Case inversion in Georgian

Syntactic Properties and Sentence Processing

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Abstract The morphological and syntactic facts from Georgian create a unique puzzle for the study of sentence processing. The word order is characterized by considerable freedom and case marking is not uni-directionally associated with θ-roles. This article presents a grammatical account of Georgian case marking and a study on incremental sentences processing. The empirical findings show that case is indeed a more reliable cue than word order in processing clauses with thematically ambiguous arguments. Furthermore, the obtained data suggest an asymmetry between dative experiencers and dative actors, such that only the revision of the thematic properties of the latter is associated with high processing cost.

1 PRELIMINARIES

That the human sentence processing mechanism makes use of all available cues for grammatical function assignment and structure building in incremental sentence processing is a very natural assumption that has been confirmed in a number of experimental studies. MacWhinney et al. (1984) were among the first showing this by demonstrating that overt case marking, morphological agreement information and syntactic position are used to different degrees in different languages in a sentence interpretation experiment.

Early online-studies concerned with the effect of explicit morphological marking used morphological information that is (relatively) unambiguous in nature. For example, Krems (1984) found increased reading times for German sentences beginning with an NP unambiguously marked for the accusative case that almost always marks direct objects only (as compared to sentences beginning with a nominative noun phrase), a result later confirmed by Hemforth (1993) and Fanselow et al. (1999a), see also Felser et al. (2003), Fiebach et al. (2002) for related ERP-based results.

Unambiguous case marking need not, however, indicate the grammatical function and/or structural position of the NP bearing it in an unambiguous way. While subjects are marked with the nominative case and indirect (second) objects with

the dative case in a language like German, the correlation is not a biunique one, since nominative and dative NPs occur in the position of direct (first) objects, too – the former do so in passive and unaccusative contexts, the latter do so when they instantiate idiosyncratic case frames of a number of verbs such as *helfen* 'help'. The question arises whether (and if so, how) explicit morphological information that is syntactically ambiguous is used in online sentence processing.

Recent results of Bornkessel et al. (2002, 2003) suggest that such information is put to use and in a way much reminiscent of ambiguous structural information: morphological cases are linked to interpretation preferences that can be expressed in various ways, either as inviting hypotheses concerning the relative thematic position of the NP arguments (such that nominative NPs are preferentially interpreted as the highest argument of a predicate) as in the proposal of Bornkessel et al., or as preferences for the location of the NPs in the structural representation of the clause; for instance, datives trigger a default placement into the indirect object position (the specifier of VP in certain recent syntactic models, see, e.g., Chomsky 2005), while nominatives are preferentially located in the subject position (the specifier of vP in such models).

As suggested by the findings of Bates et al. (1982), languages seem to make use of morphologically explicit but syntactically ambiguous case information to different degrees. Röhm et al. (2007) present electrophysiological evidence for the claim that morphological case plays a very minor role in the online processing of Icelandic, a language with rigid constituent order and a rich morphological case system showing very little correspondence between case and grammatical function. This property contrasts with the apparently strong impact of the morphological case in German, in which there is at least a set of implicative relations between the case and grammatical function (if subject then nominative, if indirect object then dative, if accusative then direct object).[1] In addition, German differs from Icelandic in being a language with flexible constituent order, i.e. deviations from the basic order are possible under particular configurations of semantic and pragmatic conditions.

In the present paper, we will consider the influence of explicit case marking on sentence processing in Georgian. Georgian may help us to disentangle the reasons for the different treatment of case in German and Icelandic. Just like German, Georgian is a flexible word order language. Thus, if the availability of scrambling is the factor that differentiates German from Icelandic with respect to the role of case in online processing, Georgian and German should behave alike in the latter domain as well. On the other hand, there is no overwhelming correspondence between the explicit case and grammatical function in Georgian. The case affix labeled as 'dative' in Georgian grammar appears with direct and indirect objects, as well as with structural subjects. Nominative case affixes appear with subjects and direct objects. Ergative affixes occur with actor phrases in the aorist tense. The crucial point from the viewpoint of sentence processing is whether there is a uni-

[1] Exceptions to these generalizations (e.g., verbs with two accusative objects, verbs with genitive and accusative) are lexically conditioned.

directional case-to-argument association, i.e., if the processing of the inflectional properties of the arguments allows for unambiguous inferences concerning their syntactic function (if case *C*, then function *F*), independently of any additional information (such as lexical information or the inflectional properties of the verb). In turn, the ergative is the only case linked to grammatical function (if ergative, then subject). Given that the ergative is a peripheral case (it shows up with the aorist only) and that indirect objects are a rare category, one can argue that Georgian is closer to Icelandic than to German with respect to the grammatical interpretation of case, which may trigger parallels in case of processing if that aspect of the morphology-syntax correspondence is relevant.

In order to assess the role of explicit case information in the processing of Georgian, we carried out two reaction time experiments (see section 3). In particular, we examined the role of case inversion that is exemplified in (1). Depending on the inflectional properties of the verb (conjugation class and tense), arguments in Georgian show two different case-marking patterns (among others): in the direct pattern, which is illustrated in (1a), the nominative marked constituent bears the θ-role of an actor and the undergoer constituent bears an oblique case, namely the dative; in the inverse pattern, which is illustrated in (1b), the actor constituent bears the dative case, while the nominative argument is the undergoer.

(1) (a) ǯarisk'ac-i monadire-s da-č'r-i-s.
soldier-NOM hunter-DAT PR(FUT)-cut-THM-S.3.SG
'The soldier will wound the hunter.'

(b) ǯarisk'ac-s monadire
soldier-DAT hunter(NOM)
da-u-č'r-i-a.
PR(PFV)-(INV.S.3)PV-cut-PRF-INV.O.3(INV.S.SG)
'The soldier has wounded the hunter.'

The structure of the article is as follows. Section 2 outlines the Georgian case system with particular emphasis on the morphological and syntactic phenomena that contribute to our understanding of case inversion. Based on the conclusions of this grammatical account, Section 3 presents an experimental study on the processing of Georgian sentences with the case-marking patterns illustrated in (1).

2 GRAMMATICAL FACTS ON CASE INVERSION

2.1 The case system of Georgian

In interaction with aspectual/modal categories, Georgian verb (conjugation) classes license three different case-marking patterns, which are presented in Table 1 (see Harris 1981:1, Blevins 2005). The roles indicated in this table should be understood as abstractions out of the θ-roles ('proto-roles' in the sense of Dowty

1991). An ‘actor’ stands for the highest participant involved in the event, who may be an agent or an experiencer depending on the event at issue; the ‘goal’ encompasses recipients and beneficiaries; the ‘undergoer’ is the participant that is affected or effected through the event or the (non-agentive) stimulus of an experiential event.

The case affix labeled ‘dative’ is the product of case syncretism between accusative and dative (this affix is labeled ‘dative’ following the Georgian grammatical tradition, see Tschenkéli 1958, Harris 1981, Hewitt 1995 among others). Synchronically, this affix shows mixed properties as will be exemplified below: when it is licensed by thematic properties, it is used for the marking of goals and non-volitional actors, which is a function reminiscent of the dative in Indo-European languages; when it is structurally licensed, it marks the lower argument, hence having the properties of an accusative. The case affix labeled ‘ergative’ (also called ‘narrative’ in Georgian grammar; see Harris 1990, 1993, Hewitt 1987) marks actors.

