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Locality and variation in Finnish structural case

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Abstract Finnish has both nominative and genitive objects. The two cases are normally in a complementary distribution based on the local syntactic context (Jahnsson's Rule). The pattern breaks down in nonfinite clauses where the conditioning is non-local and the cases may occur in free variation. This puzzling pattern can be understood if we make the following assumptions: (i) structural case distinguishes the external argument from other arguments; (ii) structural case assignment is cyclic. In our optimality-theoretic analysis the choice of case is determined by the interaction of markedness constraints that apply cyclically and faithfulness constraints that protect case assigned on prior cycles. Non-locality arises because faithfulness is violable; free variation arises because constraint conflicts can be resolved in multiple ways. In addition to categorical well-formedness contrasts the analysis predicts degrees of well-formedness in cases of free variation.

Keywords Case · Locality · Cyclicity · Variation · Intermediate well-formedness · Optimality Theory

1 Introduction

Structural case has been the subject of much cross-linguistic research and has provided evidence for very different theoretical positions. In early GB, the Case Filter

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required overt NPs to have abstract case (Chomsky 1981). Abstract case and morphological case were initially assumed to be directly related, but it was soon pointed out that they were relatively independent, perhaps the best-known example being that of dative subjects in Icelandic (Zaenen et al. 1985). What is characteristic of this research program is the focus on the licensing of NPs in which morphological case plays a somewhat secondary diagnostic role.

In more recent work, one can distinguish two main views on structural case. One view holds that case is assigned to NPs by functional heads via agreement (e.g., Chomsky 2000, 2001; Legate 2008; Vainikka and Brattico 2014); for an overview, see Bobaljik and Wurmbrand (2009). An alternative view holds that case is assigned to an NP depending on the presence of other NPs in the same local domain (e.g., Yip et al. 1987; Marantz 1991; Maling 1993; Harley 1995; McFadden 2004, 2009; Sigurðsson 2006; Bobaljik 2008; Baker and Vinokurova 2010; Baker 2014, 2015; Levin and Preminger 2015; Poole 2015, 2016).

Finally, researchers of a functionalist orientation (e.g., Mallinson and Blake 1981; Comrie 1989) have understood structural case in terms of the need to identify and distinguish arguments, in particular direct objects (P) in nominative-accusative languages and transitive subjects (A) in ergative-absolutive languages. Interpreted as violable constraints in the sense of Optimality Theory (Prince and Smolensky 1993/2004), such functional principles have yielded new insights into structural case assignment (e.g., Legendre et al. 1993; de Hoop and Malchukov 2008).

In this paper, we will focus on two empirical phenomena that pose problems for all these approaches. The first is the problem of *non-locality*. It is commonly assumed that structural case is assigned within some local domain. In GB and Minimalism, this has been understood as a local head-government relation or local agreement between a lexical or functional head and the nominal in question (e.g., Chomsky 1981; Pesetsky and Torrego 2004, 2011; Bobaljik and Wurmbrand 2005). Apparent instances of long-distance case assignment have been argued to be in fact local (McFadden 2009). In non-derivational frameworks such as HPSG or LFG, the locality of case assignment has been attributed to local constraints on lexical selection, local constructional properties (e.g., Pollard and Sag 1994; Przepiórkowski 1999; Malouf 2000; Kim and Choi 2004) or local constraints on the association of case and grammatical functions (Zaenen et al. 1985; Nordlinger 1998; Butt 2006). Similarly, in Optimality Theory (Prince and Smolensky 1993/2004) case assignment has been understood in terms of constraints distinguishing core arguments within a local domain (Legendre et al. 1993; Woolford 2000; Aissen 2003; de Hoop and Malchukov 2008; Anttila and Kim 2011). However, there are many known examples where case assignment seems less local than expected; see, e.g., Zaenen et al. (1985) and Sigurðsson (2006) for Icelandic; Dench and Evans (1988) and Blake (1994) for languages of Australia; Raposo and Uriagereka (1990) for European Portuguese; Polinsky and Potsdam (2001) for Tsez; Bhatt (2005) for Hindi-Urdu; Legate (2005) for English; and most relevantly for our purposes, Kiparsky (2001); Brattico (2012); and Vainikka and Brattico (2014) for Finnish. Much less often discussed is the problem of *free variation*. This is a situation where two distinct cases, e.g., nominative and accusative, are interchangeable in the same environment, with no difference in meaning.

Finnish objects occur in four cases: nominative (NOM), genitive (GEN), accusative (ACC), and partitive (PAR).[1] The distribution of the partitive is a long-standing puzzle that involves semantic conditions (see, e.g., Kiparsky 1998); the accusative is limited to human pronouns. Both will be set aside here. In this paper we will focus on the nominative and the genitive whose distribution is largely complementary and syntactically conditioned (see, e.g., Hakulinen and Karlsson 1975).[2] The problems of non-locality and free variation arise in nonfinite clauses illustrated in (1) and (2). In both examples the matrix verb 'think' takes a non-finite complement 'Matti to have shot a bear.' The examples differ in matrix voice: (1) is active, (2) is passive.

(1) Pekka luul-i [Mati-n ampu-nee-n **karhu-n**].
Pekka.NOM think-PAST [Matti-GEN shoot-ACT.PERF-GEN **bear-GEN**]
'Pekka thought Matti to have shot a/the bear.'

(2) Kylä-ssä luul-tiin [Mati-n ampu-nee-n
village-INE think-PASS.PAST [Matti-GEN shoot-ACT.PERF-GEN
karhu ~ karhu-n].
bear.NOM ~ bear-GEN]
'In the village Matti was thought to have shot a/the bear.'

These examples show that matrix voice matters to case in the embedded clause: the embedded object is invariably GEN under active, but varies NOM ∼ GEN under passive with no difference in meaning. The non-locality problem has been discussed in, e.g., Vainikka (1989, 1993, 2003), Maling (2004), Kiparsky (2001, 2010), Brattico (2012), and Vainikka and Brattico (2014). The free variation problem has to the best of our knowledge never been explored in depth, with the remarkable exception of Itkonen (1976, 1981) whose work will be reviewed below. For the sake of brevity, we shall call these structures *Itkonen structures*.

Other non-finite complements show similar patterns. One such structure is discussed by Ikola (1950, 1957, 1964, 1989) and illustrated in (3) and (4):

(3) Pekka arvostel-i [päätös-tä ampu-a
Pekka.NOM criticize-PAST [decision-PAR shoot-1INF
karhu ~ karhu-n].
bear.NOM ~ bear-GEN]
'Pekka criticized the decision to shoot a/the bear.'

[1] Abbreviations: ACC 'accusative', ACT 'active', ELA 'elative', GEN 'genitive', IMP 'imperative', INE 'inessive', NOM 'nominative', P 'person', PAR 'partitive', PASS 'passive', PAST 'past tense', PERF 'perfective aspect', PL 'plural', PRES 'present/imperfective aspect', PX 'possessive suffix', SG 'singular'.

[2] The terminology surrounding Finnish structural case is somewhat confusing. One common view posits an abstract accusative (ACC) which is morphologically realized as zero (ACC/∅) homophonous with the nominative and as *-n* (ACC/n) homophonous with the genitive; see, e.g., Vainikka and Brattico (2014). In this paper, we take the view that the zero accusative is the nominative (see, e.g., Jahnsson 1871, and subsequently Timberlake 1974; Milsark 1985; Taraldsen 1985; Mitchell 1991; Maling 1993; Toivainen 1993; Nelson 1998; Kiparsky 2001) and the *-n* accusative is the genitive (see, e.g., Penttilä 1963; Vainikka 1989; Kiparsky 2001).

(4) Taas arvostel-tiin [päätös-tä ampu-a **karhu**].
again criticize-PASS.PAST [decision-PAR shoot-1INF **bear.NOM**]
'Again, the decision to shoot a/the bear was criticized.'

Here 'criticize' takes an NP object which contains a VP complement. The embedded object varies NOM ∼ GEN under an active matrix clause with no difference in meaning, but is invariably NOM under a passive matrix clause (see, e.g., Brattico 2012). For the sake of brevity, we shall call these structures *Ikola structures*.

Our solution to the non-locality problem builds on the assumption that case assignment is cyclic: case in a complex clause is a function of case in its constituents. The cycle has occupied a central place in linguistics since at least Chomsky et al. (1956) and continues to play a role under the notion of phase (Chomsky 2001). We interpret the cycle in terms of *Stratal Optimality Theory* (Kiparsky 2000): case is assigned by markedness constraints in a cyclic fashion; locality is imposed by faithfulness constraints that protect case assigned on prior cycles. Since faithfulness is violable the analysis predicts non-local effects under specific circumstances.

Our solution to the free variation problem starts from the insight that case is assigned by competition: the case assigned to an NP depends on the presence of other NPs in the same local domain. This "configurational" view of case assignment is discussed in, e.g., Zaenen et al. (1985), Yip et al. (1987), Marantz (1991), Maling (1993), Harley (1995), McFadden (2004, 2009), Sigurðsson (2006), Bobaljik (2008), Baker (2014, 2015), Levin and Preminger (2015), and Poole (2015, 2016). In certain environments, especially ones where markedness and faithfulness conflict, the competition results in multiple outcomes in the sense of *Partial Order Optimality Theory* (Anttila 1997; Anttila and Cho 1998/2003; Djalali 2014), hence variation. Crucially, the analysis does not stop at predicting variation, but also predicts degrees of well-formedness among the variants.

The paper is structured as follows. Section 2 lays out the basic empirical generalizations, gives an analysis of simplex clauses, and introduces our background assumptions about the place of variation in grammar. Section 3 derives the case patterns in Itkonen structures. In addition to well-formedness contrasts of the familiar categorical kind the analysis predicts intermediate degrees of well-formedness in cases of variation. Section 4 extends the analysis to Ikola structures. Section 5 addresses other nonfinite constructions. Section 6 discusses the alternative view that structural case is assigned through agreement, focusing on Vainikka and Brattico (2014), a recent agreement-based analysis of Finnish structural case, concluding that a cyclic analysis stated in terms of violable constraints goes further. Section 7 concludes the paper.

2 Preliminaries

2.1 Jahnsson's rule

The basic generalization about object case in Finnish is known as *Jahnsson's Rule* (Jahnsson 1871; Kiparsky 2001). The rule is stated in (5) and illustrated in (6) and (7).

(5) JAHNSSON'S RULE: If the verb has an overt subject, the object is genitive (GEN); if the verb has no subject, the object is nominative (NOM).[3]

(6) a. Active intransitive
Matti nukku-i.
Matti.NOM sleep-PAST
'Matti slept.'

b. Active transitive
Matti ampu-i **karhu-n**.
Matti.NOM shoot-PAST **bear-GEN**
'Matti shot a/the bear.'

(7) a. Imperative
Ammu **karhu**.
shoot.IMP **bear.NOM**
'Shoot a/the bear!'

b. Passive
Karhu ammu-ttiin.
bear.NOM shoot-PASS.PAST
'The bear was shot.'

The active transitive (6b) has an overt subject, therefore the object is GEN. The imperative (7a) and passive (7b) have no subject, therefore the object is NOM. While passivization demotes the subject, the object remains an object and is not promoted to subject; see, e.g., Manninen and Nelson (2004) and Kiparsky (2013).[4]

These case patterns have received a straightforward explanation in terms of the *Case Tier Hypothesis* (Yip et al. 1987; Maling 1993, 2004, 2009). The hypothesis is stated in (8):

(8) Given the hierarchy of grammatical functions SUBJ > OBJ > ADV
a. The most prominent NP gets NOM; the remaining NPs get GEN.
b. NPs bearing lexical/inherent cases are skipped.

