theoretical frame provided by Lakoff's metaphorical semantics. In other words, we shall assume that the MATTER sense is a motivated extension of the spatial senses that primarily expressed by those prepositions. According to the above-mentioned framework, a preposition is chosen to express MATTER when there is a metaphorically (i.e., analogically) motivated link between its BSM and the MATTER sense. A sense extension of MATTER (that is, a further sense extension of the BSMs via MATTER) shall be then examined, which – in a way consistent with another widespread metaphor – justifies the employ of MATTER to express linguistic medium.

Abbreviations:

AUT	autonomous	OBJ	object pronoun
BSM	basic spatial meaning	OBL	oblique pronoun
COP	copula	PASSV	passive
DET	determiner	PERF	perfect
Eng.	English	PL	plural
FEM	feminine	POSS	possessive
IMP	imperative	PP	prepositional phrase
INF	infinitive	PPSTPTC	passive past participle
Ir.	Irish	SG	singular
It.	Italian	SUBJ	subject pronoun
lm	landmark	tr	trajector
MSC	masculine	VN	verbal noun

1 Introduction

As has been outlined in Frenda 2005b, in this journal, section 2, "metaphorical semantics" is what Lakoff (1993) calls an approach to linguistics based on the explanatory power of metaphor used as an interpretive tool. Such tool Lakoff had been sharpening and defining in a great deal of studies, culminating with Lakoff (1987) and the illuminating case studies contained therein. In particular, his analysis of the English preposition *over* and its extensive polysemy (ibid.: 416–61) was a model of primary importance for my own comparative analysis of Irish and Italian prepositions and metaphoric sense extensions thereof (Frenda, 2005a).

In the present article a brief presentation will be given of the means employed by Irish and Italian to express the MATTER relations, drawing on the material presented in Frenda (2005a).

2 A characterization of MATTER as a sense extension

The MATTER relation is a linguistically expressed relation between figure and ground (or tr[ajector] and lm [landmark]: cf. Frenda 2005b: section 3 and footnote 2) whereby the latter designates the matter *of* which the former is made. In English, a way of expressing such relation is the preposition *of*, but other ways also exist, e.g. denominal adjectives or nouns used in apposition, as examples (1–3) respectively illustrate:

(1) This ring is made *of gold*.
(2) A *golden* watch was found yesterday.
(3) He grasped the *brass* knob and opened the door.

We will be concerned here with just the first kind of MATTER expressions, those realized by means of a prepositional phrase.

According to the premises of Lakoff's (1993) metaphorical semantics, as has been recalled in Frenda 2005b, section 2, metaphorical mappings are responsible for the sense extensions linking the interrelated meanings of polysemous items. In our case, metaphorical mapping provides a motivation for quite different conceptual relations to be expressed by one and the same preposition, as Lakoff (1993:27) illustrates with the two meanings of *through* (a spatial and a "social" one, respectively) in *I drove through the tunnel* and *I got my job through my uncle*.

It has also been observed (Lakoff and Johnson, 1980:59; Talmy, 2000a:179; Sweetser, 1990:18, 27ff. and passim; Zelinsky-Wibbelt, 1993a:4) that where sense extensions occur by means of metaphor, they normally go from concrete to abstract rather than the other way round, and that space is the most basic and concrete domain, upon which other kinds of less concrete relations may be modelled by means of metaphorical mapping. Lakoff and Johnson (1980:56) claim that simple spatial concepts, like UP, are more likely than others to be grasped directly (i.e. without resorting to metaphorical ways of understanding) because they come from daily, physical experience, and can therefore provide the basis upon which more or less abstract sense extensions can be built, while Levinson (2003:xvii) states that

> [s]patial cognition is at the heart of our thinking. It has long been noted that spatial thinking provides us with analogies and tools for understanding other domains, as shown by the efficacy of diagrams, the pervasive spatial metaphors of everyday language, the evocativeness of place in memory … Spatial cognition probably plays this central role because it seems to be the evolutionarily earliest domain of systematic cross-modal cognition: any animal needs to relate what its eyes, ears and limbs tell it about the immediate structure of the world around it. (Levinson, 2003:xvii)

Therefore, where prepositions have a spatial meaning among other, non-spatial ones, we shall accordingly assume that the latter are related to the former in a way that is motivated by the occurrence of metaphorical sense extensions.

3 MATTER in Irish and Italian

3.0 outline

In the next two sections we shall examine how Irish and Italian express the concept of MATTER. In particular, we shall focus on both (a) what BSMs MATTER is a sense extension of in each language and (b) what prepositions are involved in its expressions. In order to do so, each section will have the following structure: first, a few examples will be presented of MATTER expressions (the examples will be sorted out according to the preposition employed). Then, each preposition will be considered in respect of what BSM(s) it corresponds to.

Our examples are drawn from the Irish and Italian corpora of Frenda (2005a: Appendices B and C). The methodology and sources employed for the purposes of their setting up are explained in Frenda (2005a:28–32).

3.1 irish

Irish has two prepositions at its disposal to express MATTER: *de* and *as*, as shown in example (4) and (5) below, respectively:

(4) A. *tá* *sé* *déanta* ***de*** *phrás*
be SUBJ:3SG.MSC make.PPSTPTC **out of** brass
'it is made of brass'
(Christian Brothers, 2004:135)

B. *rinneadh* *gual* ***dem*** *chroí*
make.PAST.AUT charcoal **out of.POSS:1SG** heart
'my heart was seared' (lit. 'charcoal was made out of my heart')
(Ó Cíosóig, 1997:8)

(5) A. *Rud* *a* *dhéanamh* ***as*** *cré*
thing to make.VN **out of** clay
'To make something from clay'
(Ó Dónaill, 1977: s.v. *as*)

B. *abair* ***as*** *Gaeilge* *é*
say.IMP.2SG **out of** Irish OBJ:3SG.MSC
'Say it in Irish'
(Christian Brothers, 2004:136)

Whereas both (4) and (5.A) make sense as physical descriptions,[29] (5.B) does not. That is, no physical image is evoked by (5.B) in that no object and no material appear as the tr and lm respectively. Here, the MATTER relation is extended to express LINGUISTIC MEDIUM, according to Reddy's (1979) CONDUIT METAPHOR, which views communication as the process of packing objects (i.e., messages) into apt containers (i.e., linguistic expressions) and sending them to the receiver, who is in charge of unpacking (i.e., decoding) them. It is the CONDUIT METAPHOR, as Reddy argues, that motivates expressions such as *Try to put more meaning into fewer words* and many others, of which he gives an ample repertoire. Since – according to this metaphor – messages are objects, and the same message can assume different realizations if expressed in different languages, then languages can be thought of as the different materials that a message can be made of, so that it might retain the same function, but look (or sound) different. Therefore, LANGUAGE IS THE MATTER MESSAGES ARE MADE OF is a perfectly well motivated rider of the CONDUIT METAPHOR (Frenda, 2005:138).

Both *de* and *as* express the BSM OFF/FROM/OUT OF, that is one that can be characterized – following Talmy's (2000b:55) "Ground's Conformations" and Dirven's (1993:73f.) classification of English preposition – as basically expressing *separation* (also cf. Frenda, 2005a:107–8), as the English glosses and translations also show. A few examples of their spatial usages are given in (6) and (7) below:

(6) A. *Tóg* ***den*** *chathaoir* *é*
lift.IMP.2SG **off.DET** chair OBJ:3SG.MSC
'Lift it off the chair'
(Mac Congáil, 2004:70)

B. *ribe* ***d'*** *fhéasóg* *an* *fhir*
hair **from** beard DET man.GEN
'a hair from the man's beard'
(Mac Congáil, 2004:69)

(7) A. ***as*** *a* *teach*
out of POSS:3SG.FEM house
'out of her house'
(Mac Congáil, 2004:67)

[29] It does not matter, here, that the image described by 4.B has no factual reference to the current state of affairs within which it is uttered, since it is an Irish idiomatic set expression meant to evoke the emotional sphere. Of course, this set expression too is analyzable and explicable in terms of metaphorical semantics.