Table 1. Proto-roles and case-marking patterns

case-marking pattern	actor	undergoer	goal
A	ergative	nominative	dative
B	nominative	dative	dative
C	dative	nominative	(postpositional)

The case-marked arguments are cross-referenced on the verb through person affixes. In patterns A and B, two sets of affixes are used for the cross-reference of the actor, undergoer and goal constituents.[2] In pattern C, the nominative argument corresponds to the affix set that marks actors in the other patterns and the dative argument to the affix set that marks goal constituents in the other patterns, whereby the postpositional goal is not cross-referenced at all, which shows that it has adjunct status.

Case-marking patterns are determined by the verb (conjugation) class in interaction with its tense/aspect/mood properties. Following the Georgian grammatical tradition, inflectional categories are classified into three series (or ‘screeves’): *Series I*: present (indicative/subjunctive), future (indicative/subjunctive), imperfect, conditional; *Series II*: aorist indicative, optative; and *Series III*: present perfect, pluperfect. Georgian verbs are divided into four conjugation classes that – in interaction with the series – determine different case-marking patterns for the clausal arguments as presented in Table 2. Class membership is not fully predictable by the semantic properties of the verb (see Aronson 1989) but some rough correlations with syntactic/semantic properties are identifiable (see Harris

[2] The sets of affixes display many instances of overlap, in particular whenever two argument markers compete for a single available slot. Without proceeding into details, the resolution of these conflicts is determined by the interaction of morphotactic constraints and constraints derived by the person and argument hierarchies (see detailed account in Anderson 1984, Carmack 1997).

1981:228ff.): class 1 mainly contains active transitive verbs and a large class of derived causatives; class 2 contains unaccusatives, analytic passives that are formed with the class 2 verb *ikneba*, as well as synthetic passives with change of state semantics; class 3 contains unergative verbs and class 4 mainly contains verbs with a non-volitional actor.

Table 2. Case marking in classes and series (see Harris 1981:2, 118)

	series I	series II	Series III
classes 1&3	B	A	C
class 2	B		
class 4	C		

The following examples illustrate the facts about case marking. Example (2) illustrates the case patterns of a class 1 verb. The present form (series I) in (2a) licenses case-marking pattern B, the aorist form (series II) in (2b) licenses pattern A and the perfect form (series III) in (2c) licenses pattern C.

(2) (a) Class 1, pattern B
dato nino-s c'ign-s a-čuk-eb-s.
Dato(NOM) Nino-DAT book-DAT (IO.3)PV-donate-THM-S.3.SG
'Dato will give a book to Nino (as a present).'

(b) Class 1, pattern A
dato-m nino-s c'ign-i a-čuk-a.
Dato-ERG Nino-DAT book-NOM (IO.3)PV-donate-AOR.S.3.SG
'Dato gave a book to Nino (as a present).'

(c) Class 1, pattern C
dato-s nino-s-tvis c'ign-i
Dato-DAT Nino-GEN-for book-NOM
u-čuk-eb-i-a.
(INV.S.3)PV-donate-THM-PRF-INV.O.3(INV.S.SG)
'(Apparently) Dato has given a book to Nino (as a present).'

Two classes of verbs deviate from the basic pattern illustrated in (2), as shown in (3). These verbs license an invariable case-marking pattern that is not influenced by the tense properties of the verb. Examples (3a-b) illustrate the syntactic behavior of a class 2 verb that licenses pattern B and a class 4 verb that licenses pattern C.

(3) (a) Class 2, pattern B
dato nino-s elodeba/daeloda/dalodebia
Dato-NOM Nino-DAT (IO.3)wait(S.3.SG) (present/aorist/perfect)
'Dato waits/waited/has waited for Nino.'

(b) Class 4, pattern C

dato-s	nino	sʒuls/sʒulda/
Dato-DAT	Nino(NOM)	(INV.S.3)hate(INV.O.3/INV.S.SG) (present/past)

sʒulebia.
(SINV.3)hate(OINV.3/SINV.3.SG) (perfect)
'Dato hates/hated/has hated Nino.'

Turning back to the question whether Georgian displays uni-directional case-to-argument associations, the data presented in this section show that nominative and dative affixes are mapped to different arguments, which imply that they are only probabilistic predictors for argument structure. The only Georgian case that is uni-directionally associated with a particular θ-role is the ergative.

2.2 Inherent vs. structural cases

In line with recent accounts of Georgian case marking (Joppen-Hellwig 2001, Blevins 2005), we assume two distinct layers of case licensing, a non-structural and a structural one. The non-structural layer encompasses cases that are either determined by the role properties of the argument (inherent case), or are idiosyncratically stipulated by particular verbal heads through lexical specification (lexical case) (see Chomsky 1981, Fanselow 2000, 2002, Stiebels 2000: 46–55, Butt and King 2005, Woolford 2006: 111, among others). The structural layer applies to the set of eligible arguments that do not receive case through a lexical or thematic rule. At this layer, case is licensed in a hierarchical manner, such that the highest eligible argument receives the highest available case (following the hierarchy nominative > accusative > dative) (see Wunderlich 1997, Stiebels 2000). Depending on the theoretical framework, the argument hierarchy is either determined by the embeddedness in the syntactic configuration or by the hierarchy of theta roles (see a comparison of the alternative accounts in Fanselow 2000).

Our basic assumptions concerning the Georgian case marking system are given in Table 3 (based on previous accounts in Joppen-Hellwig 2001, Blevins 2005). Non-structural cases are specified either through lexical specification of the verbal head (this holds for dative$_\lambda$ in the B_3 pattern) or through the thematic properties of the arguments (see dative$_\theta$ in all other cases). The case marking of the remaining arguments is subject to structural licensing (marked as *s* in Table 3). Structural licensing takes place in a hierarchical manner, such that the highest case (nominative > dative) marks the highest eligible argument (actor > undergoer). The crucial difference of Table 3 with respect to the account of case inversion is that it distinguishes between a subclass of case-marking pattern B that involves a structurally marked dative undergoer (B_1) and another subclass of the same case-marking pattern that involves a non-structurally marked dative undergoer (B_2). Furthermore,

Table 3 contains some additional information about the classes of verbs that do not occur with all three arguments, which is abstracted away in Table 1.

Table 3. Layers of case licensing*

case-marking pattern	Actor	undergoer	goal
A_1 (class 1, series II)	ergative$_\theta$	s_H	dative$_\theta$
A_2 (class 3, series II)	ergative$_\theta$	-	dative$_\theta$
B_1 (class 1, series I)	s_H	s_L	dative$_\theta$
B_2 (class 3, series I)	s_H	-	dative$_\theta$
B_3 (class 2)	s_H	dative$_\lambda$	(postpositional)$_\theta$
C_1 (class 1/3, series III)	dative$_\theta$	s_H	(postpositional)$_\theta$
C_2 (class 4)	dative$_\theta$	s_H	-

* x_θ = inherent case; x_λ = lexical case; s_H = structural case, higher in the argument hierarchy; s_L = structural case, lower in the argument hierarchy

Evidence for the assumptions in Table 3 comes from three types of phenomena that are discussed in the following sections: (a) thematic relatedness of the non-structural cases (see 2.3), (b) eligibility for A-movement (see 2.4) and (c) stratal uniqueness effects (see 2.5). A further diagnostic for the non-structural case is the occurrence of case preservation effects under A-movement: an argument with a non-structural case does not change case properties when it undergoes such operations as passivization or raising (see Yip et al. 1987: 225, Woolford 2006: 118). Previous literature on Georgian shows that case preservation effects cannot be diagnosticized in this language, since passivization is either not possible or involves a change of verb class and raising constructions are formed on the basis of non-finite verb forms (see Harris 1981: 156-167).