The Case Tier Hypothesis can be illustrated from examples (6)–(7). If the clause has a subject it receives NOM (6ab); if in addition the clause has an object it receives GEN (6b); if the clause lacks a subject, but has an object, the object receives NOM (7ab).

The skipping of lexical/inherent cases can be illustrated from *existential clauses* (Ikola 1964: 32; Hakulinen and Karlsson 1979: Sect. 9.3.2; Vilkuna 2000: Sect. 4.4.2; Hakulinen et al. 2004: 893–894, 923) where we have a locative NP marked by a semantic case, an intransitive verb such as *olla* 'be', and a second NP. An example is given in (9).

(9) Metsä-ssä ol-i **karhu**.
forest-INE be-PAST **bear.NOM**
'In the forest there was a bear.'

[3]The statement in (5) cannot be found as such in Jahnsson's book. What we do find is a statement that the presence of a subject matters to making the object accusative (Jahnsson 1871: 10) and the absence of a "personal" subject matters to making it nominative (Jahnsson 1871: 14). Jahnsson's Rule is problematic if taken as an inviolable constraint (see Vainikka and Brattico 2014), but what is correct about it can be captured in terms of violable constraints, as we will see shortly.

[4]Any statement of Jahnsson's Rule must mention two special cases. First, human pronouns have a dedicated accusative form that is insensitive to the presence vs. absence of subject, e.g., *Ota minu-t* take.IMP 1P.SG-ACC 'Take me!' Second, plural objects are always realized in the unmarked nominative, e.g., *Matti ampui karhu-t* Matti.shot bear-PL.NOM 'Matti shot the bears'. Both will be set aside here.

The first NP *metsä-ssä* 'forest-INE' is skipped because it has an inherent inessive case. This leaves *karhu* 'bear' as the most prominent available NP which therefore receives NOM. Note that it does not matter whether *karhu* is a subject or an object, or neither, because the theory assigns case hierarchically, denying any direct connection between case and grammatical function.

Predicative clauses are an outstanding puzzle for the Case Tier Hypothesis because NOM is assigned twice. As shown in (10), both subject and predicative are NOM.

(10) **Matti** o-n **sotilas**.
Matti.NOM be-PRES.3P.SG **soldier.NOM**
'Matti is a soldier.'

The puzzle can be solved if we assume that case assignment operates on *argument structure*. Semantically, the predicative is not an argument, but a predicate that takes the subject as its argument showing agreement with it (Hakulinen and Karlsson 1979: Sect. 9.4; Vilkuna 2000: Sect. 3.2.2; Matushansky 2008). The predicative clause is thus like an intransitive clause in that it only contains one argument. The two NPs are thematically of equal prominence because they are linked to one and the same argument. This captures the two occurrences of NOM.

2.2 Classical Optimality Theory

In this section, we will develop an analysis of Finnish structural case in Optimality Theory and work out its predictions in simplex clauses. For a concise survey of work on case in Optimality Theory, see de Hoop (2009). The intuition behind our analysis can be stated as follows: case marking serves to distinguish the external argument from all other arguments; case marking should be avoided, if possible, especially on the external argument; and case marking proceeds in a cyclic fashion. These ideas are mostly traditional. In particular, the distinguishing function of case, the costliness of case marking, and the principle of the cycle are all familiar from earlier literature. Where we depart from the simplest imaginable theory built on these ideas is in the repeated reference to the external argument: it is the external argument that needs to be distinct from all other arguments, and it is the external argument that tolerates case marking the least. This departure will be empirically motivated in the course of the subsequent discussion. Our optimality-theoretic analysis states these informal intuitions in terms of the following three violable constraints:

(11)
a. *MARKEDCASE — Do not case-mark an argument.
b. *MARKEDCASE/E — Do not case-mark an external argument.
c. UNIQUENESS — The external argument on the current cycle must be distinct in case from all other arguments outside the external argument.

We assume that nominative is the unmarked case; any other case violates *MARKEDCASE (*MC). For precedents, see, e.g., Legendre et al. (1993), Aissen (1999, 2003), for similar views outside Optimality Theory, see, e.g., Vainikka (1989, 1993), McFadden (2009), McFadden and Sundaresan (2011). Marking an external argument is particularly costly and violates both *MARKEDCASE and *MARKEDCASE/E (*MC/E).

At the same time, UNIQUENESS (*UNIQ) requires the external argument to be distinct in case from all other arguments. For precedents, see, e.g., Wiik (1972), Hakulinen and Karlsson (1975), Toivainen (1993), T. Mohanan (1994), Anttila and Fong (2000), Wunderlich and Lakämper (2001), de Hoop and Malchukov (2008). Finally, we assume that case assignment is cyclic; for the same conclusion in a different framework, see Baker (2014). The cyclicity assumption will become relevant in complex clauses.

We now illustrate how this analysis accounts for case patterns in simplex clauses. First, consider transitive clauses. Inputs are argument structures that specify the number of NP arguments, the identity of the lexical verb, and the lexical/inherent cases assigned by the verb, if any. NP/E is an external argument; NP is an internal argument. Violations are marked by integers. The desired winner is marked by the symbol ☞.[5]

(12) **Matti** ampu-i **karhu-n**.
Matti.NOM shoot-PAST **bear-GEN**
'Matti shot a/the bear.'

(13) Transitive clause

NP/E NP	*MC/E	UNIQ	*MC
(a) *NOM NOM		1	
☞ (b) NOM GEN			1
(c) *GEN NOM	1		1
(d) *GEN GEN	1	1	2

The competition takes place between the unmarked NOM object and the marked GEN object. We are assuming that other marked cases such as elative (ELA) and inessive (INE) are ruled out independently unless licensed by faithfulness to lexical/inherent case, a point to which we will return shortly. In tableau (13) candidates (c) and (d) can never win, no matter how the constraints are ranked, because they are *harmonically bounded*: (c) has a superset of the violations of (b); (d) has a superset of the violations of (a); see, e.g., McCarthy (2008): 80–83. Harmonically bounded candidates are highlighted by graying out the entire row. To rule out candidate (a) we need the ranking UNIQ ≫ *MC. In other words, it is more important for the external argument to be distinct in case from other arguments than it is to avoid case. The required ranking is shown by an arrow above the tableau. The ordering of *MC/E with respect to the other two constraints is irrelevant.

Required rankings are easy to find with the help of a *comparative tableau* (Prince 2002a, 2002b; McCarthy 2008: Ch. 2; Brasoveanu and Prince 2011) where all loser rows have their constraints labeled **W** for 'favors the winner,' **L** for 'favors the loser,' or are else left unlabeled, as shown in (14).

[5]Certain adverbs of duration, measure, and frequency also receive structural case and behave more or less like objects, e.g., *Pekka nukkui tunni-n* 'Pekka slept an hour-GEN', *Kala painoi kilo-n* 'The fish weighed a kilo-GEN', *Pekka luki kirja-n kerra-n* 'Pekka read the book-GEN once-GEN'; see, e.g., Maling (1993). However, adverbs allow variation not found in argument case. For discussion of adverb case and an optimality-theoretic analysis, see Anttila and Kim (2011).

(14) Transitive clause (comparative tableau)

NP/E NP	*MC/E	UNIQ	*MC
(a) *NOM NOM		**W** 1	**L**
☞(b) NOM GEN			1
(c) *GEN NOM	**W** 1		1
(d) *GEN GEN	**W** 1	**W** 1	**W** 2

A ranking makes the desired winner optimal if it guarantees that all **L**s are dominated by some **W**. It is easy to see that the ranking UNIQ ≫ *MC is necessary to rule out (a). No other rankings are required. Harmonically bounded candidates (c) and (d) only contain winner-favoring constraints and thus require no ranking. Comparative labels are useful for making ranking arguments and we will use them occasionally for that purpose.[6]

Second, consider existential clauses. Following Kiparsky (2001), we take existential clauses to be intransitive clauses with an internal argument.

(15) Talo-ssa o-n **karhu**.
house-INE be-3P.SG **bear.NOM**
'There's a bear in the house.'

(16) Existential clause

NP-INE NP	*MC/E	UNIQ	*MC
☞ (a) INE NOM			
(b) *INE GEN			1

We assume that the inessive case on the locative NP is protected by an undominated constraint MAX-LEX that requires faithfulness to lexical/inherent case, making it invariant under structural case assignment. Only the second NP is available for structural case. Since the constraint UNIQ is idle, this NP receives the unmarked NOM. No rankings are needed; the ungrammatical candidate (b) is harmonically bounded.

Third, we turn to predicative clauses. Since the two NPs represent the same external argument the constraint UNIQ is idle and both NPs receive the unmarked NOM. No rankings are needed; all ungrammatical candidates are harmonically bounded.

(17) **Matti** o-n **sotilas**.
Matti.NOM be-3P.SG **soldier.NOM**
'Matti is a soldier.'

[6]A reviewer notes that the harmonically bounded candidate *GEN NOM with marked case on the subject and unmarked case on the object resembles the pattern in ergative languages, raising the question of how they would be analyzed. The reviewer suggests two possible solutions: (i) Ergative is inherent; see, e.g., Woolford (2006), Anand and Nevins (2006), Legate (2008), and McFadden (2009). Under this view, the ergative case would be protected by faithfulness to inherent case; (ii) Ergative is structural, see, e.g., Marantz (1991) and Baker (2014). Under this view, one could propose an additional constraint *MC/I 'Do not case-mark an internal argument' and ergative and accusative languages would be distinguished based on how this constraint is ranked relative to the others. We leave the choice between these two alternatives open.

(18) Predicative clause

NP/E NP/E	*MC/E	UNIQ	*MC
☞ (a) NOM NOM			
(b) *NOM GEN	1		1
(c) *GEN NOM	1		1
(d) *GEN GEN	2		2

This analysis of simplex clauses will serve as the starting point for our discussion. In the following sections, we will extend the analysis to variation in complex clauses.[7]

2.3 Partial Order Optimality Theory

Before turning to the variation facts we will lay out our assumptions about the place of variation in grammar. In Classical Optimality Theory (Prince and Smolensky 1993/2004) a grammar is a language-specific *total order* of universal constraints: every constraint is ranked with respect to every other constraint. Given our three constraints we have the six possible total orders shown in (19), together with their predictions for the simplex clauses. The three grammars compatible with Finnish are enclosed in a box.