B. *Tóg* ***as*** *seo* *é*
take.IMP.2SG **from** here OBJ:3SG.MSC
'Take it away from here'
(Christian Brothers, 2004:136)

As can be seen, *de* seems to focus on the OFF and FROM aspects of the BSM, i.e., respectively, separation as loss of contact (OFF) and origin (FROM); *as*, on the other hand, focuses on the OUT OF and FROM aspects, where OUT OF emphasizes the enclosure-like conformation of the origin (lm).

3.2 italian

Two prepositions are available for the purpose of expressing MATTER relations in Italian too, but two distinct BSMs are involved. The two prepositions, as can be seen in examples (8) and (9), are *di* and *in*:

(8) A. *un* *palazzo* ***di*** *metallo* *con* *una* *sfera*
one building **of** metal with one sphere
di *vetro*
of glass
'a building made of metal, with a glass sphere'
(Calvino, 1992:381)

B. *rocce* ***di*** *basalto*
rocks **of** basalt
'rocks of basalt'
(Calvino, 1992:394)

(9) A. *rilegature* ***in*** *pergamena*
bindings **in** parchment
'parchment bindings'
(Calvino, 1992:394)

B. *[tracciati]* *segnati* ***in*** *inchiostri* *di*
[routes] draw.PPSTPTC.PL **in** inks of
diverso *colore*
different colour
'[routes] drawn [on a map] by means of many-coloured inks'
(Calvino, 1992:434)

C. *dimmelo* ***in*** *inglese*
say.INF-OBL:1SG-OBJ:3SG.MSC **in** English
'tell me in English'
(*DII*:1921, s.v. *in*)

Before moving on to examine the BSMs of the two Italian prepositions, we would like to point out examples (9.B, C). (9.B) is peculiar in that the preposition *in* (as the English translation would also suggest) is used in a sense that can be considered something in between MATTER proper and MEANS: inks, pencils and such – as opposed, for instance, to brushes – are *used up* as they are employed. Therefore, whereas a brush can be considered as a mere instrument, inks and such are both the means and the matter. In Italian, only the latter kind of MEANS (or MATTER/MEANS) may be expressed by the preposition *in*, as the unacceptability of (9.B′) below shows:

(9) B′. **[tracciati]* *segnati* ***in*** *pennelli di* *diversa* *grandezza*
[routes] draw.PPSTPTC.PL **in** brushes of different size
'[routes] drawn [on a map] by means of brush of different sizes'
(Frenda, 2005:60)

A correct alternative would be a PP governed by *con* 'with' (***con*** *pennelli di diversa grandezza*) (Frenda, 2005:60).

As to (9.C), the same observations hold as we have already stated in 3.1 about example (5.B), i.e., an expression of MATTER is being employed to specify LINGUISTIC MEDIUM according to the CONDUIT METAPHOR (notice that the preposition *in* is also employed in English for the same purpose).

Two very different BSMs are conveyed by *di* and *in*: referring back (Frenda 2005b**,** Figure I), they are OFF/FROM/OUT OF and IN(TO) respectively. We have already been considering the former in 3.1, and it was observed that its BSM is SEPARATION. Deferring for a moment the discussion relative to It. *in*, we shall see a few examples concerning the spatial use of *di*:

(10) A. *Andiamo* ***di*** *città* *in* *città*
go.1PL **from** town to town
'We go from town to town'
(Sensini, 1988:210)

B. *Il* *più* *bravo* ***della*** *squadra* *è stato premiato*
DET more good **from.DET** **team** award. PERF.PASSV.3SG
'The best member of the team was given a prize'
(Sensini, 1988:209)

Whereas in (10.A) *di* expresses SEPARATION proper, in (10.B) a very close extension of SEPARATION is expressed, which still falls within the spatial domain and is commonly termed

PARTITIVE. The link between SEPARATION and PARTITIVE was indicated in Frenda (2005a:121f.) in the act of singling/carving out *x* (tr) from *X* (lm), an act that may consist in either a physical separation of the formerly undivided whole (as in *Have a piece of cake!*) or the psychological process of concentrating one's attention on *x* as *separate*, distinct from *X*.[30]

As regards IN(TO), Talmy (2000b:55) and Dirven (1993:73f.) categorize it as a *basic* spatial relation. In Frenda (2005:37), IN(TO) was described as evoking a lm which has certain boundaries within which tr is located (static) or ends up being located after a movement (dynamic) – cf. *Your toys are in the box* vs. *Put your toys in(to) the box*. In other word, the BSM may be dubbed as one of static or dynamic INCLUSION. Examples (11.A, B) will illustrate the static and dynamic aspect respectively:

(11) A. *fare* *il* *bagno* ***nella*** *vasca* *di* *un* *giardino*
do.INF DET bath **in.DET** pool of one garden
'take a bath in a garden pool'
(Calvino, 1992:364)

B. *devi* *entrare* ***nelle*** *scuderie*
must.2SG enter.INF **into.DET** stables
'you must go into the stables'
(Calvino, 1992:395)

3.3 motivations for the sense extension

Having seen by means of which prepositions the MATTER relation is expressed in Italian and Irish, and which BSMs are associated with such prepositions, we shall now look into the reasons why the BSMs OFF/FROM/OUT OF and IN(TO) associate with MATTER – in other words, what motivates the sense extensions of the two BSMs in question as ways of expressing the MATTER relationship between tr and lm.

3.3.1 A *matter* of separation. The sense extension of SEPARATION to express MATTER is cross-linguistically common: we have seen it in English, Irish and Italian. A discussion of this topic is found in Lakoff and Johnson (1980:72–5), where the metaphor THE OBJECT COMES **OUT OF** THE SUBSTANCE is taken into account together with its mirror-image counterpart THE

[30] PARTITIVE singles element x_i *out of* a set *X* comprised of elements $x_1, x_2, \ldots, x_n$, all interchangeable with x_i and with one another with respect to a common property (i.e., their belonging to *X*). The PARTITIVE function can also be taken as extracting a portion *x* out of some mass *X*, where the size of the portion taken, as well as the precise region of *X* it is taken from, are not determined by *X*'s properties (cf. *a cup of tea*, *a spoonful of flour*) (Frenda, 2005a:122).

SUBSTANCE GOES **INTO** THE OBJECT (which the authors illustrate with *I made a statue **out of** clay* and *I made the clay you gave me **into** a statue*, respectively):[31]

> We conceptualize changes of this kind – from one state into another, having a new form and function – in terms of the metaphor THE OBJECT COMES OUT OF THE SUBSTANCE. This is why the expression *out of* is used in the above examples: … the statue is viewed as emerging out of the clay. … the substance clay is viewed as the CONTAINER (via the SUBSTANCE IS A CONTAINER metaphor) from which the object – namely, the statue – emerges .(Lakoff and Johnson, 1980:73)

3.3.2 A *matter* of inclusion. Whereas a handy and well-studied motivation was available – as we have just seen – for the SEPARATION → MATTER sense extension, a motivation for the INCLUSION → MATTER sense extension is not easily available. As noted in Frenda (2005:59), a similar English construction is used – as shown in (12) to mark INHERENT PROPERTY:

(12) This shirt is very nice. Does it come **in** red/**in** a larger size?
(Frenda, 2005:59)

The PPs *in red/in a larger size* express qualities of the shirt that are inherent to it, that is, qualities that may not be altered. MATTER, too, is an inherent property, and it is possible to find it expressed by an *in*-PP in the same English construction with *come* (13):

(13) This jacket comes **in** both tweed and wool.
(Frenda, 2005:59)

Having said that, it remains to be explained what motivates the association between the spatial sense of INCLUSION conveyed by the preposition *in* and the metaphorical sense of MATTER.[32] Further investigations, to consist in cross-linguistic comparison of a cross-linguistically wider range of material, will – we believe – prove of crucial importance to this goal.