2.3. Thematic relatedness

Cases that are licensed by a thematic rule are restricted to a particular range of thematic relations to the verbal head. This is quite straightforward for the marking of goal (recipient and beneficiary) arguments in patterns A and $B_{1/2}$. That the licensing condition goal $\rightarrow$ dative$_\theta$ fails to apply for pattern C_1 is an effect of stratal uniqueness that is discussed in section 2.5.

The case affix labeled 'ergative' is thematically related to the actor role, a fact that is extensively discussed by Harris (1990). Licensing the ergative affix in series II depends on the thematic properties of the argument: it marks actors of either transitive (class 1) or unergative (class 3) verbs but not undergoers of either transitive (class 1) or unaccusative (class 2) verbs. The thematic relatedness of the ergative affix in Georgian suggests that it is not a structural case.

The dative$_\theta$ in pattern C occurs with two types of arguments. First, it marks actors of class 4 verbs that share in common that they do not exercise volitional con-

trol on the event (in most part, these arguments are experiencers). Evidence for the non-volitionality of these arguments is provided through distributional diagnostics: the occurrence of an adverb that requires the volitional involvement of the actor is not acceptable with class 4 verbs, see (4).

(4) Class 4, pattern C_2
#dato-s nino ganzrax s-ʒul-s.
Dato-DAT Nino(NOM) purpose INV.S.3-hate-INV.O.3(INV.S.SG)
'Dato hates Nino on purpose.'

Furthermore, the dative$_\theta$ in pattern C marks actors of transitive verbs in series III (perfect tense). The perfect in Georgian involves stative aspect and has epistemic properties: the speaker asserts that he has not direct evidence that the conveyed proposition took place. These aspectual/modal properties do not exclude volitional actors, as shown through the grammaticality of example (5) that involves a Class 1 verb in the perfect tense and an adverb asserting the volitional involvement of the actor constituent. However, native speaker intuitions suggest that utterances in the perfect tense involve an assertion about the truth value of a particular proposition letting the volitional or non-volitional involvement of the speaker unspecified (see Harris 1981, Asatiani and Ivanishvili 2007 for further discussion). Some indirect distributional evidence comes from the interaction with negation. Negative facts in the past are encoded in the perfect, while positive facts are encoded in the aorist (see Joppen-Hellwig 2001: 142).

(5) Class 1, series III, pattern C_1
dato-s nino-s-tvis c'ign-i ganzrax
Dato-DAT Nino-GEN-for book-NOM purpose
u-čuk-eb-i-a.
(INV.S.3)PV-donate-THM-PRF-INV.O.3(INV.S.SG)
'(Apparently) Dato has given Nino a book (as a present) on purpose.'

The dative$_\lambda$ in pattern B_3 is a lexical case, i.e., it is lexically determined by the verbal head. Thematically, these arguments are undergoers, which is in line with the view that case licensing by the verbal head can only apply within the VP proper (see Fanselow 2000, Woolford 2006). That the undergoer-dative in pattern B_3 (class 2 verbs) is licensed differently than the undergoer-dative in pattern B_1 (class 1 and 3 verbs) is supported by evidence from stratal uniqueness effects that are discussed in section 2.5.7.

2.4. A-movement

The data discussed in the following reveal a contrast with respect to the eligibility of particular arguments for A-movement of the passive type. This contrast gives empirical support to the distinction between two subclasses of verbs that occur with the case marking pattern B: class 1 verbs and class 2 verbs. Passivization of

Class 1 verbs (case-marking pattern B_1) is illustrated in (6). The undergoer-dative in (6a) is not preserved under A-movement (passivization) in (6b), which supports the view that case marking is structurally licensed in this class: the highest argument in the configuration receives the nominative case (see also Tuite 1987).

(6) Class 1, series I, pattern B_1

(a) nino vano-s č'r-i-s.
Nino(NOM) Vano-DAT wound-THM-S.3.SG
'Nino wounds Vano.'

(b) vano i-č'r-eb-a (nino-s mier).
Vano(NOM) PASS-wound-THM-S.3.SG Nino-GEN by
'Vano is wounded (by Nino).'

Class 2 verbs (case-marking pattern B_2) do not allow for A-movement of the passive type, as illustrated in (7). The difference between the two verb classes relates to the fact that the higher argument of class 2 verbs does not have agentive properties (see also discussion of similar facts from Icelandic in Yip et al. 1987: 225). A large subset of the verbs in this class consists in deponentia.

(7) Class 2, pattern B_3

(a) nino vano-s st'umr-ob-s/
Nino(NOM) Vano-DAT (IO.3)visit-THM-S.3.SG
e-čxub-eb-a.
(IO.3)PV-fight-THM-S.3.SG
'Nino is visiting/fighting with Vano.'

(b) *vano nino-s mier i-st'umr-eb-a/
Vano(NOM) Nino-GEN by PASS-visit-THM-PASS-S.3.SG
i-čxub-eb-a.
PASS-fight-THM-S.3.SG
(intended) 'Vano is visited/fighted by Nino'.

These data support the view that the case-marking pattern B subsumes two superficially identical but qualitatively different subtypes: subtype B_1 involves a higher argument with agentive properties and a lower argument that is structurally marked for the dative case; subtype B_3 involves a higher argument without agentive properties and a lower argument that is marked for the dative case through the lexical specification of the verb.

2.5. Stratal uniqueness

Stratal uniqueness requires that the case-to-argument correspondences at each layer of case licensing are biunique, i.e., that case affixes within each layer are unambiguously associated with one and the same argument (see Perlmutter and Postal 1986: 92, Stiebels 2000: 64, Blevins 2005). The fact that the same case affix may occur on two different arguments in certain patterns (see dative affix on

the undergoer and goals in pattern B) but cannot occur on two different arguments in other patterns (see dative affix on actors but not on goals in pattern C) reveals that case licensing of the latter arguments – but not of the former – takes place within the same licensing layer. Following the assumptions in Table 3, double occurrence of the dative affix is not banned when the undergoer dative is structurally licensed and the goal dative is thematically licensed, as in pattern B_1 but is excluded when both arguments bear a non-structural case, as in pattern C_1.

Previous accounts that subsume class 1 and class 2 verbs under the same case-marking pattern (see pattern B in Table 1) do not mention the fact that the addition of a dative goal is only possible for class 1 and 3 verbs (see Table 3). A goal constituent with class 2 is not encoded through the dative case but is headed by a postposition, as exemplified in (8a-b).

(8) Class 2, pattern B_3

(a) nino vano-s šesaxeb dato-s
Nino(NOM) Vano-GEN about Dato-DAT
e-lap'arak'-eb-a.
(IO.3)PR-speak-THM-S.3.SG
'Nino is speaking with Dato about Vano.'

(b) *nino vano-s dato-s e-lap'arak'-eb-a.
Nino(NOM) Vano-DAT Dato-DAT (IO.3)PV-speak-THM-S.3.SG

Further evidence for stratal uniqueness is provided by causative verbs, which are class 1 verbs independently of the conjugation class of the base verb (see Harris 1981:132).[3] The facts from class 1 verbs in the three case-marking patterns are presented in (9).