(19) The six total orders

TOTAL ORDER	TRANSITIVE	EXISTENTIAL	PREDICATIVE
1. UNIQ ≫ *MC/E ≫ *MC	NOM GEN	INE NOM	NOM NOM
2. UNIQ ≫ *MC ≫ *MC/E	NOM GEN	INE NOM	NOM NOM
3. *MC/E ≫ UNIQ ≫ *MC	NOM GEN	INE NOM	NOM NOM
4. *MC ≫ UNIQ ≫ *MC/E	NOM NOM	INE NOM	NOM NOM
5. *MC/E ≫ *MC ≫ UNIQ	NOM NOM	INE NOM	NOM NOM
6. *MC ≫ *MC/E ≫ UNIQ	NOM NOM	INE NOM	NOM NOM

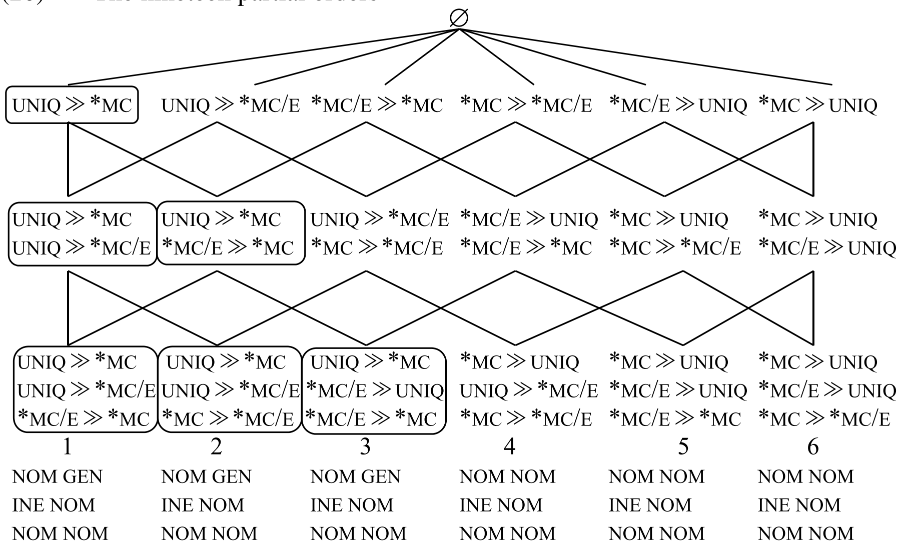
Which of the total orders 1–3 is the actual grammar of Finnish? Since all of them get the facts right it might seem that the choice does not matter. The problem is that making any choice at all forces one to say more than is warranted. For example, the evidence at hand does not determine the mutual ranking of *MC/E and *MC, yet the total order assumption will force one to choose either *MC/E ≫ *MC or *MC ≫ *MC/E. While analysts are often content to choose any total order that works, the choice is at best arbitrary and at worst incorrect given more data.

[7] A reviewer inquires about the analysis of human pronouns. The basic generalization is that human pronouns are ACC as internal arguments: *Minä näin sinu-t* 'I saw you-ACC' (active transitive); *Sinu-t nähtiin* 'You-ACC were seen' (passive transitive); *Minu-lla on sinu-t* 'I have you-ACC' (lit., 'On me is you', possessive); cf. *Minä olen hän* 'I am he.NOM' (predicative). This generalization could be stated as an undominated constraint. For the potential exception of unaccusatives, see Nelson (1998: 83–84). Not all human pronouns are alike. For example, *joku* 'someone' behaves like a lexical noun in terms of case, e.g., *Minä näin jo-n-ku-n* 'I saw someone-GEN' (active transitive); *Joku nähtiin* 'Someone.NOM was seen' (passive transitive); *Minu-lla on joku* 'I-ADE have someone.NOM' (possessive). We will return to the case marking of *joku* briefly below. The differential case marking of pronouns vs. lexical nouns is a complex problem that we cannot satisfactorily solve here; for an OT approach, see Aissen (2003).

What the evidence does show is that the ranking UNIQ ≫ *MC must be part of the grammar of Finnish. This ranking is shared by all the empirically correct total orders, but none of the empirically incorrect ones. We can say this and nothing more if we assume that the grammar of Finnish is the *partial order* {UNIQ ≫ *MC}, or equivalently, the set of total orders {1, 2, 3}.[8] This is the key assumption of Partial Order Optimality Theory (see, e.g., Anttila 1997; Anttila and Cho 1998/2003; Djalali 2014), the version of Optimality Theory adopted in this paper.

Just as (19) visualizes the six possible total orders hidden in a set of three constraints, (20) visualizes the nineteen possible partial orders. The partial orders compatible with the Finnish data are enclosed in boxes.

(20) The nineteen partial orders



The total orders appear at the bottom, numbered as in (19), together with their predictions for the simplex clauses (transitive, existential, predicative). The partial orders are arranged vertically by the subset relation: each mother grammar is the intersection of its daughter grammars.

There are two points of linguistic interest here. First, every partial order can be translated into a set of total orders.[9] This means that we can view an individual's grammar in two different ways: as a ranking relation, i.e., a set of ordered pairs of constraints, or as a set of total orders, i.e., a set of classical grammars. The choice between the two is a matter of convenience. We illustrate this in (21) for the six partial orders consistent with the Finnish data.

[8] An optimality-theoretic grammar can be defined as a set of ordered pairs *R* in the constraint set *C*, i.e., as a binary relation in *C*. In Classical Optimality Theory *R* is irreflexive, asymmetric, transitive, and connected. Partial Order Optimality Theory omits the connectedness assumption, see, e.g., Anttila and Cho (1998/2003). An introduction to ordering can be found in Partee et al. (1993: 39–53); for a formalization of Partial Order Optimality Theory, see Djalali (2014).

[9] The reverse does not hold: there are many sets of total orders that are not partial orders. For example, the set {1, 6} is not a partial order.

(21) Two views of grammar

RANKING RELATION	TOTAL ORDERS
{UNIQ ≫ *MC}	{1, 2, 3}
{UNIQ ≫ *MC, UNIQ ≫ *MC/E}	{1, 2}
{UNIQ ≫ *MC, *MC/E ≫ *MC}	{1, 3}
{UNIQ ≫ *MC, UNIQ ≫ *MC/E, *MC/E ≫ *MC}	{1}
{UNIQ ≫ *MC, UNIQ ≫ *MC/E, *MC ≫ *MC/E}	{2}
{UNIQ ≫ *MC, *MC/E ≫ UNIQ, *MC/E ≫ *MC}	{3}

Second, grammars are ordered by *simplicity*, defined as the amount of ranking information. The simplest grammar compatible with the Finnish data has one single ranking: {UNIQ ≫ *MC}. There are five other grammars that are also compatible with the data, but all contain more ranking information. Note that the amount of ranking information is inversely correlated with the number of total orders: the simplest grammar {UNIQ ≫ *MC} is compatible with largest number of total orders {1, 2, 3}. Of all the grammars compatible with the Finnish data, {UNIQ ≫ *MC} is the simplest. Assuming that simpler theories are better, all else being equal, this grammar must be our choice.

(22) The grammar of Finnish structural case:
UNIQ ≫ *MC (inferred from simplex clauses)

The key empirical advantage of Partial Order Optimality Theory is its ability to seamlessly combine invariant and variable patterns. We will assume that an individual randomly selects a total order compatible with the partial order at the moment of performance and evaluates it in the standard optimality-theoretic fashion. The grammar {UNIQ ≫ *MC} = {1, 2, 3} correctly predicts no variation in simplex clauses: the outcome is the same, no matter which of the three total orders is selected. In contrast, consider the hypothetical grammar {*MC/E ≫ *MC} = {1, 3, 5}. It is easy to see from diagram (20) that this grammar predicts NOM ∼ GEN variation in transitive clauses, a pattern not found in Finnish simplex clauses.[10]

The goal of the analysis is to find the simplest partial order that correctly predicts the Finnish case patterns. We will start by examining the empirical generalizations in complex clauses, showing that in some environments the case pattern is invariant (either NOM or GEN) while in other environments it is variable (NOM∼GEN). We will also observe that in the variable environments there are preferences: some environments prefer NOM, other environments prefer GEN. This raises two important general questions:

[10] A reviewer inquires about the empty grammar at the top of the diagram. The empty grammar allows any possible ranking of the three constraints, but that does not mean it allows any possible output pattern. In the case of (20), the empty grammar predicts variation in transitive clauses (NOM GEN ∼ NOM NOM), but no variation in existential (INE NOM) or predicative (NOM NOM) clauses. This is like actual Finnish except that it allows NOM ∼ GEN variation on direct objects. To the best of our knowledge, there is no such native dialect, but it might well be the dialect of a second language speaker whose first language lacks case inflection. Assuming that constraints are universal and rankings language-particular, the empty grammar is what a child brings into the world before exposure to language data. Such a grammar permits extensive variation, but in a way tightly constrained by Universal Grammar. In particular, the predicted dialect conforms to all the implicational universals that follow from these constraints, as discussed in Sect. 3.4.

(23) Why does variation (NOM ~ GEN) occur in some environments, but not in others?

(24) Why do different variable environments prefer different cases (NOM vs. GEN)?

In the sections to come, we will answer these questions. We first identify the simplest partial order compatible with the invariant patterns, and then show that it also predicts the variable patterns, including the quantitative preferences among the variants. This finding provides support for an interesting generalization succinctly formulated by Bane (2011): categorical data can explain much of the variable data.

3 Itkonen structures

3.1 Empirical generalizations

Itkonen structures, traditionally known as referative constructions (Hakulinen et al. 2004, Sect. 538–542), are nonfinite propositional complements of verbs like 'say', 'think', 'want', and 'believe'. These complement clauses are headed by a participle inflected for voice, aspect, and case. An example is given in (25).[11]

(25) Pekka luul-i [Mati-n nukku-va-n].
Pekka.NOM think-PAST [Matti-GEN sleep-ACT.PRES-GEN]
'Pekka thought Matti to be sleeping.'

The subject of the nonfinite clause is GEN. This GEN is independent of Jahnsson's rule and does not participate in the case alternations described above. Neither is it assigned by the matrix verb unlike in English where similar sentences involve Exceptional Case Marking (ECM); witness the fact that it does not alternate with NOM when the matrix verb is passivized, as shown in (1) and (2), repeated below.

(26) Pekka luul-i [**Mati-n** ampu-nee-n karhu-n].
Pekka.NOM think-PAST [**Matti-GEN** shoot-ACT.PERF-GEN bear-GEN]
'Pekka thought Matti to have shot a/the bear.'

(27) Kylä-ssä luul-tiin [**Mati-n** ampu-nee-n
village-INE think-PASS.PAST [**Matti-GEN** shoot-ACT.PERF-GEN
karhu ~ karhu-n].
bear.NOM ~ bear-GEN]
'In the village Matti was thought to have shot a/the bear.'

What is the source of the GEN on the subjects of nonfinite clauses? Vainikka (1989: 306, 1993: 138, 2011) argues that it is a structural default case for [Spec,XP] where X is a lexical category N, A, P, V, in this case [Spec,VP]. Based on evidence from binding, extraction, and adverb placement, Kiparsky (2010) argues that the GEN subject

[11] The following underlying forms may be assumed: the voice morphemes are /-∅/ 'active' and /-ttA/ 'passive'; the aspect morphemes are /-vA/ 'present', /-nee/ 'perfect', /ttA-vA/ 'passive, present', and /-tU/ 'passive, perfect'. The case morpheme is invariably /-n/ 'genitive'.

must in fact be located higher, in [Spec,CP], and proposes that the GEN is assigned by an empty complementizer in C. Both proposals share the view that this GEN is associated with a particular syntactic position. Here we will assume that this GEN is a structural case associated with the specifier of any nonfinite XP where X is N, A, P, V, or C. Crucially, it lies outside the case alternation system related to Jahnsson's Rule. We derive this from a high-ranking constraint [SPEC,−FIN] = GEN that requires GEN in these structural positions. The "default" nature of this GEN is evident from the fact that it is overridden by lexical/inherent case if one is required by the embedded participle (Vainikka 1993: 132, fn. 6). In terms of our analysis, this means that [SPEC,−FIN] = GEN is crucially dominated by the constraint MAX-LEX which requires faithfulness to lexical/inherent case.