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[31] It is important not to take examples such as *make the clay into a statue* for instances of the sense extension IN(TO) → MATTER. The difference between the two conceptual types is evident: whereas in the type *make the clay into a statue* the *in*-PP has the artefact NP as its object (*statue*), in the type we are considering the PP would take as its object the matter NP (*clay*).

[32] It has been observed (Sheerin, 1996:146) that the instrumental sense of the preposition *in* was introduced into Latin (and, hence, into other European languages) as a result of heavy syntactic calques from Hebrew, which came with the first translations of the Bible (also cf. Collins, 1985:50; Palmer, 1954:188). In Biblical Hebrew (Waltke and O'Connor, 1990:196–9), the preposition *b* had the (בְּ) spatial meaning of INCLUSION and was also employed to express instruments and "the material with which an act is performed", as in *He overlaid the floor of the temple **with** [*בְּ =]*boards of cypress* (1 Kgs 6:15) (ibid.: 197). Having said that, though, we have only shifted the problem back in time, the reason why Biblical Hebrew associates INCLUSION with MATTER/MEANS being left unexplained.

4 Conclusions

Drawing upon the analyses carried out in Frenda (2005), we have gone through a brief survey of the prepositional expressions employed by Irish and Italian to express the relation of MATTER ("tr is made *of* lm, a tr *of* lm"), finding that two BSMs, roughly labelled SEPARATION and INCLUSION, were involved. It was observed, too, that whereas the former was common in both the languages, the latter was employed in Italian only. We have also seen that English, employed in the discussion and for the purpose of glossing the linguistic material, sided with Italian in employing both SEPARATION and INCLUSION for the expression of MATTER. To recap, three languages out of three commonly utilize SEPARATION for the purpose under debate, while INCLUSION is used by two out of three.

After giving a few examples of both the extended sense and the basic, spatial one, we set to look into what motivations there were for these two BSMs to develop a sense extension as a means of expressing MATTER. Whereas an explanation was easily found for one sense extension, i.e. SEPARATION → MATTER, which had already been examined by Lakoff and Johnson (1980), we were not able to find any justification for the second sense extension, i.e., INCLUSION → MATTER, and left the problem to further investigation.

However, we took the opportunity to look into a further sense extension of MATTER, i.e. LINGUISTIC MEDIUM, which was alluded to in the title of this article. Our purpose in doing so was to show the recursive nature of metaphorical sense extensions: the use of Ir. *as*, It. *in* to introduce the indication of linguistic code was *not* taken to stem directly from SEPARATION or INCLUSION, i.e., from a BSM, but rather to develop from a sense extension thereof, namely MATTER, via the well-known CONDUIT METAPHOR.

References

Calvino, I. (1992) *Romanzi e racconti II.* Milano: Mondadori

Christian Brothers – The Irish Christian Brothers (2004) *New Irish grammar*. Dublin: C J Fallon

Collins, J. F. (1985) *A primer of Ecclesiastical Latin*. Washington, D. C.: The Catholic University of America Press

DII: Dizionario inglese italiano, italiano inglese (2001) [Torino]: Paravia e Oxford University Press

Dirven, R. (1993) Dividing up physical and mental space into conceptual categories by means of English prepositions. In Zelinsky-Wibbelt (ed.): 73–97

Frenda, A. S. (2005a) *Metaphor and space: A cognitive-based analysis of Irish and Italian prepositions*. Unpublished MPhil dissertation. Trinity College Dublin

Frenda, A. S. (2005b) *Cross-linguist comparisons: A case study involving Irish and Italian prepositions. ITB Journal Issue 12 - Dec 2005. Available for download from:* http://www.itb.ie/site/researchinnovation/itbjournal.htm

Lakoff, G. (1987) *Women, fire, and dangerous things: What categories reveal about the mind.* Chicago and London: The University of Chicago Press

— (1993) The Syntax of Metaphorical Semantic Roles. In *Semantics and the lexicon.* J. Pustejovsky (ed.) Dordrecht: Kluwer Academic Publishers: 27–36

Levinson, S. C. (2003) *Space in language and cognition: Explorations in cognitive diversity*. Cambridge: Cambridge University Press

Ó Cíosóig, M. (1997) *Annagael*. Dublin: Coiscéim

Ó Dónaill, N. (1977) *Foclóir Gaeilge-Bearla*. Dublin: Stationery Office

Mac Congáil, N. (2004) *Irish grammar book.* Indreabhán, Conamara: Cló Iar

Palmer, L. R. (1954) *The Latin language*. London: Faber and Faber Limited

Reddy, M. J. (1979) The conduit metaphor: A case of frame conflict in our language about language. In *Metaphor and thought*. A. Ortony (ed.) Cambridge: Cambridge University Press: 284–324

Sensini, M. (1988) *La grammatica della lingua italiana: Guida alla conoscenza e all'uso dell'italiano scritto e parlato.* Milano: Arnoldo Mondadori Editore

Sheerin, D. (1996) Christian and biblical Latin. In *Medieval Latin: An introduction and bibliographical guide*. F. A. C. Mantello (ed.) Washington, D. C.: The Catholic University of America Press

Sweetser, E. (1990) *From etymology to pragmatics: Metaphorical and cultural aspects of semantic structure*. Cambridge: Cambridge University Press

Talmy, L. (2000a) *Toward a cognitive semantics. Vol. I.* Cambridge, MA: MIT Press

— (2000b) *Toward a cognitive semantics. Vol. II.* Cambridge, MA: MIT Press

Waltke, B. K. and M. O'Connor (1990) *An introduction to Biblical Hebrew syntax*. Winona Lake, IN: Eisenbrauns

Zelinsky-Wibbelt, C. (1993a) Introduction. In C. Zelinsky-Wibbelt (ed.): 1–24

— (ed.) (1993b) *The semantics of prepositions: From mental processing to natural language processing.* Berlin: Mouton de Gruyter

ANALYSIS OF RESPONSE OF FLEXIBLE PAVEMENTS USING FINITE ELEMENT METHOD

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Abstract

The characteristic response of flexible pavements under traffic load depict a delayed lateral strain relaxation (Viscoelasticity), a phenomenon that may be more accurately and expeditiously analysed using finite element (FE) viscoelastic response models. In this study a flexible pavement was modelled using ANSYS/ED finite element software suite. The pavement model was subjected to cyclic loading that simulated three levels of truck loads on 10R20 tyres at four tyre inflation pressures (viz. 350,490,630 and 770 kPa). The modelled results were in good agreement with the measured in-situ full-scale test data. Therefore, for known pavement material characteristics and tyre-pavement contact regime, finite element method could be used to efficiently estimate the fatigue life of flexible pavement with thin bituminous surfacing layers.

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Introduction

Characteristic response of in-situ bituminous pavement layers, due to vehicular loading has been extensively studied (Huhtala et al., 1990, Hartman, 2000, Owende et al., 2001). The results depict a delayed lateral strain relaxation (viscoelasticity) which varies with lateral position of wheel loads on a pavement (Fig. 1), and truck operational parameters such as tyre inflation pressure and axle load. For trucks with multiple axles, such viscoelastic paving material behaviour may lead to accumulation of strain (Huhtala et al., 1989) and therefore accelerated pavement distress, i.e., defects on the pavement surface (fatigue cracking and potholes) or substratum (rutting/heaving), which may limit their serviceability (Martin et al., 2000) and eventually causing failure.

Pavement failure is determined by criteria based on longitudinal rutting or fatigue cracking in the wheel tracks (Cebon, 2000). However, large elastic deflections on thin pavements with weak foundations cause fatigue failure (cracking) that undermine the substructure before appreciable rutting has occurred; hence, fatigue cracking is the limiting criterion. Structural performance of a flexible pavement is therefore primarily affected by factors that influence the critical tensile strain at the bottom of the surfacing layer (Ullitdz, 1987). For any given pavement attributes, the axle load, axle configuration, suspension type, and tyre inflation pressure will all affect the magnitude and distribution of stresses, strains, and displacements in its structure (Owende et al., 2001).

The objective of this study was therefore to model pavement response due to the transient traffic loads and the time dependency of material properties, considering the viscoelastic characteristics of bituminous materials. In order to verify the efficiency of the model, the predicted response was to be compared to accurately measured in-situ response data for such a pavement.