(9) (a) Class 1, series I, pattern B_1
soso dato-s nino-s-tvis c'ign-s
Soso(NOM) Dato-DAT Nino-GEN-for book-DAT
a-čuk-eb-in-eb-s.
(IO.3)PV-donate-THM-CAUS-THM-S.3.SG
'Soso makes Dato give Nino a book (as a present).'

(b) Class 1, series II, pattern A_1
soso-m dato-s nino-s-tvis c'ign-i
Soso-ERG Dato-DAT Nino-GEN-for book-NOM
a-čuk-eb-in-a.
(IO.3)PV-donate-THM-CAUS-AOR.S.3.SG
'Soso made Dato give Nino a book (as a present).'

[3] Hence, causativization can be only used as a diagnostic for the case properties that depend on inflection within class 1.

(c) Class 1, series III, pattern C_1
soso-s dato-s-tvis nino-s-tvis mi-sa-cem-ad
Soso-DAT Dato-GEN-for Nino-GEN-for PR-PTC-give-ADV
c'ign-i
book-NOM
u-čuk-eb-in-eb-i-a.
(INV.S.3)PV-donate-THM-CAUS-THM-PRF-INV.O.3(INV.S.SG)
'(Apparently) Soso has made Dato give Nino a book (as a present).'

Table 4 summarizes the case-marking patterns presented in (9a-c) in comparison to the basic patterns of Table 3. The causee argument is marked by an inherent dative in patterns A_1 and B_1, hence it excludes the use of the dative for the goal constituent in both patterns and it does not conflict with the structural dative marking of undergoers in pattern B_1. In pattern C_1, the inherent dative of the causer does not allow for a second inherent dative for the causee, which is rendered through a PP instead.

Table 4. Case licensing of causative verbs

		causer	actor/causee	undergoer	goal
A_1	basic		ergative$_\theta$	s_H	dative$_\theta$
	causative	ergative$_\theta$	dative$_\theta$	s_H	(postpositional)$_\theta$
B_1	basic		s_H	s_L	dative$_\theta$
	causative	s_H	dative$_\theta$	s_L	(postpositional)$_\theta$
C_1	basic		dative$_\theta$	s_H	(postpositional)$_\theta$
	causative	dative$_\theta$	(postpositional)$_\theta$	s_H	(postpositional)$_\theta$

2.6. Summary

This section has shown that there are two distinct and ordered layers of the licensing case: the first layer is non-structural and determines the case according to case-marking information in the subcategorization frame of the verb. In the second layer, case marking is structural, i.e., it is determined by the position of the argument in the syntactic configuration. The two layers are ordered, since structural case marking applies to those arguments that do not already bear a non-structural case.

The crucial point of the account sketched in the previous sections is that the contrast between the direct and inverse patterns is not the result of a symmetric mutual exchange of the case marking of the arguments. Direct case marking arises when both actor and undergoer receive case properties from the structural configuration, whereas inverse case marking arises when the actor is not eligible for structural case marking. This view implies that the dative affix has a twofold contribution to the case system: in the direct case marking of class 1 verbs, the dative of

the direct object is the morphological exponent of the lower structural case (hence it functionally corresponds to the accusative); the dative affix of inverse actors or indirect objects is a non-structural case.

It has to be noted that there is *no syntactic evidence that case marking affects argument asymmetries*. The facts from word order (Skopeteas and Fanselow 2009, 2010), from control predicates and from binding properties (see Harris 1981, Asatiani 1982, Amiridze 2005, 2006, McGinnis 1997, 2004) provide evidence for argument asymmetries that suggest a hierarchical syntactic structure, such that actor > undergoer. In all these phenomena, whenever evidence for a syntactic asymmetry is available, it holds that $\{NP_{NOM} > NP_{DAT}\}$ in the direct case-marking pattern and $\{NP_{DAT} > NP_{NOM}\}$ in the inverse case-marking pattern, which amounts to saying that {actor > undergoer} holds across case-marking patterns, or simply that case marking does not interact with argument asymmetries.

3 SYNTACTIC PROCESSING OF CASE

3.1. Preliminaries

The aim of this section is to formulate the observations in section 2 in terms of optimality theoretical constraints in order to derive predictions concerning the processing of Georgian sentences. We subsume the licensing conditions for inherent and lexical cases under a common constraint that prevents deviations from the specifications carried by the verbal head. This constraint applies on pairs of the form {role→case} that correspond to the non-structural cases licensed by the verbal head (either lexically or through its inflectional properties). The relevant pairs for the marking of actor and undergoer are two: {actor→dative$_\theta$ (class 4 verbs, perfect series of class 1 verbs), undergoer→dative$_\lambda$ (class 2 verbs)}. The constraint on the selectional properties is formulated in (10) and is not violable in Georgian.

(10) Constraint I: SELECTION
Do not violate specifications of the predicate concerning non-structural case licensing.

Structural case marking is strictly determined by locality, i.e., the highest eligible (non-structurally case marked) argument receives the highest case. This condition is formulated in terms of a violable constraint that ranges over two ordered sets: the set of arguments {external, internal} and the set of morphological cases {nominative, dative} and bans disharmonic alignments between these hierarchies.

(11) Constraint II: LOCALITY
Do not mark the highest argument with the non-highest eligible structural case.

Word order is a probabilistic cue for grammatical functions in Georgian. Actors precede undergoers in the canonical word order but deviations from this order are possible – though contextually restricted (see in particular Harris 1981, Apridonidze 1986, Asatiani 2007, 2008, Skopeteas et al. 2009, Skopeteas and Fanselow 2009 and 2010). Notably, undergoer constituents may scramble over actor constituents, when the former but not the latter are discourse-anaphoric. In view of these facts, we assume that the default interpretation of an {argument, argument} chain will be {actor, undergoer}. These facts are straightforwardly captured by a violable constraint that bans deviations from the canonical word order (in the sense of Grimshaw 1997).

(12) Constraint III: STAY
Do not move.

The constraints above apply in strict order (see ranking in (13)). The constraint SELECTION is not violable, i.e., violations of the selectional properties of the verbal head lead to non-grammatical expressions. Structural case licensing has the status of an elsewhere condition, i.e., it applies on the subset of arguments that do not bear a non-structural case. This asymmetry is captured through the constraint ranking: SELECTION dominates LOCALITY. Word order is dominated by the case licensing constraints, since scrambling object constituents over subject constituents is always possible – and indeed frequently attested. .

(13) SELECTION >> LOCALITY >> STAY

Optimality theoretical constraints refer to the choice of an optimal candidate among a set of possible structures, hence they straightforwardly apply on language production. In the context of our investigation, these constraints are used in order to account for data from language processing, which requires the above constraints to be part of the hearer's model. The underlying assumption is that *the hearer assumes that the speaker observes the constraints and their ranking*.