The most striking fact about Itkonen structures is the long-distance interaction between matrix clauses and embedded clauses (see, e.g., Vainikka 2003; Vainikka and Brattico 2014). Particularly interesting are the variable patterns where either NOM or GEN is possible, but not to an equal degree, resulting in intermediate well-formedness judgments which depend on the input. In Kiparsky's (2010) words: "With respect to case assignment [Itkonen structures] are neither fully opaque domains, nor totally transparent ones, but complexly translucent." The variable patterns are illustrated below.[12]

(28) In embedded transitive clauses
  a. If the matrix verb is active, the object is GEN.
  b. If the matrix verb is passive, the object varies NOM∼GEN.

(29) Pekka luul-i [Mati-n ampu-nee-n
Pekka.NOM think-PAST [Matti-GEN shoot-ACT.PERF-GEN
***karhu/karhu-n**].
bear-*NOM/GEN]
'Pekka thought Matti to have shot a/the bear.'

(30) Mati-n luul-tiin [ampu-nee-n
Matti.GEN think-PASS.PAST [shoot-ACT.PERF-GEN
karhu ∼ karhu-n].
bear.NOM ∼ GEN]
'Matti was thought to have shot a/the bear.'

In addition to case variation, (30) also illustrates a word order generalization: if there is no matrix subject, as in passive matrix clauses, some postverbal constituent is usually fronted to the left of the matrix verb, reflecting a stylistic preference by which canonical declarative sentences tend to start with a nominal constituent (Hakulinen and Karlsson 1979: 303–305; Vilkuna 1989: 40). The fronted constituent may be the

[12] A reviewer asks about possible interpretational or structural differences between NOM and GEN. We have the explicit affirmation of Hakulinen and Karlsson (1975: 339): "No meaning difference is associated with the morphological difference between [genitive] and [nominative] [...]." Itkonen (1981: 105) discusses one potential difference, the influence of prescriptive rules, but dismisses it as irrelevant. We will see that the choice between NOM and GEN is largely predictable. If there were some unidentified structural difference involved, the evidence would simply show that the choice between the two structures is largely predictable.

embedded subject, here *Matin* 'Matti-GEN'. The process appears to have no effect on structural case.[13]

Next, consider embedded existential clauses. Here we get variation under both actives and passives, but NOM and GEN are not on an equal footing. The basic pattern is stated in (31) and illustrated in (32) and (33).

(31) In embedded existential clauses
 a. If the matrix verb is active, the NP prefers GEN.
 b. If the matrix verb is passive, the NP prefers NOM.

(32) Pekka luul-i [metsä-ssä ole-va-n
Pekka.NOM think-PAST [forest-INE be-ACT.PRES-GEN
?karhu ~ karhu-n].
bear-?NOM ~ GEN]
'Pekka thought there to be a bear in the forest.'

(33) Metsä-ssä luul-tiin [ole-va-n **karhu ~ ?karhu-n**].
forest-INE think-PASS.PAST [be-ACT.PRES-GEN **bear.NOM ~ ?GEN**]
'There was thought to be a bear in the forest.'

Finally, we turn to embedded predicative clauses. Again, we get variation, but with different preferences. The basic pattern is stated in (34) and illustrated in (35) and (36).

(34) In embedded predicative clauses
 a. If the matrix verb is active, the predicative prefers NOM.
 b. If the matrix verb is passive, the predicative strongly prefers NOM.

(35) Pekka luul-i [Mati-n ole-va-n
Pekka.NOM think-PAST [Matti-GEN be-ACT.PRES-GEN
sotilas ~ ?sotilaa-n].
soldier.NOM ~ ?GEN]
'Pekka thought Matti to be a soldier.'

(36) Mati-n luul-tiin [ole-va-n **sotilas ~ ??sotilaa-n**].
Matti-GEN think-PASS.PAST [be-ACT.PRES-GEN **soldier.NOM ~ ??GEN**]
'Matti was thought to be a soldier.'

3.2 A cyclic analysis

Any analysis of the above data must somehow accommodate the systematic patterns of variation. In some environments the case pattern is invariant (either NOM or GEN); in other environments it is variable (NOM~GEN). Our strategy will be to first identify

[13] Interrogative pronouns and topicalized NPs appear to be different. Itkonen (1981: 115–116) notes that GEN is preferred in cases like *Kene-n* [*hän sanoi vieraa-n olevan t*]? who-GEN [he.NOM said guest-GEN be-ACT.PRES-GEN *t*] 'Who did he say the guest to be?' *Yhtä hullu-n* [*minä luulen hänen olevan t kuin ennenkin*] as crazy-GEN [I believe he-GEN be-ACT.PRES-GEN *t* as before] 'I believe him to be as crazy as ever.' It is not clear to us what to make of this pattern.

the simplest partial order compatible with the invariant patterns. We will then show that this partial order also predicts the variable patterns, including the quantitative preferences documented by Itkonen (1976, 1981), with no adjustments or modifications.

3.2.1 Active matrix clauses

We start by considering case patterns under active matrix clauses. In (37) we have an active matrix clause combined with an embedded existential clause:

(37) Pekka luul-i [talo-ssa ole-va-n
Pekka.NOM think-PAST [house-INE be-ACT.PRES-GEN
?karhu ∼ karhu-n].
bear-?NOM ∼ GEN]
'Pekka (NP/E) thought there to be a bear (NP) in the house.'

What does our current analysis predict? UNIQ requires the external argument (*Pekka*) in the matrix clause to be distinct from the internal argument (*karhu-n*) in the embedded clause. The expected outcome is GEN, as in the simplex transitive clause *Matti ampui karhu-n* 'Matti.NOM shot a/the bear-GEN' in (13). But why is NOM (*karhu*) possible at all? In his article on case variation in complex clauses, Itkonen (1976: 77) makes an insightful suggestion: NOM appears on the strength of analogy with simplex clauses. As shown in (38), in the simplex clause we have *karhu* 'bear.NOM'. According to Itkonen, it is the nominative in the simplex clause that is responsible for the optional appearance of *karhu* 'bear.NOM' in the complex clause.[14]

(38) Itkonen's proposal: NOM in the simplex clause triggers NOM in the complex clause

a. Talo-ssa o-n **karhu**.
house-INE be-3P.SG **bear.NOM**
'There's a bear in the house.'

b. Pekka luul-i [talo-ssa ole-va-n **?karhu**
Pekka.NOM think-PAST [house-INE be-ACT.PRES-GEN **bear-?NOM**
∼ karhu-n].
∼ GEN]
'Pekka thought there to be a bear in the house.'

Empirically Itkonen's generalization seems to be exactly on the mark. Theoretically it provides evidence for the cycle: NOM occurs in the simplex clause for transparent reasons and is optionally inherited into the complex clause because the derivation is cyclic. Following Stratal Optimality Theory (Kiparsky 2000), we implement the cycle in terms of *Input-Output Faithfulness*. The relevant constraints are stated in (39):

[14]This proposal is anticipated in Hakulinen and Karlsson (1975: 345). For Itkonen, the data provided evidence against the transformational grammar of the day: he pointed out that his generalization would presuppose peculiar "sideways derivations" where output structures communicate with one another.

(39) Faithfulness constraints:
a. MAX/NP 'No case deletion in an NP'
b. DEP/NP 'No case insertion in an NP'

Faithfulness (DEP/NP) favors NOM (*karhu*) inherited from the first cycle; markedness (UNIQ) favors GEN (*karhu-n*) because it keeps the arguments distinct. As we will see shortly, in a system like Finnish where constraint ranking is partial the outcome is variation: GEN respects markedness, NOM respects faithfulness.

We now turn to the GEN case on the participle.[15] In Finnish, matrix verbs commonly mark their infinitival and participial complements with case. For example, verbs like 'ask' and 'forbid' mark the infinitive heading their VP-complement with the semantically appropriate local case (Fong 1997a, 1997b). Here we posit a general constraint that requires all nominal heads of a complement clause to be case-marked, i.e., to be non-nominative. The constraint is stated in (40); for precedents, see Aissen (2003: 447) and Anttila and Kim (2011). The formulation is intentionally general: the constraint applies to all nominal heads within the complement clause that are capable of case inflection, NPs as well as the participle.

(40) $*\varnothing_C$(CP) 'All nominal heads in a complement clause must be case-marked.'

The tableau in (41) shows the constraint violation profiles for all six constraints. The cases inherited from the first cycle are shown in the input. Recall that the inessive case INE is protected by the undominated constraint MAX-LEX which requires faithfulness to lexical/inherent case, ruling out all candidates where INE has been replaced by some other case, say, NOM or GEN. The grammatical candidates (a) and (b) are marked with the symbol ☞.

(41) Embedded existential

NP/E [NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	$*\varnothing_C$(CP)
(a)☞ NOM [INE oleva-n GEN]			1		1	
(b)☞ NOM [INE oleva-n NOM]				1		1
(c) *GEN [INE oleva-n GEN]	1		1	1	2	
(d) *GEN [INE oleva-n NOM]	1				1	1
(e) *NOM [INE oleva GEN]			1		1	1
(f) *NOM [INE oleva NOM]				1		2
(g) *GEN [INE oleva GEN]	1		1	1	2	1
(h) *GEN [INE oleva NOM]	1				1	2

Only candidates (a), (b), and (d) are viable; the rest are harmonically bounded. In particular, $*\varnothing_C$(CP) renders harmonically bounded all the candidates (e)–(h) where the participle is NOM (*oleva*). This is because there always exists a candidate with an identical violation profile except that it does better on $*\varnothing_C$(CP). We can therefore omit candidates with a NOM participle from all subsequent tableaux.

[15] The theoretical literature on Finnish case is remarkably silent about the source of this GEN. Setälä (1901: 109) calls it an accusative singular. We are not aware of any competing analyses. Parallel examples exist in Sakha (Yakut) (Baker and Vinokurova 2010: 615) and Uzbek (Gribanova 2016).

The analytical task is to find the simplest partial order that includes the grammatical (a) and (b), but excludes the ungrammatical (d), while maintaining the correct patterns in simplex clauses. With three constraints the simplest partial order was easy to find by visual inspection; with six constraints we need a computer. The simplest grammar compatible with all the data is shown in (42). This grammar was found with the help of OTOrder (Djalali and Jeffers 2015), a web application for working with Partial Order Optimality Theory. Only one additional ranking is needed for Itkonen structures: *MC/E ≫ DEP/NP. The tableau updated with the new ranking is shown in (43).