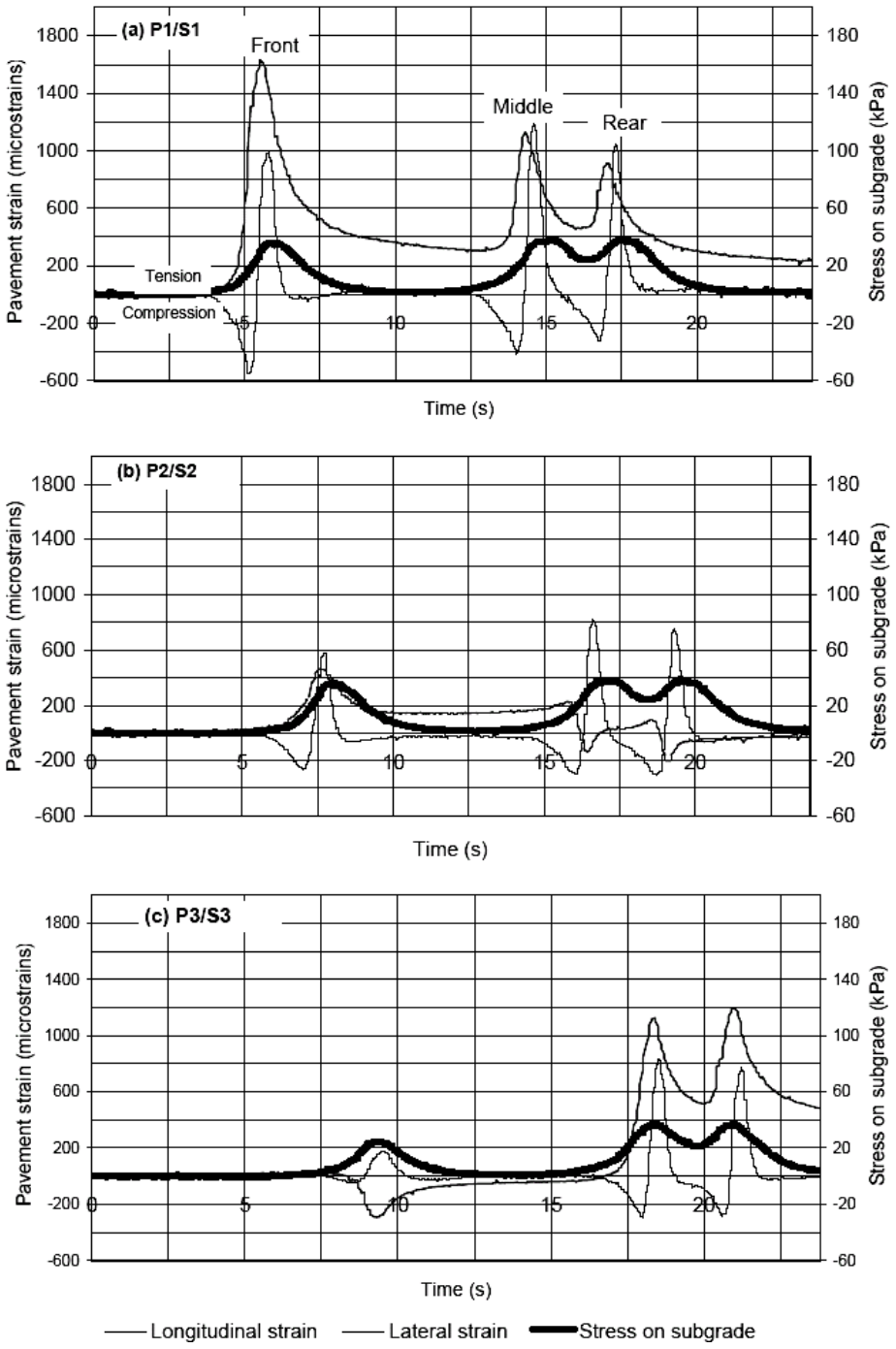

Fig. 1. Illustration of pavement response output of longitudinal and lateral strains, and stress on the subgrade corresponding to three lateral positions on a wheel track. The magnitudes correspond to single front wheel, dual middle wheel, and dual rear wheel loads of 31.7, 44.6, and 44.1 kN, respectively, and tyre inflation pressure of 630 kPa (Owende et al., 2001)

Materials and Methods

Pavement model and loading conditions

The pavement model considered in this study consisted of 50 mm of asphalt layer of Dense Basecourse Macadam (DBM), 200 mm of crushed rock base, and 400 mm of sandy gravel subbase overlaid on a subgrade of peat. Illustration in Fig. 2 depicts the cross-section of the experimental road from which the model verification data was derived. Owende et al., 2001 details the experimental conditions and precautions that were implemented to assure integrity of the in-situ experimental data used in the verification of the finite element model in this study.

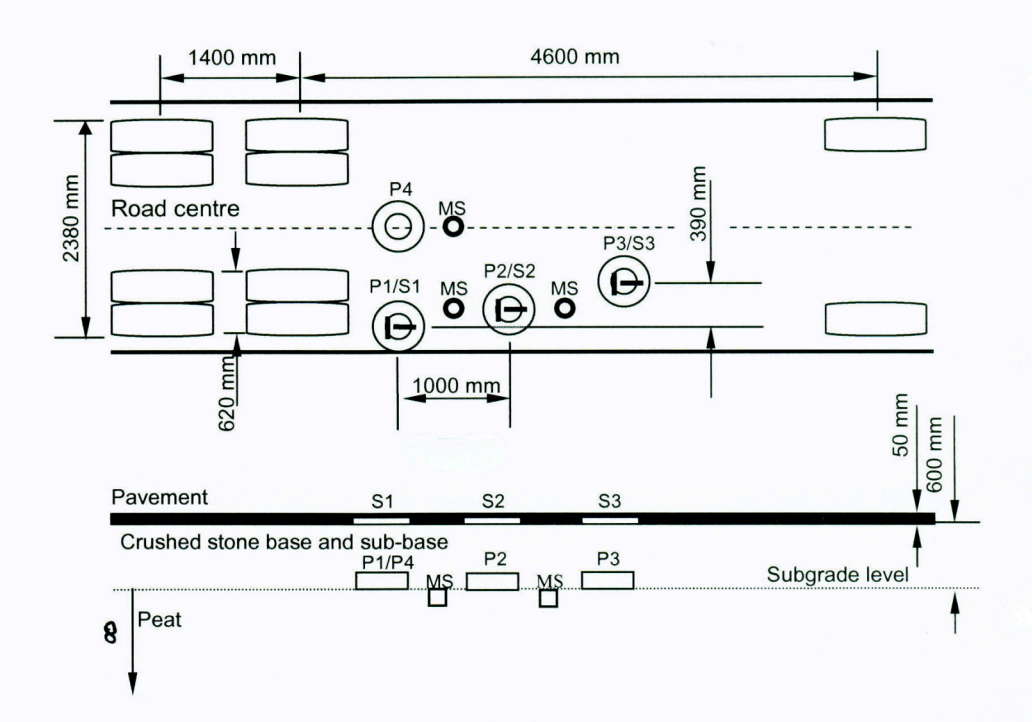

Fig. 2. Schematic of pavement model, positioning of wheel loads and location of sensors including, Strain Transducers (S1, S2, S3), Pressure Cells (P1, P2, P3 and P4), and Moisture Sensors (MS); axle spacing and track width of experimental truck are superimposed (Owende et al., 2001).