3.2 Incremental optimization

In sentence comprehension, the hearer incrementally develops assumptions about clause structure that are derived by the constraint interaction in (13) and these assumptions are subject to revision during the incremental parsing of the utterance (see Fanselow et al. 1999b and the model of incremental optimization in De Hoop and Lamers 2006). At the time point $<t_1>$ of the utterance in (14), the speaker has processed the case and word order properties of two lexical NPs (i.e., NP_{NOM} NP_{DAT}). His/her assumptions about clause structure at this time point are determined by LOCALITY and STAY. Both constraints suggest that the nominative and first NP is the actor constituent (see Tableau 1). At the time point $<t_2>$, the speaker has processed the verb. The verb belongs to class 1/series I, i.e., it does not license

any inherent case and SELECTION is vacuously satisfied. Hence, the optimal interpretation in $<t_1>$ is identical to the optimal interpretation in $<t_2>$.

(14) Class 1, series I, pattern B_1
ǯarisk'ac-i monadire-s da-č'r-i-s.
soldier-NOM hunter-DAT $<t_1>$ 'will wound' $<t_2>$
'The soldier will wound the hunter.'

Tableau 1. ACT→nom&first, V: class 1, series I; see (14)

NP_{NOM} NP_{DAT}... $<t_1>$	...V $<t_2>$	SELECTION	LOCALITY	STAY
☞ ACT→nom&first	☞ ACT→nom&first			
ACT→dat&non-first	ACT→dat&non-first		*	*

Though superficially identical, the situation with class 2 verbs is slightly different (see (15)). Verbs of this class are lexically specified for a dative undergoer, hence the input at $<t_2>$ involves the information that the undergoer bears $dative_{\lambda}$. By consequence, SELECTION applies at $<t_2>$, reinforcing the assumption already made by LOCALITY and STAY at $<t_1>$.

(15) Class 2, pattern B_3
ǯarisk'ac-i monadire-s e-lod-eb-a.
soldier-NOM hunter-DAT $<t_1>$ 'waits' $<t_2>$
'The soldier waits for the hunter.'

Tableau 2. ACT→nom&first, V: class 2; see (15)

NP_{NOM} NP_{DAT}... $<t_1>$	...V {UND→dat} $<t_2>$	SELECTION	LOCALITY	STAY
☞ ACT→nom&first	☞ ACT→nom&first			
ACT→dat&non-first	ACT→dat&non-first	*	*	*

In sentence (16), the NP_{DAT} NP_{NOM} order creates a conflicting situation at $<t_1>$: LOCALITY predicts that the actor is the nominative argument, while STAY makes the opposite prediction. The conflict at $<t_1>$ is resolved by the constraint ranking in favor of the former prediction and this option is confirmed at $<t_2>$, since the class 1 series I verbal head does not license any inherent argument and SELECTION is vacuously satisfied.

(16) Class 1, series I, pattern B_1
monadire-s ǯarisk'ac-i da-č'r-i-s.
hunter-DAT soldier-NOM $<t_1>$ 'will wound' $<t_2>$
'The soldier will wound the hunter.'

Tableau 3. ACT→nom&non-first, V: class 1, series I; see (16)

NP_{DAT} NP_{NOM}... <t_1>	...V <t_2>	SELECTION	LOCALITY	STAY
☞ ACT→nom&non-first	☞ ACT→nom&non-first			*
ACT→dat&first	ACT→dat&first		*	

SELECTION applies with a class 2 verb (see (17) and Tableau 4). Incremental optimization proceeds in the same way as for class 1 series I verbs (compare Tableaux 3 and 4) but the verb that is processed at <t_2> is lexically specified for a $dative_{\lambda}$ undergoer. The outcome of the application of SELECTION reinforces the interpretation that results from the ranking of LOCALITY and STAY at <t_1>.

(17) Class 2, pattern B_3
monadire-s ǯarisk'ac-i e-lod-eb-a.
hunter-DAT soldier-NOM <t_1> 'waits' <t_2>
'The soldier waits for the hunter.'

Tableau 4. ACT→nom&non-first, V: class 2; see (17)

NP_{DAT} NP_{NOM}... <t_1>	...V{UND→dat} <t_2>	SELECTION	LOCALITY	STAY
☞ ACT→nom&non-first	☞ ACT→nom&non-first			*
ACT→dat&first	ACT→dat&first	*	*	

Sentences (18)-(19) present sentences in which the verb licenses a $dative_{\theta}$ actor. Up to <t_1>, the hearer has processed the same case and order information as in sentences (16)-(17) and is confronted with the same conflict between LOCALITY and STAY, which suggests a nominative actor. Processing the selectional properties of the verbal head in <t_2> involves a revision of the assumed argument structure, since the class 1, series III verb in (18) and the class 4 verb in (19) license a $dative_{\theta}$ actor. This revision is presented in Tableau 5: the optimal candidate at <t_1> differs from the optimal candidate at <t_2>.

(18) Class 1, series III, pattern C_1
monadire-s ǯarisk'ac-i da-u-č'r-i-a.
hunter-DAT soldier-NOM <t_1> 'has wound' <t_2>
'The hunter has wound the soldier.'

(19) Class 4, pattern C_2
monadire-s ǯarisk'ac-i s-ʒul-s.
hunter-DAT soldier-NOM <t_1> 'hates' <t_2>
'The hunter hates the soldier.'

Tableau 5. ACT→dat&first, V: class 1, series III or class 4; see (18)-(19)

NP_{DAT} NP_{NOM}...	...V{ACT→dat}	SELECTION	LOCALITY	STAY

<t_1>	<t_2>			
☞ ACT→nom&non-first	ACT→nom&non-first	*		*
ACT→dat&first	☞ ACT→dat&first		*	

Finally, sentences (20)-(21) illustrate the revision of a stronger initial assumption about the thematic properties of the processed NPs. Both LOCALITY and STAY suggest that NP_{NOM} is an actor. However, the verb processed at <t_2> licenses a dative$_\theta$ actor (see Tableau 6).

(20) Class 1, series III, pattern C_1
ǯarisk'ac-i monadire-s da-u-č'r-i-a.
soldier-NOM hunter-DAT <t_1> 'has wound' <t_2>
'The hunter has wound the soldier.'

(21) Class 4, pattern C_2
ǯarisk'ac-i monadire-s s-ʒul-s.
soldier-NOM hunter-DAT <t_1> 'hates' <t_2>
'The hunter hates the soldier.'

Tableau 6. ACT→dat&non-first, V: class 1 (III) or class 4; see (20)-(21)

NP_{NOM} NP_{DAT}... <t_1>	...V{ACT→dat} <t_2>	SELECTION	LOCALITY	STAY
☞ ACT→nom&first	ACT→nom&first	*		
ACT→dat&non-first	☞ ACT→dat&non-first		*	*

The constraint interactions presented so far differ in the following respects:

- some sentences involve at <t_2> a revision of the hearer expectations at <t_1> (see Tableaux 5 and 6),
- the hearer's expectations at <t_1> involve two different degrees of "strength" depending on the constraint interactions that motivate them. A 'strong' assumption at <t_1> is motivated by converging evidence from both LOCALITY and STAY (see Tableaux 1, 2 and 6). A 'weak' assumption at <t_1> is motivated by LOCALITY but involves conflicting evidence from the lower ranked constraint STAY (see Tableaux 3, 4 and 5). In the latter cases, LOCALITY suggests that the dative argument is an undergoer but STAY suggests that it is an actor. It is only due to the ranking of LOCALITY over STAY that the former expectation is stronger at <t_1>.