(42) The grammar of Finnish structural case (updated version)
UNIQ ≫ *MC (inferred from simplex clauses)
*MC/E ≫ DEP/NP (inferred from Itkonen structures)

(43) Embedded existential

NP/E [NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*Øc(CP)
(a)☞ NOM [INE oleva-n GEN]			1		1	
(b)☞ NOM [INE oleva-n NOM]				1		1
(c) *GEN [INE oleva-n GEN]	1		1	1	2	
(d) *GEN [INE oleva-n NOM]	1				1	1
(e) *NOM [INE oleva GEN]			1		1	1
(f) *NOM [INE oleva NOM]				1		2
(g) *GEN [INE oleva GEN]	1		1	1	2	1
(h) *GEN [INE oleva NOM]	1				1	2

The grammar correctly rules out the ungrammatical (d), but predicts variation (a) ∼ (b). How exactly does that happen? We first note that (d) loses because the new ranking guarantees that it will always lose against (a), as shown in (44):

(44) Embedded existential: (a) vs. (d)

NP/E [NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*Øc(CP)
(a)☞ NOM [INE GEN]			1		1	
(d) *GEN [INE NOM]	1 **W**		**L**		1	1 **W**

The variation (a) ∼ (b) arises in the following way. The grammar has six constraints, but only two rankings. This means that it contains all the total orders that respect the rankings UNIQ ≫ *MC and *MC/E ≫ DEP/NP. There are 180 such total orders. Tableau (45) shows the competition between (a) and (b).

(45) Embedded existential: (a) ∼ (b)

NP/E [NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*Øc(CP)
(a)☞ NOM [INE oleva-n GEN]			1		1	
(b)☞ NOM [INE oleva-n NOM]				1		1

Let us assume that at the moment of performance the speaker randomly chooses a total order consistent with this partial order (Kiparsky 1993; Anttila 1997; Anttila and

Cho 1998/2003; Riggle 2010). The winner will be (a) (= GEN) or (b) (= NOM), depending on the speaker's choice. It is easy to see from (45) that only four constraints matter: DEP/NP and *MC are violated by (a) and UNIQ and *$\varnothing_C$(CP) are violated by (b). It is the mutual ranking of these four constraints that decides the outcome. For example, (a) wins if UNIQ ranks highest and (b) wins if DEP/NP ranks highest. The outcome will thus sometimes be GEN, sometimes NOM, depending on the speaker's choice of total order. In other words, the grammar predicts variation.

The grammar also correctly handles embedded transitive clauses. An example is given in (46), repeated from (29).

(46) Pekka luul-i [Mati-n ampu-nee-n
Pekka.NOM think-PAST [Matti-GEN shoot-ACT.PERF-GEN
***karhu/karhu-n**].
bear-*NOM/GEN]
'Pekka thought Matti to have shot a/the bear.'

We start from the full set of candidates. The input contains three NPs, each of which must choose between NOM and GEN. This yields the eight candidates in (47).

(47) Embedded transitive: High-ranking constraints

NP/E [NP/E-**NOM** NP-**GEN**]	MAX-LEX	[SPEC,−FIN]=GEN	…
☞ (a) NOM [GEN GEN]			
(b) *NOM [GEN NOM]			
(c) *GEN [GEN GEN]			
(d) *GEN [GEN NOM]			
(e) *NOM [NOM GEN]		1**W**	
(f) *NOM [NOM NOM]		1**W**	
(g) *GEN [NOM GEN]		1**W**	
(h) *GEN [NOM NOM]		1**W**	

MAX-LEX is inactive since the input contains no lexical/inherent cases. [SPEC,−FIN] = GEN rules out the candidates (e)–(h) where the subject of the embedded nonfinite clause is NOM. This leaves the candidates (a)–(d). It now falls upon the remaining six constraints notated "…" in tableau (47) to select the correct output (a).

(48) Embedded transitive: Lower-ranking constraints

NP/E [NP/E-**NOM** NP-**GEN**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*$\varnothing_C$(CP)
☞ (a) NOM [GEN GEN]	1		1		2	
(b) *NOM [GEN NOM]	1	1**W**	1	1 **W**	1 **L**	1 **W**
(c) *GEN [GEN GEN]	2		1	2	3	
(d) *GEN [GEN NOM]	2	1	1	1	2	1

This tableau shows that candidate (a) correctly wins. Candidate (b) is ruled out by the familiar ranking UNIQ ≫ *MC; candidates (c) and (d) are harmonically bounded. Note that candidate (a) does not violate UNIQ despite having two instances of GEN. This is because UNIQ only applies to the external argument on the current cycle.

Finally, the grammar correctly predicts variation in embedded predicatives. All ungrammatical candidates are harmonically bounded.

(49) Pekka luul-i [Mati-n ole-va-n
Pekka.NOM think-PAST [Matti-GEN be-ACT.PRES-GEN
sotilas ∼ ?sotilaa-n].
soldier.NOM ∼ ?GEN]
'Pekka thought Matti to be a soldier.'

(50) Embedded predicative

NP/E [NP/E-**NOM** NP/E-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ NOM [GEN GEN]	2		2		2	
(b) ☞ NOM [GEN NOM]	1		1	1	1	1
(c) *GEN [GEN GEN]	3		2	2	3	
(d) *GEN[GEN NOM]	2		1	1	2	1

We now summarize our analysis of case under active matrix clauses. UNIQ strives to distinguish the external argument from all other arguments. This favors GEN in embedded clauses of all kinds. However, embedded clauses differ in terms of faithfulness. In transitive clauses the faithful choice is GEN: markedness and faithfulness agree and there is no variation. In existential and predicative clauses the faithful choice is NOM: markedness and faithfulness conflict, which yields variation reflecting the speaker's free choice among the available total rankings at the time of performance.

3.2.2 Passive matrix clauses

Next, we turn to passive matrix clauses. The key difference is that passives have no external argument and hence there is no pressure to distinguish arguments. In embedded transitive clauses we have a conflict: markedness favors NOM; faithfulness favors GEN. This results in variation.

(51) Matti ampu-i **karhu-n**.
Matti.NOM shoot-PAST **bear-GEN**
'Matti shot a/the bear.'

(52) Mati-n luul-tiin [ampu-nee-n **karhu ∼ karhu-n**].
Matti.GEN think-PASS.PAST [shoot-ACT.PERF-GEN **bear.NOM ∼ GEN**]
'Matti was thought to have shot a/the bear.'

(53) Embedded transitive

[NP/E-**NOM** NP-**GEN**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ [GEN GEN]	1		1		2	
(b) ☞ [GEN NOM]	1	1	1		1	1

There are only two competitive candidates: [GEN GEN] and [GEN NOM]. The other possible candidates *[NOM GEN] and *[NOM NOM] with a NOM-subject in the embedded nonfinite clause are ruled out by the high-ranking [SPEC,−FIN] = GEN as illustrated above. For this reason they have been omitted from the tableau. Note that the embedded subject *Matin* is optionally fronted to the left of the matrix verb. This does not make it part of the matrix cycle: we assume that optional stylistic fronting is invisible to cyclic evaluation. Since the matrix clause has no external argument UNIQ is not violated.

The situation is similar in embedded existential and predicative clauses. This time faithfulness favors NOM in the embedded clause, but GEN is also attested due to partial ranking as shown below in (56) and (59). These examples also provide independent evidence for *∅C(CP): without it GEN would be harmonically bounded and variation would not be possible.

(54) Talo-ssa o-n **karhu**.
house-INE be-PRES.3P.SG **bear.NOM**
'There is a bear in the house.'

(55) Talo-ssa luul-tiin [ole-va-n **karhu ∼ ?karhu-n**].
house-INE think-PASS.PAST [be-ACT.PRES-GEN **bear.NOM ∼ ?GEN**]
'There was thought to be a bear in the house.'

(56) Embedded existential

[NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	***MC**	*∅C(CP)
(a) ☞ [INE GEN]			1		**1**	
(b) ☞ [INE NOM]						1

(57) Matti o-n **sotilas**.
Matti.NOM be-PRES.3P.SG **soldier.NOM**
'Matti is a soldier.'

(58) Mati-n luul-tiin [ole-va-n **sotilas ∼ ??sotilaa-n**].
Matti-GEN think-PASS.PAST [be-ACT.PRES-GEN **soldier.NOM ∼ ??GEN**]
'Matti was thought to be a soldier.'

(59) Embedded predicative

[NP/E-**NOM** NP/E-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ [GEN GEN]	2		2		2	
(b) ☞ [GEN NOM]	1		1		1	1

The analysis now covers both simplex clauses and Itkonen structures. It consists of six constraints and two rankings. The rankings were based on categorical judgments and were needed to rule out plainly ungrammatical candidates. We noted that in some environments the analysis predicts variation, but stopped short of trying to explain the intermediate well-formedness judgments among the variants. We will now take a closer look at the variation and the preferences among the variants.

3.3 Variation in complex clauses

The case variation in complex clauses was explored in a remarkable experimental study by Itkonen (1976, 1981). Itkonen's strategy was to vary the syntactic context in order to see how that affects the choice of case. He constructed 28 stimulus sentences where the case of the second NP in the complement clause was left open and then presented the stimuli to 128 native speakers asking them to choose between NOM and GEN based on their intuitive judgment (*kielikorva* 'language ear'). The subject population consisted of 38 first-year students majoring in Finnish and 90 students majoring in other subjects. The difference between the two groups turned out marginal (Itkonen 1981: 105). Itkonen's 28 stimuli can be divided into three groups:

(60)

	Matrix clause	Embedded clause	Sentences	Stimuli
1.	Active/Passive	Existential/Predicative	4	16
2.	Active/Passive	Existential	3	6
3.	Active/Passive	Other	3	6

Group 1 consists of four minimal quadruplets: the matrix clause can be active or passive; the embedded clause can be existential or predicative; and there are four distinct sentences. This yields $2 \times 2 \times 4 = 16$ stimuli in all. Group 2 consists of three minimal pairs: the matrix clause can be active or passive; the embedded clauses are all existential; and there are three distinct sentences. This yields $2 \times 1 \times 3 = 6$ stimuli in all. Group 3 is more heterogeneous and only reported on in the revised and expanded version of the original study (Itkonen 1981). It consists of three minimal pairs: the matrix clause can be active or passive and the three embedded clauses are all different in structure (transitive passive, transitive infinitival passive, permissive). This yields $2 \times 3 = 6$ stimuli in all. The design yields plenty of information about the active vs. passive contrast which is relevant in all 28 stimuli (14 actives, 14 passives). It gives somewhat less information about the existential vs. predicative contrast which is only relevant in 16 stimuli (8 existentials, 8 predicatives).

Let us consider some illustrative examples. In (61), we have a minimal quadruplet from Group 1 that combines matrix active vs. passive with embedded existential vs. predicative. For each example, the subjects were asked to report whether they preferred NOM or GEN in the NP highlighted in bold.

(61) a. Active + existential
Ole-n luul-lut jokaise-ssa seurakunna-ssa
be-1P.SG think-ACT.PAST every-INE parish-INE
ole-va-n **kappalainen/kappalaise-n**.
be-ACT.PRES-GEN **chaplain.NOM/chaplain-GEN**
'I have thought there to be a chaplain in every parish.'