Pavement material properties and the finite element model

The elastic material properties of the modelled pavement layers are provided in Table 1. Viscoelasticity was also considered, and the response was compared to the corresponding response of linear elastic pavement material. A material is considered to be viscoelastic if its stress response consists of elastic and viscous characteristics, whereby, upon application of a load, the elastic response is instantaneous while the viscous response occurs over time. For small strains, the constitutive equation for an isotropic viscoelastic material is expressed as (Blab et al., 2002; ANSYS inc, 1999):

$$\sigma = \int_0^t 2G(t-\tau)\frac{de}{d\tau}d\tau + I\int_0^t K(t-\tau)\frac{d\Delta}{d\tau}d\tau \quad (1)$$

Where σ=Cauchy stress

e = deviatoric part of the strain

Δ = Volumetric part of the strain

G(t) = shear relaxation kernel function

K(t) = bulk relaxation kernel function

t = current time

τ = past time

I = unit tensor

The viscoelastic material curve fitting tool in ANSYS (1999) was used to determine the material constants of the prony series expansion for shear modulus option from experimental data. The data (Table 2) was obtained from four point bending tests performed at temperature, 20°C, void content, 7.4% and a frequency of 4Hz (Hartman, 2000). The experimental data was then used in ANSYS, to define a third order of the prony series expansion. Non-linear regression and correlation analysis was performed on the data to obtain the coefficients of the prony series. The curve fitting results were inspected graphically and compared to the experimental data. The fitted coefficients were then written as ANSYS non linear data table commands to the material model database for the subsequent finite elements analyses.

Table 1: Layer thickness and elastic material Properties (Hartman, 2000)

Layer	Thickness (mm)	Modulus of Elasticity (MPa)	Poisson's Ratio
Asphalt	50	2,300	0.30
Base	200	55	0.35
Subbase	400	25	0.40
Subgrade	Infinite	10	0.45

A pavement structure with the layer profile shown in Fig. 2 was modelled in ANSYS/ED finite element suite as plain strain, using PLANE82 elements, an 8-node quadratic element with two degrees of freedom at each node i.e. translations in the horizontal and vertical directions. PLANE183 elements with viscoelastic capability were used for the non linear viscoelastic model (ANSYS inc, 1999). Considering the symmetry in the truck-pavement interactions, a 2D pavement model under half wheel load of length 1500 mm and 2000 mm in

the lateral and longitudinal directions, respectively, and a road profile depth of 2650 mm was considered for analysis. The model pavement structure was then meshed (see Fig. 3).

Table 2. Curve fitting data for viscoelastic prony coefficients from four point bending fatigue test (Adapted from Hartman, 2000)

Cycles	Time(s)	Stiffness Modulus,E (MPa)	Shear Modulus, G (MPa)
10	2.5	2536	975
20	5.0	2383	916
30	7.5	2440	938
40	10.0	2437	937
50	12.5	2469	950
60	15.0	2495	960
70	17.5	2561	985
80	20.0	2528	972
90	22.5	2475	952
100	25.0	2392	920
200	50.0	1550	596
300	75.0	1521	585
400	100.0	1551	597
500	125.0	1563	601
550	137.5	1601	616
950	237.5	1402	539
1050	262.5	1390	535
1150	287.5	1408	542
1250	312.5	1420	546
1350	337.5	1462	562
1450	362.5	1481	570
1550	387.5	1474	567
2550	637.5	1298	499
3550	887.5	1043	401
4550	1137.5	589	227
4590	1147.5	551	212

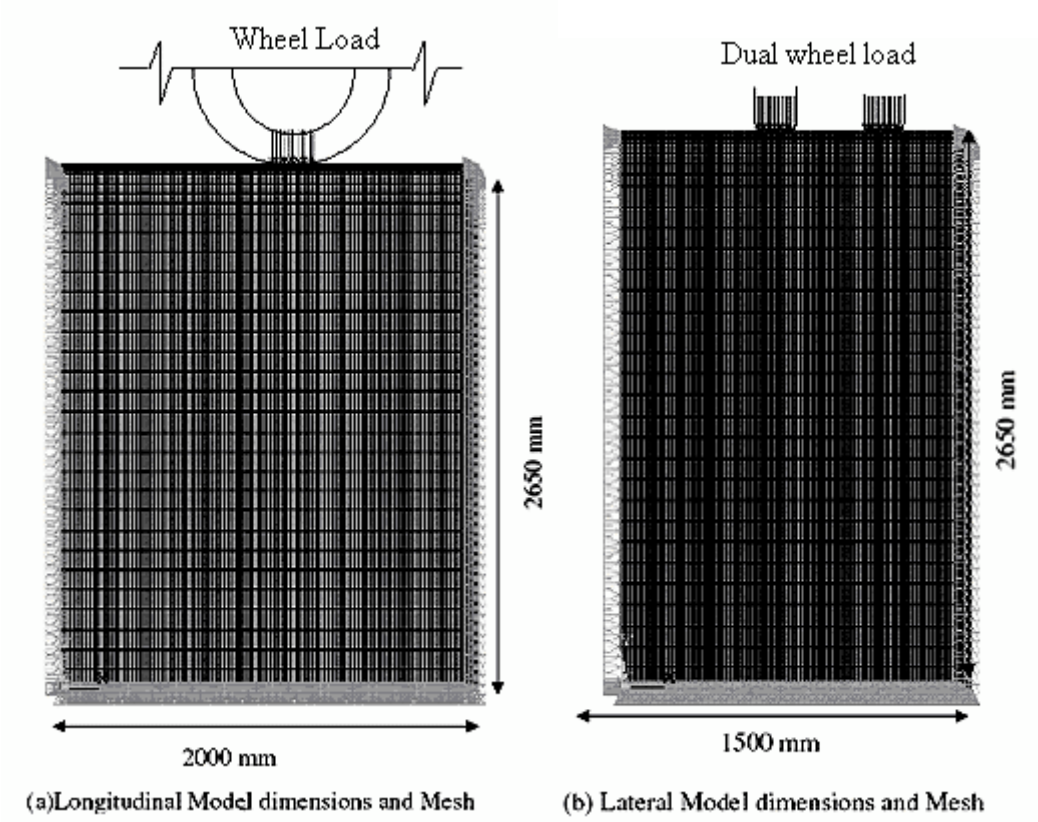

Fig. 3. The Finite Element Mesh showing the physical dimensions and the imposed boundary conditions and load distribution.

For the longitudinal 2D model, the bottom nodes and the nodes corresponding to the edge of the pavement were fully constrained. In the transverse 2D model, all nodes were horizontally constrained along the line of symmetry, but are free to move in the vertical direction. The model was subsequently subjected to cyclic loads to simulate the wheel configuration of the three axled truck (Fig. 2). Three levels of wheel loads (when the truck is empty, half loaded and fully loaded) and four tyre inflation pressures of 350, 490, 630 and 750 kPa were applied to the finite element model. The normal contact pressure was assumed to be uniformly distributed over the contact area. In this analysis, the top surface was considered to be free from any discontinuities (with no cracks) or unevenness, and the interface between layers was considered to be fully bonded i.e., with no gaps.

Extraction of simulation data

Nodes corresponding to the respective location of the sensor groups located in the wheel track (Fig. 2) and for which verification data from in-situ field experiment were available were selected for the simulation. Nodes at a depth of 40 mm and 750 mm from the tyre-pavement interface in the model were selected to correspond to the strain transducers located at the bottom of the DBM layer and the pressure cells at the top of the subgrade respectively. In the transverse plane, nodes at a distance of 1070 mm, 920 mm and 680 mm from the line of

symmetry (see Fig.3) in the horizontal direction of the cartesian plane were selected to correspond to the group sensors P1/S1, P2/S2 and P3/S3 respectively. Whereas for the longitudinal plane, nodes at a distance of 1100 mm were selected to correspond to pressure sensors P1/S1 and P3/S3 in Fig 2.

Results and Discussion

The peak longitudinal and lateral strains incurred by each wheel passage at the set wheel load and tyre pressure combinations were obtained and verified against the corresponding in-situ experimental data.

Characteristics of pavement surfacing layer interfacial strains and stress on subgrade

Fig. 4 shows the predicted pavement strains in the longitudinal direction. The observation indicates that the longitudinal strain shifts from compression (negative values) to tension (positive values) and back to compression with the simulated wheel passes, which was consistent with available evidence (Owende et al., 2001, Huhtala et al., 1990, Douglas, 1999, Siddharthan et al., 1998). The predicted compressive strain before and ahead of the wheel was approximately equal.