Combining these differences results in a scale that reflects the extent to which the optimal candidate in <t_2> is expected at <t_1> (see Table 5). The order in Table 5 implies that thematic revision at <t_2> is expected to have the stronger impact on processing difficulty. Whenever thematic revision is involved, it will be easier to process when the expectation at <t_1> is weak. If no revision is involved, then the strength of the expectations at <t_1> will increase the ease of processing. The aim

of our empirical study is to examine whether the asymmetries in Table 5 have a discernible effect on the processing time.

Table 5. Predictions

(predicted) ease of processing		strength of assumption at $<t_1>$	thematic revision at $<t_2>$	Tableau
NP_{NOM} NP_{DAT}...	V	strong	no	1
	V{UND→dat}	strong	no	2
< NP_{DAT} NP_{NOM}...	V	weak	no	3
	V{UND→dat}	weak	no	4
< NP_{DAT} NP_{NOM}...	V{ACT→dat}	weak	yes	5
< NP_{NOM} NP_{DAT}...	V{ACT→dat}	strong	yes	6

Note, furthermore, that a further distinction is possible among the Tableaux that does not involve thematic revision at $<t_2>$: in case of class 1 verbs (Tableaux 1 and 3), SELECTION is vacuously satisfied, while in case of class 2 verbs SELECTION reinforces the hearer's expectations. This asymmetry allows for further predictions concerning the strength of the reinforcement of hearer's expectations. However, we will not be able to consider this asymmetry in our study, since the experimental design does not involve minimal pairs for the contrast between class 1 and class 2 verbs.

7.3.3 Method

Our study consists in two independent experiments that were performed within the same experimental sessions, as explained below. The first experiment examines the contrast between series I and series III in class 1 verbs and the second experiment examines the contrast between class 2 and class 4 verbs, see experimental conditions in (22)-(23). Each experiment contains two factors, 'case' {actor→nominative, actor→dative} and 'order' {actor→first, actor→non-first}, which are crossed, hence rendering 4 experimental conditions.

(22) Experiment I: series' contrast
  (a) actor → nominative and first (class 1, series I); see (14)
  (b) actor → nominative and non-first (class 1, series I); see (16)
  (c) actor → dative and first (class 1, series III); see (18)
  (d) actor → dative and non-first (class 1, series III); see (20)

(23) Experiment II: classes' contrast
  (a) actor → nominative and first (class 2); see (15)
  (b) actor → nominative and non-first (class 2); see (17)
  (c) actor → dative and first (class 4); see (19)
  (d) actor → dative and non-first (class 4); see (21)

The task was implemented in a DMDX presentation. Native speakers were shown a nominative and a dative NP on the screen (either in the nominative-first or in the dative-first order) and an empty slot at the place of the missing verb. After 5 sec., the verb appeared in the clause final slot. The speakers were instructed to judge if this sentence is "right" or "false" in Georgian by pressing the corresponding keys (left SHIFT=right, right SHIFT=false) as soon as they could. Timing started when the verb appeared on the screen (time window: 10 sec).

For each experiment, 16 items were created in a factorial design rendering four data points per participant for each experimental condition. Each item contained two NPs with animate referents, which were used in all four conditions. For the first experiment, each experimental item contained a class 1 verb that was used in two different inflectional forms, namely future (series I) and perfect (series III). For the second experiment, we used verbs that lexically license a case-marking pattern: 8 items contained class 2 verbs (direct case marking) and 8 items contained class 4 verbs (inverse case marking). The complete list of verbs is given in the Appendix.

The 16 items of both experiments were distributed to four different versions of the DMDX presentations, so that every participant saw each item once. Each presentation contained four trials per experimental condition for each experiment (total: 4 trials × 4 conditions × 2 experiments = 32 trials). Additionally, 96 fillers were used that were identical in the four presentations. 32 fillers were well formed sentences with very different clause structures (intransitives, passives, verbs with adjuncts, etc.). The remaining 64 fillers displayed several violations of the selectional properties of the verbs. The 32 target sentences and the 96 fillers were pseudo-randomized for each participant. In sum, 32 participants (18 female, 14 male, age range 19-25, average: 21.9) took part in the experiment (Tbilisi, September 2005).

The choice of verbs was based on the appendix of verb classes in Harris (1981). The examined conditions are necessarily based on different inflectional forms of the same verb (Experiment I) or on different verbs (Experiment II). In order to estimate the influence of item-specific properties to the result, we performed a lexical decision experiment. The verb forms used in experiments I and II were distributed in two DMDX presentations (in order to avoid lexical repetition of the class 1

verbs in two different inflectional forms), pseudo-randomized together with a further 72 filler elements. 10 participants took part in this experiment (7 female, 3 male, age range 20-25, average: 21.7), who were different from the participants of the main experiments I and II. The resulting data set contains 5 measurements of the reaction time for each verb form used in either experiment.

7.3.4 Results

Experiments I and II resulted in a data set of 16 (target sentences) × 32 (participants) = 512 reaction time measurements each. Some measurements were classified as non-valid either because the participant judged the stimulus as 'false' or because the participant did not give any judgment within the time window (46 measurements in Experiment I and 19 measurements in Experiment II). After excluding this data, we computed the *z*-transformation of the gathered RTs per participant and excluded 1 measurement in Experiment I and 11 measurements in Experiment II that strongly deviated from the participant's means ($z > \pm 2.5$). The measurements presented below are calculated on the remaining valid RTs (Experiment I: 512 – 46 – 1 = 465 valid RTs; Experiment II: 512 – 19 – 11 = 482 valid RTs).[4]

The obtained reaction times were positively skewed (experiment I, $g_1 = .9$, SE= .1; experiment II, $g_1 = 1.2$, SE= .1); in order to meet the normality requirements of parametric tests, a logarithmic transformation (based on the natural logarithm) was applied on the primary data. The analyses reported in the following are calculated on the log transformed data. A repeated-measures analysis of variance was carried out on the logarithmized data of both experiments (at an α level of .05). This analysis revealed a significant main effect of case marking ($F_{1,31} = 23.28$, $p < .001$)[5], a significant main effect of word order ($F_{1,31} = 8.13$, $p < .01$), a significant main effect of experiment, i.e., of the factor lexical vs. inflectional licensing of case marking ($F_{1,31} = 57.26$, $p < .001$), a significant interaction between these three factors ($F_{1,31} = 4.55$, $p < .05$) and no significant effects for the interactions among the pairwise crossed factors. The crucial finding of this analysis is the significant threefold interaction 'licensing × case × order'. In order to assess the sources of this interaction, we performed analyses of variance for each experiment separately, which are reported in the following sections.

[4] The 77 missing values were distributed in the obtained data of 26 speakers, such that at least one valid reaction time was available for every speaker in every condition in both experiments.

[5] Following a proposal by Raaijmakers et al. (1999), we only report the subject analysis (averaging over items), since item variability is experimentally controlled.

7.3.4.1 Inflectional case licensing (series I vs. series III)

Experiment I examines the contrast between future (series I) and perfect (series III) of class 1 verbs. Actors and undergoers of future tense class 1 verbs are structurally case-marked, while actors of perfect tense verbs bear a non-structural dative$_\theta$ (see Table 5). The obtained means of the RTs, the means of the logarithmized measurements, as well as the means of the residuals (see below) are given in Table 6.