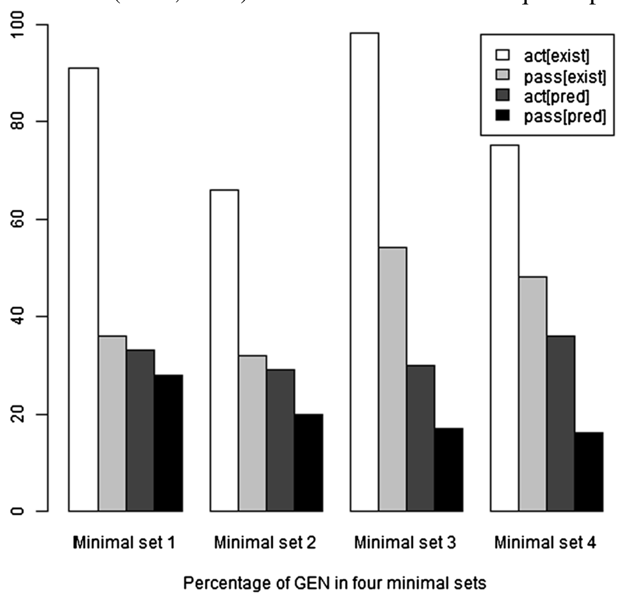
b. Passive + existential
Jokaise-ssa seurakunna-ssa luul-tiin
every-INE parish-INE be-1P.SG think-PASS.PAST
ole-va-n **kappalainen/kappalaise-n**.
be-ACT.PRES-GEN **chaplain.NOM/chaplain-GEN**
'There was thought to be a chaplain in every parish.'

c. Active + predicative
Minä ainakin luul-i-n se-n miehe-n
1P.SG at.least think- PAST-1P.SG it-GEN man-GEN
ole-va-n **kappalainen/kappalaise-n**.
be-ACT.PRES-GEN **chaplain.NOM/chaplain-GEN**
'At least I thought that man to be a chaplain.'

d. Passive + predicative
Jo-i-ssa-kin kyl-i-ssä luul-tiin se-n miehe-n
some-PL-INE-some village-PL-INE think-PASS.PAST it-GEN man-GEN
ole-va-n **kappalainen/kappalaise-n**.
be-ACT.PRES-GEN **chaplain.NOM/chaplain-GEN**
'In some villages that man was thought to be a chaplain.'

Itkonen aggregated the results across subjects and reported them as percentages. In (62) we see the outcome from his four minimal quadruplets. Groups 2 and 3 were analogous.

(62) Itkonen's (1976, 1981) results for four minimal quadruplets (Group 1)



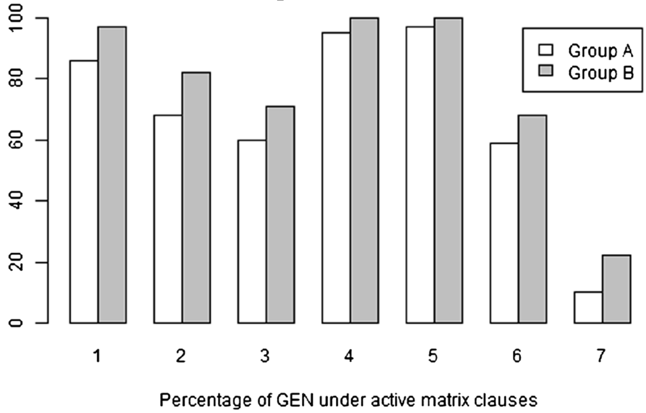
(63) Generalizations:

a. GEN is more common under actives than under passives.
b. GEN is more common in existentials than in predicatives.
c. The profiles of the four sentences are similar, but not identical.

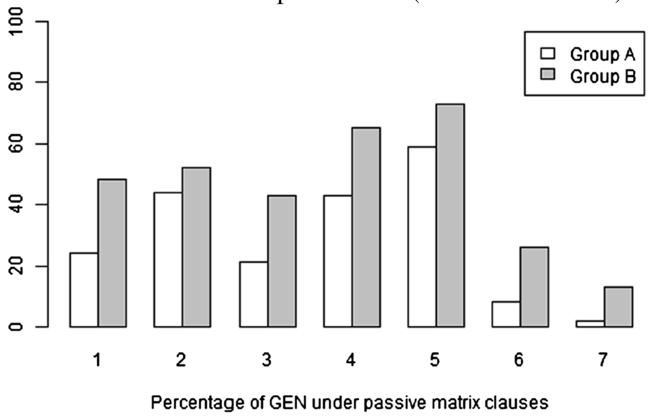
These generalizations are consistent with the intermediate well-formedness judgments reported in Sect. 3.1. They can be summarized as follows: (i) GEN is better under actives than under passives; (ii) GEN is better in transitives (not included in (62)–(63)) than in existentials and better in existentials than in predicatives. The variation is clearly not free, but structured in a way that requires a grammatical explanation.

Itkonen also observed that individuals differed systematically in their case preferences: some favored GEN, others favored NOM. For example, if subjects favored NOM in predicatives, they also favored NOM in existentials under both actives and passives (Itkonen 1981: 110–111). Itkonen showed this by dividing his subjects into two groups: Group A who favored NOM in predicatives (63 subjects) and Group B who did not (63 subjects).[16] He then asked how these two groups behaved with respect to existential clauses. He found that the individual preferences carried over from predicatives to existentials: Group A had lower counts for GEN than Group B for all seven stimulus sentences, for the actives in (64) as well as the passives in (65). Comparing the diagrams one can also see that the passive counts are systematically lower than the active counts.

(64) GEN % in embedded existentials under active matrix clauses. Group A favored NOM in embedded predicatives (Itkonen 1981: 110).



(65) GEN % in embedded existentials under passive matrix clauses. Group A favored NOM in embedded predicatives (Itkonen 1981: 110).



[16] Itkonen's criterion for "favoring NOM" was defined as choosing NOM in at least 7 sentences out of 8; the rest were grouped as "not favoring NOM." He appears to have chosen the cutoff point with an eye towards making the two groups approximately the same size (Itkonen 1981: 110); here both groups have 63 subjects.

Itkonen provided similar evidence for actives and passives: if subjects favored GEN under an active matrix verb, they also favored GEN under a passive matrix verb (Itkonen 1981: 110–111). The effect was also found to hold in the reverse direction.

Itkonen interpreted these facts as evidence for *syntactic analogy*, proposing that the surface case patterns of particular constructions (e.g., existentials and predicatives, actives and passives) influence one another (Itkonen 1977: 86–87). An alternative interpretation is that individuals have a general preference for a particular case that is reflected across the board, with differences arising from the special properties of each construction. Under this view, one would expect a single change in the grammar of case to be reflected globally, affecting every construction in the same way modulo their special properties (see, e.g., Kroch 1989). This *parametric* view of change is common among practitioners of generative grammar and it is the view we will adopt here.

How did this situation arise historically? Itkonen noted that the variation is the result of an ongoing diachronic change: GEN is receding and NOM is gaining ground. Crucially, the spread of NOM has followed a structured path, starting from predicatives and passive matrix clauses and moving on to existentials and active matrix clauses. According to Setälä's (1901: 109) grammar, predicatives used to be GEN under active matrix clauses. In the literary language of the late 1930's, NOM was still rare in this environment, but was becoming common under passive matrix verbs (Lehikoinen 1973, cited in Itkonen 1981: 92, 106, 112). At the time of Itkonen's writing, NOM had almost completely won out in predicatives, but existentials showed variation resembling the predicative situation in the 1930's. The case pattern had thus been changing simultaneously in both constructions, with existentials lagging a generation behind the predicatives. The important question is why the change GEN > NOM occurred in this order. Why did predicatives change before existentials and passives before actives? Is there something necessary about this order or could it have been different? We will shortly see that this diachronic order falls out from our synchronic analysis.

3.4 Deriving variation from grammar

Grammatical analysis usually starts from the clear cases. Some expressions are clearly grammatical and should be predicted; other expressions are clearly ungrammatical and should be excluded. The question is what to do with the intermediate cases. One view is expressed in the following well-known passage:

> [W]e may assume for this discussion that certain sequences of phonemes are definitely sentences, and that certain other sequences are definitely non-sentences. In many intermediate cases we shall be prepared to let the grammar itself decide, when the grammar is set up in the simplest way so that it includes the clear sentences and excludes the clear non-sentences. This is a familiar feature of explication. (Chomsky 1957: 14)

We will now see that our current grammar already derives the quantitative asymmetries in the intermediate cases studied by Itkonen. This is an instance of letting the grammar itself decide: given the simplest analysis of categorical cases the grammar automatically delivers the correct quantitative preferences in cases of variation, with no adjustments or modifications, providing strong support for the overall analysis.

The key observation is that some winners *entail* other winners (Prince 2002a, 2002b, 2007; Anttila and Andrus 2006). In order to see what that means, let us reconsider the inputs act[exist] and act[pred] discussed in (41) and (50). Both matrix clauses are active, but the embedded clauses are different: existential in the first, predicative in the second. The predicted outcome in both constructions is variation NOM∼GEN. All other candidates are ruled out as ungrammatical.

(66) The predicted variants in act[exist] and act[pred]

	act[exist]	act[pred]
(a)	NOM [INE **GEN**]	NOM [GEN **GEN**]
(b)	NOM [INE **NOM**]	NOM [GEN **NOM**]

The variation is localized in the last noun phrase which varies NOM∼GEN. Both variants are found for both inputs, but the variants turn out to have a very different standing in each construction. We can see this by asking what rankings must hold in order for NOM (= (b)) to be optimal for each input. Let us look at the comparative tableaux in (67) and (68), arbitrarily choosing NOM (= (b)) as the winner. No rankings are assumed.

(67) Active matrix, embedded existential

NP/E [NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*$\varnothing_C$(CP)
(a) NOM [INE GEN]			1 **W**	**L**	1 **W**	**L**
(b) NOM [INE NOM]				1		1

(68) Active matrix, embedded predicative

NP/E [NP/E-**NOM** NP/E-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*$\varnothing_C$(CP)
(a) NOM [GEN GEN]	2 **W**		2 **W**	**L**	2 **W**	**L**
(b) NOM [GEN NOM]	1		1	1	1	1

Recall that a desired winner is optimal if and only if all loser-favoring constraints (**L**) are dominated by some winner-favoring constraint (**W**). Looking at (67) we can see that (b) wins if both UNIQ and *$\varnothing_C$(CP) are dominated by either DEP/NP or *MC. Looking at (68), we can see that this automatically makes (b) win here as well because the comparative rows are identical except for the addition of one **W** (*MC/E). The upshot is that NOM in an existential clause entails NOM in a predicative clause.[17]

To take another example, let us reconsider the inputs act[exist] and pass[exist] discussed in (41) and (56). This time, both embedded clauses are existential, but the matrix clauses are different: active in the first, passive in the second. Again, the predicted outcome in both constructions is variation NOM∼GEN. All other candidates are ruled out as ungrammatical.

[17] This entailment corresponds to the rule of W-EXTENSION of Prince (2002a, 2002b): a row entails any other row that can be derived from it by replacing an empty cell with a W (see McCarthy 2008: 124–132).

(69) The predicted variants in act[exist] and pass[exist]

	act[exist]	pass[exist]
(a)	NOM [INE **GEN**]	[INE **GEN**]
(b)	NOM [INE **NOM**]	[INE **NOM**]

The variation is localized in the last noun phrase which varies NOM∼GEN. Both variants are found for both inputs, but again, the variants turn out to have a very different standing in each construction. We can see this by asking what rankings must hold in order for NOM (= (b)) to be optimal for each input. Let us look at the comparative tableaux in (70) and (71), arbitrarily choosing NOM (= (b)) as the winner. No rankings are assumed.