Fig. 5 shows the response of the pavement in the transverse direction. The corresponding peak strains were higher for the front wheel than the dual tandem wheels, even though the wheel load was less (31.7 kN and 44.6, 44.1 kN, respectively). The shape of the tensile strain curves for the dual wheels were also less steeper, and ultimate values lower than the longitudinal component (Fig. 4), possibly depicting interaction of the dual wheels.

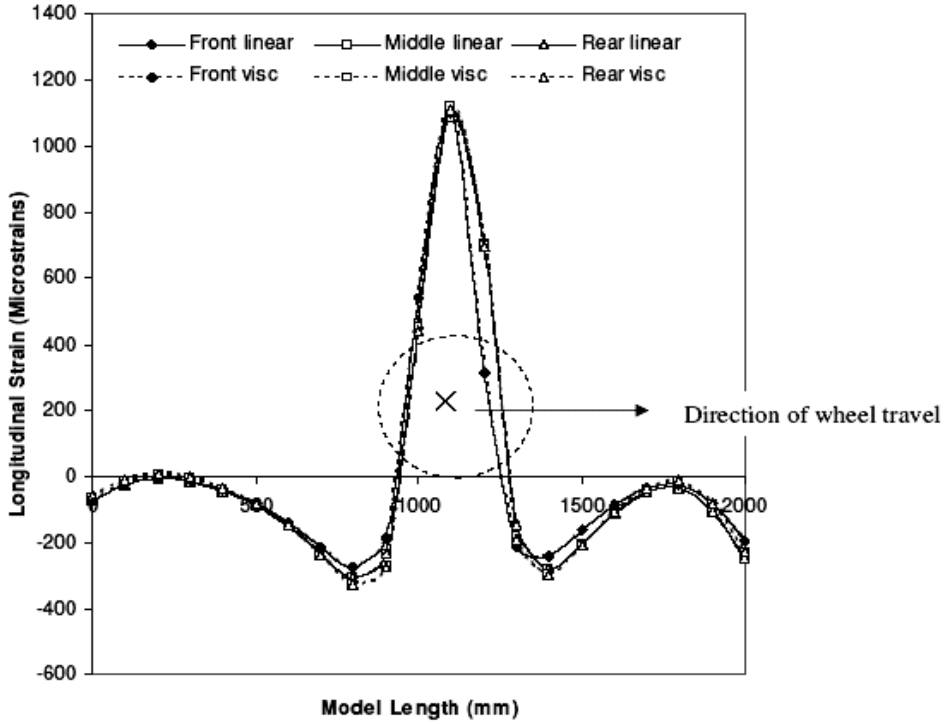

Fig. 4. Simulated longitudinal strain curve for nodes corresponding to sensor location P1/S1 at the bottom of the bituminous layer corresponding to single front, middle, and rear dual wheel loads of 31.7, 44.6, and 44.1kN

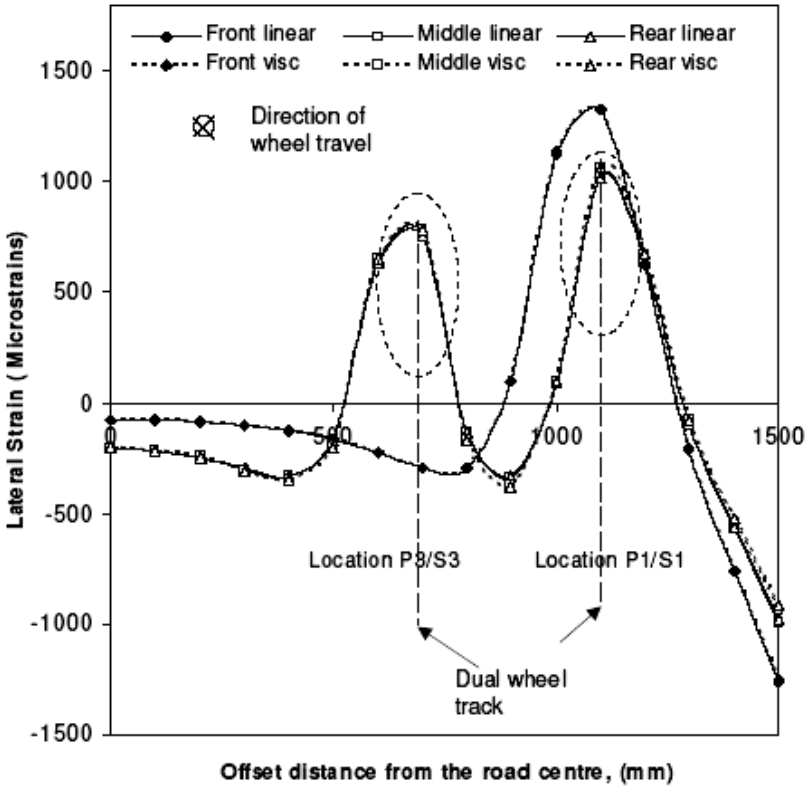

Fig. 5. Simulated lateral strain curve for nodes corresponding to sensor location P1/S1 at the bottom of the bituminous layer corresponding to single front, middle and rear dual wheel loads of 31.7, 44.6, and 44.1 kN, respectively, at tyre inflation pressure of 630 kPa.

Comparison of predicted and measured in-situ pavement response data

The individual axle time course of the observed and simulated longitudinal and lateral strains were compared graphically (Fig. 6). It was observed that the peak values of the simulated strains matched well with its in-situ measured strains in both planes, with the longitudinal strains showing a closer fit i.e lower standard error (Table 3). The model overpredicted as well as underpredicted the strains in some cases for both linear and viscoelastic models.Scattergram of the observed and simulated strains from the time course showed that the simulated strains were generally overpredictive in the longitudinal plane (Fig. 7).