Table 6. Means of RTs, logarithmized measurements and residuals in Experiment I

	First→ACT			Non-first→ACT		
	msec	log(rt)	residuals	msec	log(rt)	residuals
Nom→ACT (series I)	2 171	7.60	-.055	2 319	7.66	.007
Dat→ACT (series III)	2 558	7.75	.011	2 632	7.80	.064

As may be observed in Fig. 1, the preference for nominative actors has a strong impact on reaction times. Descriptively, we observe an additional effect of the word order. A repeated-measures ANOVA on the logarithmized data at an α level of .05 revealed a significant main effect of case marking ($F_{1,31} = 18.27$, $p < .001$); the effect of the word order as well as the interaction did not reach significance.

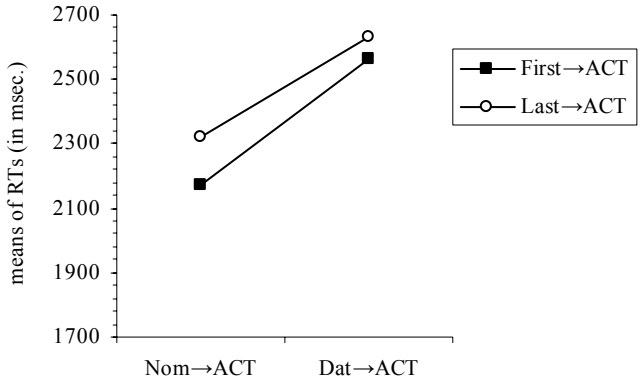

Fig. 1. Reaction times in Experiment I

On the basis of the results from the lexical decision test, we calculated the means of reaction times for each verb form. The natural logarithm of each mean was inserted to a linear regression analysis as a predictor for the logarithmized reaction times obtained by the conditions involving the corresponding verb form. This analysis gave a highly significant regression coefficient ($t = 3.74$, $p < .001$), which indicates that the processing cost of the individual verb forms has a significant

impact on sentence processing. In order to eliminate this impact, we carried out an evaluation of the residuals (see means per experimental condition in Table 6), assuming that these values give an estimate for the actual effect of the investigated factors independently of the processing cost of the individual verb forms. A repeated-measures ANOVA at an α level of .05 revealed a significant main effect of case marking ($F_{1,31} = 4.52$, $p < .05$) but neither a significant effect of order nor of the interaction between the two factors. This result confirms the significant main effect of case marking in the analysis of the reaction times and shows that this effect is independent from item-specific differences.

3.4.2. Lexical case licensing (class 2 vs. class 4)

Experiment II examines the contrast between class 2 and class 4 verbs. Class 2 verbs license a dative$_\lambda$ undergoer, while class 4 verbs license a dative$_\theta$ actor (see Table 5). The means of the obtained RTs and the corresponding logarithmized values are given in Table 7. RTs in experiment II were overall lower than the RTs of experiment I (see discussion below).

Table 7. Means of RTs, logarithmized measurements and residuals in Experiment II

	First→ACT			Non-first→ACT		
	msec	log(rt)	residuals	msec	log(rt)	residuals
Nom→ACT (class 2)	1 822	7.43	-.071	1 857	7.46	-.062
Dat→ACT (class 4)	1 870	7.46	-.003	2 264	7.65	.171

Fig. 2 indicates an ordinal interaction pattern for experiment II. A repeated-measures ANOVA, carried out on the logarithmized data at an α level of .05, revealed a significant main effect of case ($F_{1,31} = 9.73$, $p < .01$), a significant main effect of order ($F_{1,31} = 8.67$, $p < .01$) and a significant interaction between the two factors ($F_{1,31} = 9.44$, $p < .01$).

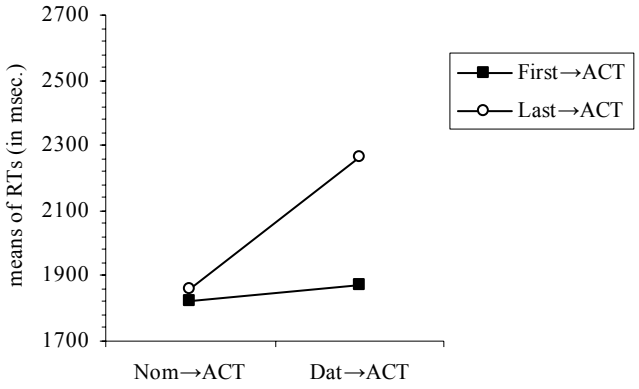

Fig. 2. Reaction times in experiment II

Paired sample (2-tailed) *t*-tests revealed significant differences for all comparisons with the 'Dat & Non-first →ACT' condition and only those (for a cumulative type I error below .05 the criterion of significance for six comparisons after the Bonferroni correction is .008).

(24) (a) Nom & First $<_{rt}$ Dat & Non-first ($t_{31} = 3.81$, $p < .001$)
(b) Nom & Non-first $<_{rt}$ Dat & Non-first ($t_{31} = 4.19$, $p < .001$)
(c) Dat & First $<_{rt}$ Dat & Non-first ($t_{31} = 3.50$, $p < .001$)

For the calculation of the effect of the individual verb forms on the obtained RTs we used the procedure described in section 3.4.1. A linear regression analysis on the RTs of the individual verbs (in the lexical decision text) and the corresponding RTs in experiment II revealed a significant regression coefficient ($t = 2.92$, $p < .01$). On the basis of a regression analysis carried out separately for every participant, we computed the means of the residuals in Table 7. A repeated-measures ANOVA at an α level of .05 revealed a significant main effect of case ($F_{1,31} = 30.03$, $p < .001$), a significant main effect of order ($F_{1,31} = 9.47$, $p < .01$) and a significant interaction effect ($F_{1,31} = 9.72$, $p < .01$). Paired *t*-tests (2-tailed) computed on the means of residuals gave the same significant differences with the logarithmized data (see (24)), as shown in (25) (significance level .008 after Bonferroni correction for six comparisons). We conclude that only the condition of a non-first dative actor involves a significantly higher processing cost.

(25) (a) Nom & First $<_{rt}$ Dat & Non-first ($t_{31} = 5.59$, $p < .001$)
(b) Nom & Non-first $<_{rt}$ Dat & Non-first ($t_{31} = 5.88$, $p < .001$)
(c) Dat & First $<_{rt}$ Dat & Non-first ($t_{31} = 3.57$, $p < .001$)

The computed residuals allow us to inspect the means' difference between the reaction times in the two experiments. Descriptively, we may observe that the overall means of the residuals does not substantially differ in experiment I (means: .006; C.I.: ±.03) and experiment II (means: .008; C.I.: ±.03), $t_{31} = .37$, $p < .8$. An

analysis of variance on the overall set of residuals (licensing × case × order) revealed that the main effect of (inflectional vs. lexical) licensing is not significant, which indicates that the difference we observe in the reaction times is eliminated if we take into account the differences in the processing cost of the verbs. We may speculate that a portion of this difference comes from the fact that the verbs of experiment I were complex inflectional forms (future or perfect), while the verbs of experiment II were presented in the present tense, which is morphologically unmarked but lexical differences may play a role as well.

3.5. Discussion

Table 8 compares the results reported in 3.4 with the predictions in Table 5. Experiment I yielded a significant main effect of case that implies two levels of processing cost: level α_I for the conditions with a nominative actor and level $\alpha_I + \beta_I$ for the conditions with a dative actor. Since the main effect of order was not significant, the related means' differences are not taken into account. In experiment II, only the order $\{NP_{NOM}\ NP_{DAT}\}$ with a dative actor differed significantly from all other experimental conditions; hence, we assume a level of processing cost α_{II} for the three conditions that involved shorter reaction times and a higher level $\alpha_{II} + \beta_{II}$ for the condition with a non-first dative actor. The resulting levels are in line with the predicted hierarchy in Table 5.