(70) Active matrix, embedded existential

NP/E [NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) NOM [INE GEN]			1 **W**	**L**	1 **W**	**L**
(b) NOM [INE NOM]				1		1

(71) Passive matrix, embedded existential

[NP-**INE** NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) [INE GEN]			1 **W**		1 **W**	**L**
(b) [INE NOM]						1

Looking at (70), we can see that (b) wins if both UNIQ and $*\varnothing_{C}$(CP) are dominated by either DEP/NP or *MC. Looking at (71), we can see that this automatically makes (b) win here as well because the comparative rows are identical except for the subtraction of one **L** (UNIQ). The upshot is that NOM in an active clause entails NOM in a passive clause.[18]

Entailments structure the space of variation in ways that result in quantitative asymmetries. This becomes evident by inspecting the predicted typology. We illustrate this in (72) for four input constructions: active vs. passive matrix clauses with existential vs. predicative complements. Our partial order predicts six possible invariant dialects. The last noun phrase (object or predicative) alternates between NOM and GEN depending on dialect and construction. We have shaded GEN for perspicuity. The typology was computed using OTSoft (Hayes et al. 2003).

(72) The six possible dialects

	act [exist]	act [pred]	pass [exist]	pass [pred]
#1	NOM [INE GEN]	NOM [GEN GEN]	[INE GEN]	[GEN GEN]
#2	NOM [INE GEN]	NOM [GEN GEN]	[INE GEN]	[GEN NOM]
#3	NOM [INE GEN]	NOM [GEN GEN]	[INE NOM]	[GEN NOM]
#4	NOM [INE GEN]	NOM [GEN NOM]	[INE GEN]	[GEN NOM]
#5	NOM [INE GEN]	NOM [GEN NOM]	[INE NOM]	[GEN NOM]
#6	NOM [INE NOM]	NOM [GEN NOM]	[INE NOM]	[GEN NOM]

[18]This entailment corresponds to the rule of L-RETRACTION of Prince (2002a, 2002b): a row entails any other row that can be derived from it by replacing an L with an empty cell (see McCarthy 2008: 124–132).

Each row represents a distinct dialect: 1 is a conservative dialect with GEN in all four constructions; 6 is an innovative dialect with NOM in all four constructions. 2–5 are intermediate dialects that have NOM or GEN depending on the construction. All six fall under the competence of a speaker of modern Finnish because all belong to the partial order that constitutes her grammar. Under this view, a single speaker controls six synchronic slices of the diachronic development that has been gradually replacing GEN by NOM over the past century. This view of grammar is sociolinguistically plausible. An individual acquiring Finnish under normal conditions is typically exposed to variation across generations as well as across registers, including the written standard that tends to be conservative as well as spoken colloquial registers that tend to be innovative. However, taken together, these dialects are not a random collection, but a grammatically natural class that constitute a single grammar characterized as a partial order.

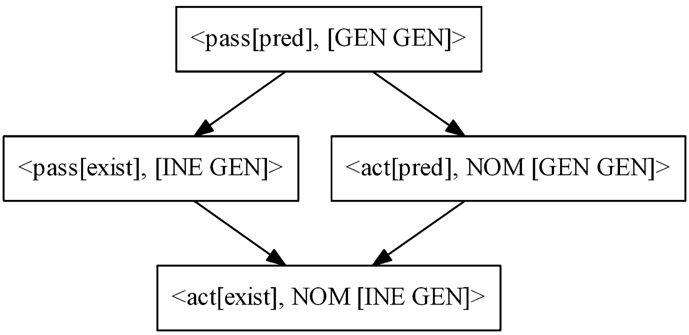
This view of grammar lends itself to a straightforward quantitative interpretation. Recall our assumption that at the moment of performance the speaker randomly selects a total order from the partial order that constitutes her grammar. A number of quantitative predictions then follow. For example, GEN is more likely to be selected with the input act[exist] than with the input act[pred]. This is because the total orders that predict GEN for the former (dialects 1–5) are a superset of the total orders that predict GEN for the latter (dialects 1–3). This correctly predicts that GEN should be more frequent in act[exist] than in act [pred].

The entailments hidden in the typology (72) are easier to see if we visualize them as the directed graph in (73). Each entailment is depicted by an arrow. The graph was computed and drawn by T-ORDER GENERATOR (Anttila and Andrus 2006).

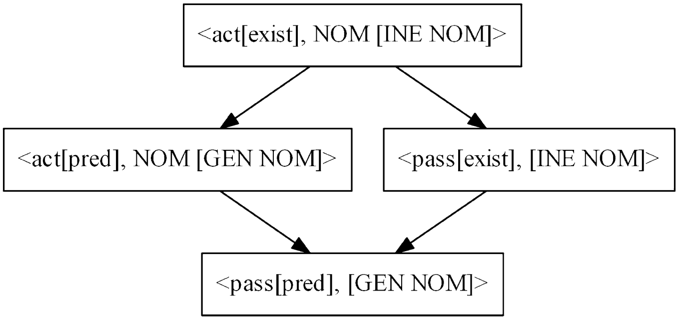
(73) Entailments among four variable Itkonen structures: the case of *chaplain*

act[exist]	'I have thought there to be a **chaplain** in every parish.'
pass[exist]	'There was thought to be a **chaplain** in every parish.'
act[pred]	'At least I thought that man to be a **chaplain**.'
pass[pred]	'In some villages that man was thought to be a **chaplain**.'

a. Case patterns where the second noun phrase is GEN



b. Case patterns where the second noun phrase is NOM



To understand these entailment graphs, consider the following examples. The first graph shows that if the alternating case is GEN in pass[pred] it must also be GEN in all the other three input structures: pass[exist], act[pred], and act[exist]. The graph further shows that if the alternating case is GEN in act[pred] it must also be GEN in act[exist], but nothing is entailed about the case under passives which may be either NOM or GEN. Finally, there can be no dialect with GEN only under passives (i.e., in pass[pred] and pass[exist]) because this would entail GEN under the corresponding actives as well. Similar entailments for NOM can be read off the second graph. Since there are only two possible outcomes (NOM, GEN) the graphs are mirror images of each other.

The graphs in (73) are theoretical predictions derived from the grammar. The corresponding empirical data from Itkonen's (1976, 1981) four minimal quadruplets are shown in (74).

(74) Percentages of GEN in Itkonen's (1976, 1981) four minimal quadruplets

	act[exist]	pass[exist]	act[pred]	pass[pred]
1.	91 %	36 %	33 %	28 %
2.	66 %	32 %	29 %	20 %
3.	98 %	54 %	30 %	17 %
4.	75 %	48 %	36 %	16 %

Comparing the predictions in (73) to the observations in (74) reveals three kinds of patterns. First, the percentage of GEN is highest in act[exist] and lowest in pass[pred] in all four quadruplets, with pass[exist] and act[pred] falling in the middle. These quantitative asymmetries are correctly predicted by the entailments: the total orders that predict GEN for act[exist] (dialects 1–5) are a superset of those that predict GEN for any other input, and conversely, the total orders that predict GEN for pass[pred] (dialect 1) are a subset of those that predict GEN for any other input. Second, GEN is systematically (slightly) more frequent in pass[exist] than in act[pred] across all four quadruplets. This is not predicted by the entailments as shown by the absence of an arrow between the two nodes. Is there any grammatical reason to expect this quantitative asymmetry or does it simply reflect external factors, such as social factors or construction frequency (see, e.g., Jarosz 2010)? We will return to this question in Sect. 4.3 after we have discussed Ikola structures. Third, the percentages vary widely across the quadruplets for reasons that remain a mystery. For example, the percentage of GEN in act[exist] is 91 % in the first quadruplet, but only 66 % in the second. Is it possible to identify any grammatical reason for such sentence-specific differences? Again, we will put this question on hold and will return to it in Sect. 4.4 once we have discussed Ikola structures.

Finally, grammatical entailments hold in the domain of historical change. Our analysis predicts that the change GEN > NOM had to start from matrix passives and embedded predicatives before spreading to matrix actives and embedded existentials. To see this, consider the predicted case patterns for act[exist] and pass[exist]:

(75) Three predicted dialects

	act[exist]	pass[exist]	
1.	NOM [INE **GEN**]	[INE **GEN**]	GEN in both
2.	NOM [INE **GEN**]	[INE **NOM**]	alternation
3.	NOM [INE **NOM**]	[INE **NOM**]	NOM in both
4.	NOM [INE **NOM**]	[INE **GEN**]	impossible, not predicted

Dialect 1 has GEN in both constructions, i.e., the change GEN > NOM has not yet occurred. Dialect 2 has GEN in act[exist], but NOM in pass[exist], i.e., the change has taken place under passives resulting in a synchronic case alternation. Dialect 3 has NOM in both constructions, i.e., the change has gone to completion. Modern Finnish is a mixture of these three types of dialects, with free variation among them. Crucially, Dialect 4 where act[exist] has NOM, but pass[exist] has GEN is excluded as grammatically ill-formed. It is precisely such a dialect that would have to arise if the change were to start from actives: it would provide the step where NOM is possible under actives, but not under passives. This is a synchronically impossible state that violates one of the entailments. For this reason it is not a possible step along the path of change either. Under this view, all sorts of diachronic changes are possible, but the synchronic grammar filters out those that are not grammatically sustainable. This guarantees that language change remains grammatically benign (see, e.g., Kroch 1989; Kiparsky 2006).

We conclude with a methodological note. In variationist linguistics, it is common practice to start by excluding invariant data. Once the "envelope of variation" has been identified the analysis of variation proper begins, usually by fitting a statistical model to the variable data. Here we took the opposite approach. We started by finding the simplest grammar for the invariant patterns and discovered that variation and quantitative patterns emerged as a side-effect. Excluding invariant data would have been a bad move: it would have amounted to throwing out information that explains the structure of variation. It seems that there is much to be gained by studying variation against the backdrop of the invariant structure of the language instead of focusing on variation in isolation.

4 Ikola structures

4.1 Empirical generalizations

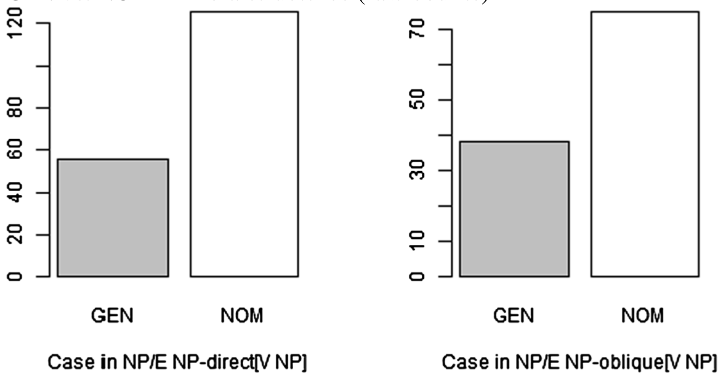
We now turn to Ikola structures that exhibit case variation similar to Itkonen structures, but with intriguing differences. Examples are given in (76) and (77):

(76) Matti sa-i tilaisuude-n ampu-a **karhu ∼ karhu-n**.
Matti.NOM get-PAST opportunity-GEN shoot-1INF **bear.NOM ∼ bear-GEN**
'Matti (NP/E) got an opportunity (NP) to shoot a/the bear (NP).'

(77) Matti sa-i tehtävä-kse-en ampu-a **karhu ∼ karhu-n**.
Matti.NOM get-PAST task-TRA-3P.PX shoot-1INF **bear.NOM ∼ bear-GEN**
'Matti (NP/E) was tasked with (NP) shooting a/the bear (NP).'