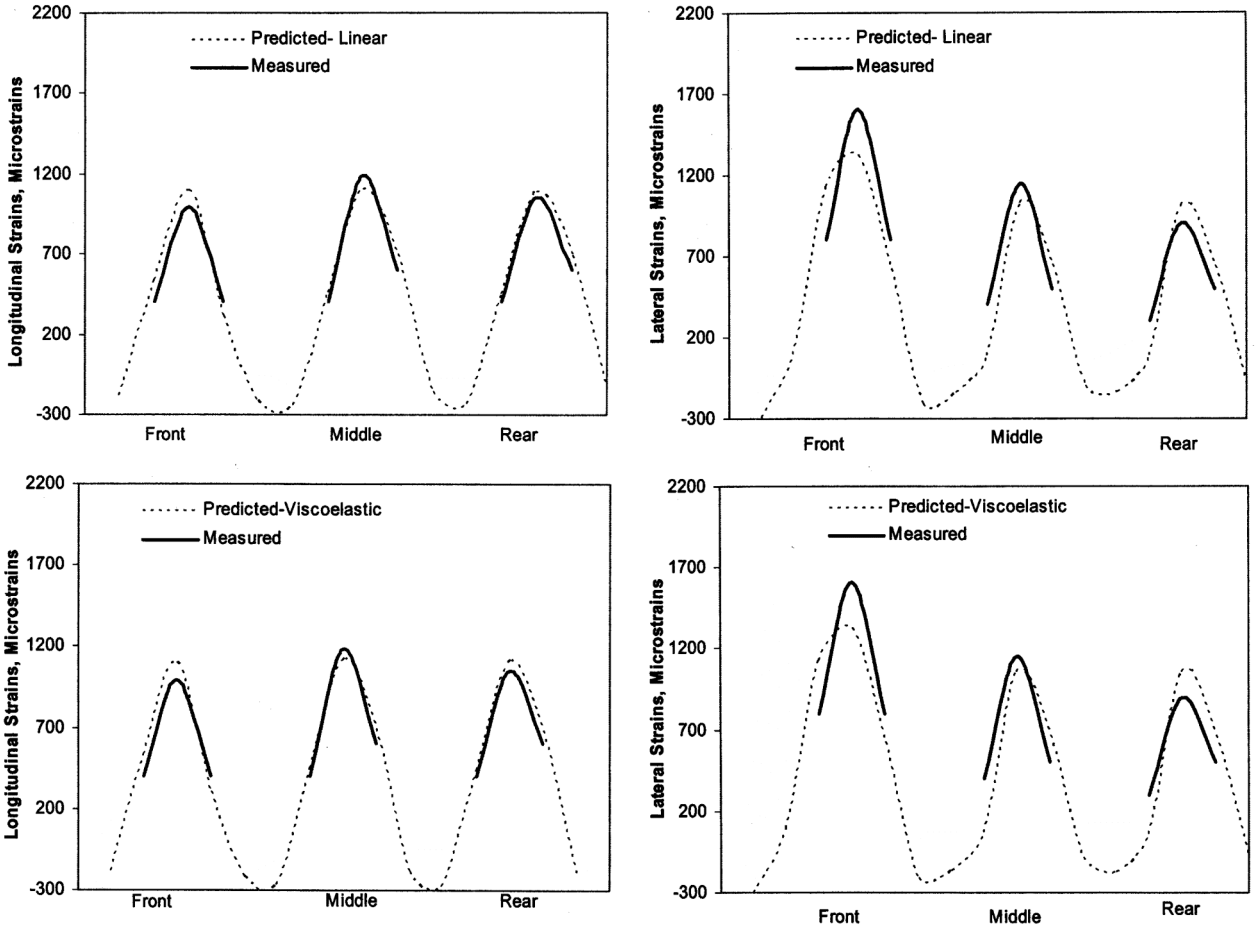

Fig. 6. Individual axle time course for measured and predicted longitudinal and lateral strains corresponding to single front wheel, middle and rear dual wheel loads of 31.7, 44.6 and 44.1 kN, respectively, at tyre inflation pressure of 630 kPa (90 psi). Linear (top) and viscoelastic (bottom) material characteristics of DBM layer are considered.

Table 3: Error analysis of predicted against measured strains

Model Statistical Parameter	Predicted Strains			
	Lateral		Longitudinal	
	Linear	Viscoelastic	Linear	Viscoelastic
RMS Error (%)	28.3	29.7	13.6	13.2
SE(Microstrains)	248	260	103	100
$t_{calculated}$	0.21	0.15	-0.32	-0.13
$t_{critical}$ (95% confidence)	2.12	2.12	2.12	2.12
Residual Analysis	Random	Random	Random	Random

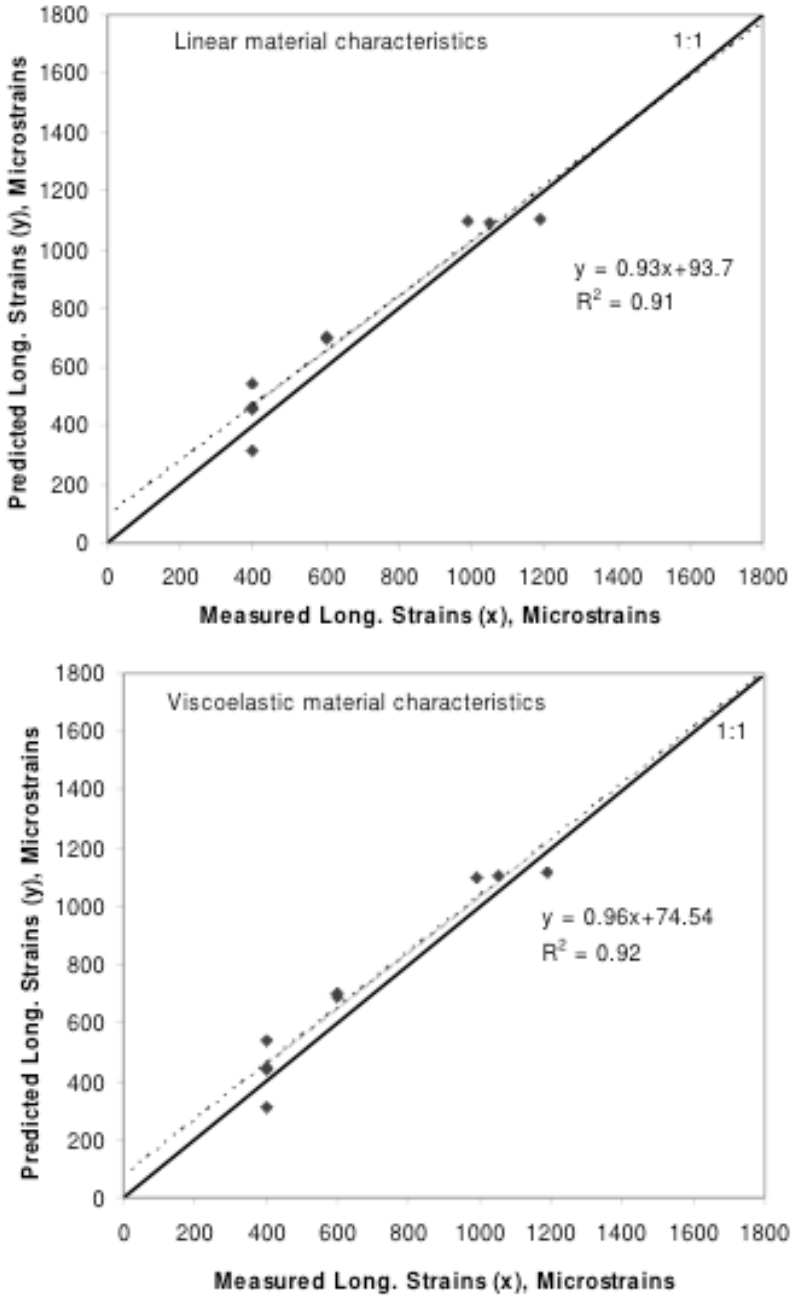

Fig. 7. Correlation between predicted and in-situ measured longitudinal strains corresponding to single front wheel, middle and rear dual wheel loads of 31.7, 44.6 and 44.1 kN, respectively, at tyre inflation pressure of 630 kPa (90 psi). Linear (top) and viscoelastic (bottom) material characteristics of DBM layer are considered.

Analysis of Variance (ANOVA), in Table 4 shows that the FE model incorporating appropriate material characteristics can be used for accurate prediction of pavement strains. Student's t-test (Montgomery, 2003) showed that the observed and simulated mean strains were not significantly different at 95% confidence level assuming a two tailed test ($t_{calculated} < t_{critical}$, see Table 4). The coefficient of determination, R^2, of 0.91 and 0.68 (when linear material properties are considered) in the longitudinal and lateral planes, respectively, indicated a close relationship between the in-situ measured and the predicted strains. Better fit was recorded for the longitudinal strains as compared to the lateral model, with RMS errors of 13% and 28%, respectively. The viscoelastic material characteristic registered a marginally better fit (R^2= 0.92) than the linear material characteristics (R^2= 0.91) on average in the longitudinal plane. However, for the lateral plane, there was a better fit when linear material characteristics were considered (R^2= 0.68)) than the viscoelastic material characteristics (R^2= 0.66).

Table 4: Analysis of Variance (ANOVA) for lateral linear model (a), lateral viscoelastic model (b), longitudinal linear model (c), and longitudinal viscoelastic model (d).

Source	*Degrees of Freedom*	*ANOVA Sum of Squares*	*Mean Square*	*F Calculated*	*F critical*[a]
(a) Plot Lateral Strains, Linear Model					
Model	1	939789.9	939789.9	15.21[b]	5.59
Error	7	432410.1	61772.9		
Total	8	1372200.0			
Root Mean Square Error			219.2		
R^2	0.69				
(b) Lateral Strains, Viscoelastic Model					
Model	1	898388	898388.0	13.27[b]	5.59
Error	7	473812	67687.4		
Total	8	1372200			
Root Mean Square Error			229.4		
R^2	0.66				
(c) Longitudinal Strains, Linear Model					
Model	1	743837.1	743837.1	69.64[b]	5.59
Error	7	74762.9	10680.4		
Total	8	818600.0			
Root Mean Square Error			91.1		
R^2	0.91				
(d) Longitudinal Strains, Viscoelastic Model					
Model	1	748226.2	748226.2	74.43[b]	5.59
Error	7	70373.8	10053.4		
Total	8	818600.0			
Root Mean Square Error			88.4		
R^2	0.92				

[a] Values at a 95% level of confidence.