Table 8. Summary of predictions and results

Predictions		results (Exp. I)	results (Exp. II)
$NP_{NOM}\ NP_{DAT}$...	V({UND→dat})	α_I	α_{II}
< $NP_{DAT}\ NP_{NOM}$...	V({UND→dat})	α_I	α_{II}
< $NP_{DAT}\ NP_{NOM}$...	V{ACT→dat}	$\alpha_I + \beta_I$	α_{II}
< $NP_{NOM}\ NP_{DAT}$...	V{ACT→dat}	$\alpha_I + \beta_I$	$\alpha_{II} + \beta_{II}$

Both experiments show that word order does not have a significant impact in the conditions that involve a nominative actor. This is in line with the view that these conditions do not involve a revision of the assumed thematic properties of the processed NPs (see Table 5), which follows from the assumption that structural case information (LOCALITY) outranks word order (STAY).

The most important empirical finding is the significant threefold interaction 'licensing × case × order'. On the basis of the separate analyses of the experiments, we conclude that this effect results from the fact that the interaction 'case × order' depends on case licensing. Inflectional case licensing (Experiment I), did not yield a 'case × order' effect, since reaction times increase whenever the verb licenses a dative actor. Lexical case licensing (Experiment II), yielded a significant 'case × order' interaction. The crucial difference lies in the condition of non-first dative

actors (see Table 8). The non-canonical order of this condition is sanctioned when the hearer parses a verb that lexically licenses the dative actor.

We hypothesize that the empirical difference relates to the distinction between lexically and inflectionally licensed dative actors. It has been observed for German that a reanalysis towards a dative-first word order involves less processing effort than a reanalysis towards an accusative-first word order, since only the latter involves a reanalysis of the constituent structure (see revision of behavioral studies and qualitative neuro-physiological correlates in Bornkessel et al. 2004, Bornkessel and Schlesewsky 2007). In this view, it is not surprising that the thematic reanalysis of initial dative arguments as experiencers with class 4 verbs yields low processing cost. However, this explanation seems to be contradicted by the finding in the perfect tense of class 1 verbs. According to the observation in German, we may hypothesize that the processing of initial datives involves a reanalysis of the constituent structure with perfect tense verbs but not with experiencer verbs.

Dative actors of class 4 verbs are thematically determined by their relation to the lexical semantics of the verb. With class 1 verbs, dative actors in the perfect and nominative actors in the present denote the same range of thematic relations with the verb and mark both the external argument. Their case properties reflect the impact of the modal properties of the perfect to the relevance of the actor's involvement to the event (following assumptions in the literature summarized in section 2.3). We may thus speculate that the revision of the thematic properties of the morphological case with this verb group is associated with a reanalysis of the assumed constituent structure. Further research is required in order to test the implications of this claim and its compatibility with non-structural case licensing.

4. CONCLUSIONS

The aim of this article is to account on the morphological and syntactic properties of case inversion in Georgian and to examine their implications for syntactic processing. We have shown that the complex case-marking patterns in Georgian arise through two layers of case licensing, non-structural and structural. Evidence for this distinction comes from the thematic relatedness of case affixes and from stratal uniqueness effects. The crucial point is that the morphological dative shows mixed properties arising from the syncretism of a structural case (accusative) and an inherent case (dative). As a structural case, the dative affix marks the lower structurally case marked argument. As a non-structural case, the dative affix marks non-volitional actors of class 4 verbs, goal arguments of class 1 verbs, actor arguments of class 1 verbs in the perfect tense and is lexically licensed as a marker of the undergoer argument of class 2 verbs.

Furthermore, we presented the findings of two experiments on incremental processing of sentences with two case arguments that are thematically ambiguous. The results of these experiments provided evidence that case marking is a more reliable cue than word order in processing thematically ambiguous expressions in

Georgian. Scrambling the undergoer over the actor constituent of verbs with a nominative actor does not result in additional processing effort. Furthermore, the experimental findings suggest a difference between lexical and inflectional licensing of dative actors, since the revision of the thematic properties of lexically licensed datives is associated with low processing effort.

As stated in the introduction, Georgian sentence processing presents an interesting puzzle, since this language displays flexible word order (such as German) and no uni-directional case-to-argument associations (such as Icelandic). The experimental findings suggest that case information is indeed more used as a cue for assumptions about argument structure in this language. In the absence of a verbal head speakers build their assumptions according to the default rules of structural case marking and less according to word order. This finding is in line with the observation that in languages with rich morphological systems case marking is a particularly strong cue for the interpretation of the thematic properties of the arguments (see Bornkessel-Schlesewsky and Schlesewsky 2009: 159).

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Abbreviations 1: 1st person; 2: 2nd person; 3: 3rd person; AOR: aorist; CAUS: causative; DAT: dative; ERG: ergative; FUT: future; GEN: genitive; INV.S: inversive subject; INV.O: inversive object; IO: indirect object; NOM: nominative; PASS: passive voice; PRF: perfect; PL: plural; PR: preverb; PFV: perfective; PV: preradical vowel; S: subject; SG: singular; THM: thematic suffix.

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APPENDIX

Class 1 (experiment I)

dač'ris 'he/she wounds him/her'; *dabans* 'he/she washes him/her'; *dak'argavs* 'he/she looses him/her'; *irčevs* 'he/she chooses him/her'; aɣmertebs 'he/she admires him/her'; *k'lavs* 'he/she kills him/her'; *xedavs* 'he/she sees him/her'; *at'arebs* 'he/she carries him/her'; *malavs* 'he/she hides him/her'; *daɣlis* 'he/she makes him/her tired'; *acek'vebs* 'he/she causes him/her to dance'; *avarǯišebs* 'he/she makes him/her to exercise'; *amɣerebs* 'he/she makes him/her to sing'; *atamašebs* 'he/she causes him/her to play'; *amušavebs* 'he/she makes him/her to work'; *amepebs* 'he/she puts him/her on the throne'.

Class 2 (experiment II)

elodeba 'he/she waits him/her'; *šeepereba* 'he/she suits him/her'; *šeesabameba* 'he/she fits him/her'; *šeesat'q'viseba* 'he/she corresponds him/her'; *etamašeba* 'he/she plays with him/her'; *elap'arak'eba* 'he/she speaks with him/her'; *ečxubeba* 'he/she fights/quarrels him/her'.

Class 4 (experiment II)

st'umrobs 'he/she visits him/her'; *uq'vars* 'he/she loves him/her'; *sɣuls* 'he/she hates him/her'; *mosc'ons* 'he/she likes him/her'; *avic'q'deba* 'he/she forgets him/her'; *axsovs* 'he/she remembers him/her'; *enat'reba* 'he/she misses him/her'; *sč'irdeba* 'he/she needs him/her'; *aint'eresebs*[6] 'he/she interests/wonders him/her'.

[6] The verbs *sč'irdeba, avic'q'deba*, *enat'reba* and *aint'eresebs* share some morphological properties with class 2/class 1 verbs, however they both have an inversive argument structure, hence they have to be considered together with the class 4 verbs.