[b] Model significant for the prediction of stains since F calculated is greater than F critical.

Fig. 8 shows the studentized residuals as a function of the measured strains. As can be seen that the plots were reasonably random, and none of the residuals was noticeably distinct from the others, and therefore there were no outliers. It can also be seen that none of the residuals

have studentized values greater than -2 or less than 2, therefore, it may be concluded that there were no unusual residuals in the analysis (Montgomery, 2003).

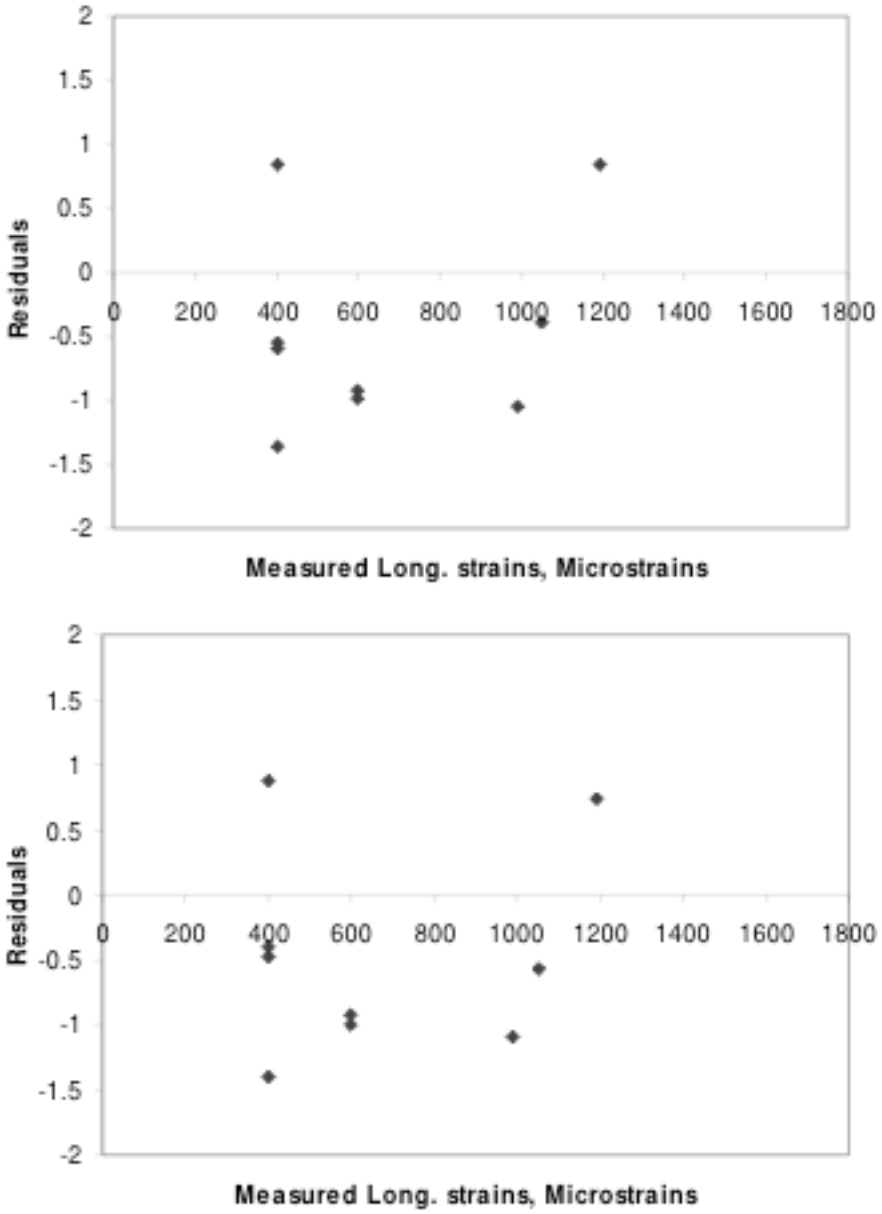

Fig. 8. Distribution of residual errors for predicted longitudinal strains corresponding to single front wheel, middle and rear dual wheel loads of 31.7, 44.6 and 44.1 kN, respectively, at tyre inflation pressure of 630 kPa. Linear (top) and viscoelastic (bottom) material characteristics of DBM layer are considered.

Therefore, the predicted and in-situ measured pavement strains due to single and dual wheel tyre configurations depicted similar response variations and matched closely in magnitude. The observed disparities could have been due to lateral wheel wander from the strain gauge positions for in-situ measurement data; possible inaccuracy in the exact location of nodes corresponding to strains gauges used in the in-situ measurements and dynamic contact area

variations. Available experimental evidence suggest that contact pressure distribution between tyre and road surface is not uniform across the tyre (De Beer et al., 1997, Huhtala et al., 1989).

Conclusion

It has been shown that for known pavement material characteristics and tyre-pavement contact regime, finite element method could be used to efficiently estimate the strain at the bottom of the bituminous surfacing layers. Such data could be used to assess the expected fatigue performance of model pavements and improve on design characteristics prior to construction.

Acknowledgements

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References

ANSYS Users Manuals. South Point, Canonsburg, PA, USA: Ansys, Inc.; 1999

Blab R, Harvey JT. Modelling Measured 3D Tyre Contact Stresses in a Viscoelastic FE Pavement Model. The international Journal of Geomechanics 2002; 2(3): 271-90.

Cebon D. Handbook of Vehicle-Road interaction. Lisse, the Netherlands: Swets & Zeitlinger B.V.; 2000.

De Beer M, Fisher C, Jooste F. Determination of pneumatic tyre/pavement interface contact stresses under moving loads and some effects on pavements with thin asphalt surfacing layers. Proceedings of the Eighth International Conference on Asphalt Pavements. Seattle, Washington; 1997, p. 179–226

Douglas RA. CIT Effects in subgrades and rolling resistance. Proc., Conf. on Forest Engrg. For Tomorrow: Machinery. Paper No.4, Forest Engrg. Group, U.K. Institution of Agricultural Engineers, Silsoe, U.K; 1999

Hartman AM. An experimental Investigation into the mechanical performance and structural integrity of bituminous road pavement mixtures under the action of fatigue load conditions. PhD. Thesis. Dept. of Mech. Engrg., University College Dublin, Ireland; 2000.

Huhtala M, Pihljamaki J, Pienimaki M. Effects of tyres and tyre pressures on road pavements. Trans. Res. Rec. 1227, Transportation Research Board, Washington D.C; 1989, p.107-114.

Huhtala M, Alkio R, Pihljamaki J, Pienimaki M, Halonan P. Behaviour of Bituminous materials under moving wheel roads. Proceedings of the association of Asphalt Paving Technologists 1990; 59:422-42.

Martin AM, Owende PMO, O'Mahony MJ, Ward SM. A timber extraction method based on pavement serviceability and forest inventory data. Forest Science 2000; 46(1):76-85.

Montgomery DC, Runger GC. Applied statistics and probability for Engineers. 3rd ed. New York: John Wiley & Sons, Inc.; 2003.

Owende PMO, Hartman AM, Ward SM, Gilchrist MD, O'Mahony MJ. Minimizing Distress on Flexible Pavements Using Variable Tyre Pressure. Journal of Transportation Engineering, ASCE 2001; 127(3):254-62.

Siddharthan RJ, Yao J, Sebaaly PE. Pavement strain from moving dynamic 3D load distribution. Journal of Transportation Engineering, ASCE 1998; 124(6):557-66

Ullidtz P. Pavement Analysis. Amsterdam: Elsevier; 1987

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