Ikola structures are NPs with a nonfinite VP complement. The embedded NP is usually NOM, but NOM ∼ GEN variation is possible under limited circumstances. The two sentence types above were chosen for illustration because together they cover 97 % of all the GEN variants in our corpus of 1,577 Ikola structures extracted from the *Aamulehti 1999* corpus; see Appendix A for details. The examples differ in the matrix object: (76) has the genitive case; (77) has an oblique case. In both sentence types NOM and GEN are robustly attested, with NOM being about twice as common as GEN.

(78) GEN VS. NOM in Ikola structures (raw counts)



Case variation is possible if the following three conditions are simultaneously satisfied (see also Hakulinen et al. 2004: Sect. 940):

(79) The variation environment

a. the matrix clause is active, i.e., has a nominative subject, and
b. the embedded VP is transitive, i.e., the NP is an internal argument, and
c. the matrix NP (= Ikola structure itself) is not an external argument.

First, the matrix clause must have a nominative subject in order for variation to occur. As shown in (80), variation is blocked under passives:

(80) Kylä-ssä saa-tiin tilaisuus ampu-a **karhu**.
village-INE get-PASS.PAST opportunity.NOM shoot-1INF **bear.NOM**
'In the village, an opportunity (NP) was obtained to shoot a/the bear (NP).'

Second, the embedded NP must be an internal argument in order for variation to occur. In (81) the embedded NP *sankari* 'hero' is a predicative that takes the subject *Matti* as its argument. No variation is possible.

(81) Matti sa-i tilaisuude-n ol-la **sankari**.
Matti.NOM get-PAST opportunity-GEN be-1INF **hero.NOM**
'Matti (NP/E) got an opportunity (NP) to be a hero (NP/E).'

The tables in (82) contrast the case patterns in Itkonen and Ikola structures under matrix active vs. passive (vertical dimension), with embedded transitive vs. predicative (horizontal dimension).

(82) a. Itkonen structures

	Transitive	Predicative
Active	GEN	NOM ∼ GEN
Passive	NOM ∼ GEN	NOM ∼ GEN

b. Ikola structures

	Transitive	Predicative
Active	NOM ∼ GEN	NOM
Passive	NOM	NOM

The case patterns differ in all four contexts, but entirely systematically: in both structures active and transitive favor GEN, passive and predicative favor NOM. The difference is that Ikola structures show a stronger preference for NOM across the board. Both the similarities and the differences require an explanation.

Finally, there is no variation if the Ikola structure itself is an external argument (NP/E): the outcome is an invariant NOM. This option is not possible in Itkonen structures. The generalization holds no matter whether the structure is a subject as in (83) or a predicative as in (84).[19]

(83) Tilaisuus ampu-a **karhu** yllätt-i Mati-n.
opportunity.NOM shoot-1INF **bear.NOM** surprise-PAST Matti-GEN
'The opportunity (NP/E) to shoot a/the bear (NP) surprised Matti (NP).'

(84) Se ol-i tilaisuus ampu-a **karhu**.
it.NOM be-PAST.3P.SG opportunity.NOM shoot-1INF **bear.NOM**
'It (NP/E) was an opportunity (NP/E) to shoot a/the bear (NP).'

To summarize, variation in Ikola structures is limited to examples like (76) and (77).[20] The variation appears to be a recent innovation: early 20th century grammarians (Setälä, Saarimaa) only recognized GEN as a possibility, but a generation later Ikola (1964: 65–66) reported variation. This suggests that the change GEN > NOM observed in Itkonen structures had also been at work in Ikola structures over the same period of time.

[19]Human pronouns take ACC even here: *Se oli tilaisuus tavata häne-t* 'It was an opportunity to meet him/her-ACC.' We noted above that *joku* 'someone' behaves like a common noun in terms of case, but internet searches turn up examples like *Sanotaan, että häät ovat paras tilaisuus tavata jo-n-ku-n* 'It is said that a wedding is the best opportunity to meet someone-GEN' where *joku* takes GEN inside a predicative, although NOM is also found. We find no such examples in our corpus. While we have no satisfactory explanation to offer it is probably not a coincidence that these GEN examples involve a human pronoun.

[20]This observation is also made by Brattico (2012: 277), although his generalization is different from ours. We will discuss Brattico and Vainikka's analysis in Sect. 6.

4.2 Analysis

The key difference between Itkonen and Ikola structures is the category of the first cycle: in Itkonen structures it is a CP, in Ikola structures it is an NP. In the Itkonen structure (85) the predicate *ampuneen* 'shot' has two arguments: *Matti* and *karhu* 'bear'. In the Ikola structure (86) the predicate *ampua* 'shoot' only has the internal argument *karhu* 'bear'. This difference in number of arguments (two vs. one) plays a crucial role in explaining the differences in case patterns, as we will see shortly.

(85) Pekka luul-i [**Mati-n** ampu-nee-n **karhu-n**]$_{CP}$.
Pekka.NOM think-PAST [**Matti-GEN** shoot-ACT.PERF-GEN **bear-GEN**]$_{CP}$
'Pekka thought Matti to have shot a/the bear.'

(86) Matti sa-i [tilaisuude-n ampu-a
Matti.NOM get-PAST [opportunity-GEN shoot-1INF
karhu ∼ karhu-n]$_{NP}$.
bear.NOM ∼ bear-GEN]$_{NP}$
'Matti got an opportunity to shoot a/the bear.'

In Ikola structures the embedded NP always gets NOM on the first cycle, no matter whether it is an internal argument as in *tilaisuus ampua karhu* 'opportunity to shoot a bear' or an external argument as in *tilaisuus olla sankari* 'opportunity to be a hero.' Case distinctions are unnecessary because there is only one argument: UNIQ is idle and the unmarked NOM wins. This is shown in (87).

(87) 1st cycle: 'opportunity to shoot a bear (NP)', 'opportunity to be a hero (NP/E)'

NP	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ NOM						
(b) *GEN					1	
NP/E	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ NOM						
(b) *GEN	1				1	

Let us now embed the output of the first cycle in a larger context. If the matrix clause is active (i.e., has an external argument) and the embedded NP contains a transitive predicate (i.e., has an internal argument) the result is NOM GEN [NOM ∼ GEN] where the embedded internal argument varies in case.

(88) Matti sa-i tilaisuude-n ampua
Matti.NOM get-PAST opportunity-GEN shoot-1INF
karhu ∼ karhu-n.
bear.NOM ∼ bear-GEN
'Matti (NP/E) got an opportunity (NP) to shoot a/the bear (NP).'

Variation arises from conflicting pressures: faithfulness favors NOM (*karhu*); markedness strives to distinguish *Matti* from other arguments, favoring GEN (*karhu-n*). Since the ranking is partial the outcome is variation. The tableau in (89) shows that only four candidates are viable; the rest are harmonically bounded. Note that the constraint *∅C(CP) is not violated because the complement is an NP, not a CP.

(89) 2nd cycle: 'Matti (NP/E) got an opportunity (NP) to shoot a/the bear (NP).'

NP/E NP-[NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) *NOM NOM [NOM]				2		
(b) *NOM NOM [GEN]			1	1	1	
(c) ☞ NOM GEN [NOM]				1	1	
(d) *GEN NOM [NOM]	1				1	
(e) ☞ NOM GEN [GEN]			1		2	
(f) *GEN NOM [GEN]	1		1	1	2	
(g) *GEN GEN [NOM]	1			1	2	
(h) *GEN GEN [GEN]	1		1	2	3	

The analytical task is to find the simplest partial order that includes the grammatical (c) and (e), but excludes the ungrammatical (a) and (d), while maintaining the correct patterns in simplex clauses and Itkonen structures. This can be done with the help of OTOrder (Djalali and Jeffers 2015). Only one additional ranking is needed for Ikola structures: *MC/E ≫ *MC. The grammar contains 150 total orders.[21]

(90) The grammar of Finnish structural case (final version)

UNIQ ≫ *MC	(inferred from simplex clauses)
*MC/E ≫ DEP/NP	(inferred from Itkonen structures)
*MC/E ≫ *MC	(inferred from Ikola structures)

This ranking correctly rules out the ungrammatical candidates. Candidate (a) loses against candidate (c) by the familiar ranking UNIQ ≫ *MC:

(91) Ruling out (a)

NP/E NP-[NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) *NOM NOM [NOM]				2 **W**	**L**	
(c) ☞ NOM GEN [NOM]				1	1	

Candidate (d) loses against candidate (e) by another familiar ranking *MC/E ≫ DEP/NP and the new ranking *MC/E ≫ *MC:

[21] It turns out that tableau (89) contains all the information needed to infer the full ranking for Finnish. This means that datum (88) allows the learner to infer all the case patterns discussed above, including the quantitative patterns in Itkonen's data.

(92) Ruling out (d)

NP/E NP-[NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(d) *GEN NOM [NOM]	1 **W**		**L**		1 **L**	
(e) ☞ NOM GEN [GEN]			1		2	

The absence of variation in embedded predicatives is also correctly predicted:

(93) Matti sa-i tilaisuude-n ol-la **sankari**.
Matti.NOM get-PAST opportunity-GEN be-1INF **hero.NOM**
'Matti (NP/E) got an opportunity (NP) to be a hero (NP/E).'

(94) 2nd cycle: 'Matti (NP/E) got an opportunity (NP) to be a hero (NP/E).'

NP/E NP-[NP/E-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) *NOM NOM [NOM]				1 **W**	**L**	
(b) *NOM NOM [GEN]	1		1	1	1	
(c) ☞ NOM GEN [NOM]					1	
(d) *GEN NOM [NOM]	1			1	1	
(e) *NOM GEN [GEN]	1		1	1	2	
(f) *GEN NOM [GEN]	2		1		2	
(g) *GEN GEN [NOM]	1			1	2	
(h) *GEN GEN [GEN]	2		1	1	3	

As in simplex predicatives like *Matti on sotilas* 'Matti is a soldier', here the matrix subject 'Matti' and the embedded predicative 'hero' represent the same external argument which is part of the current cycle. Since case is assigned to arguments, not to NPs, we assume that UNIQ is violated if either NP/E representing this external argument is identical in case to the internal argument 'opportunity'. The ungrammatical candidate (a) loses against (c) by the familiar ranking UNIQ ≫ *MC.

Under passives, Ikola structures show no variation:

(95) Kylä-ssä saa-tiin tilaisuus ampu-a **karhu**.
village-INE get-PASS.PAST opportunity.NOM shoot-1INF **bear.NOM**
'In the village, an opportunity (NP) was obtained to shoot a/the bear (NP).'

As shown in (96), this is correctly predicted: UNIQ is idle because there is no NP/E on the current cycle and both faithfulness and markedness prefer NOM. All ungrammatical candidates are harmonically bounded. In this example the embedded NP is an internal argument; the prediction is similar for embedded predicatives.

(96) 2nd cycle: 'An opportunity (NP) was obtained to shoot a/the bear (NP).'

NP [NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ NOM [NOM]						
(b) *NOM [GEN]			1		1	
(c) *GEN [NOM]					1	
(d) *GEN [GEN]			1		2	

Finally, consider examples where the Ikola structure itself is an external argument (subject, predicative):

(97) Tilaisuus ampu-a **karhu** tarjo-utu-i.
opportunity.NOM shoot-1INF **bear.NOM** present-REFL-PAST
'The opportunity (NP/E) to shoot a/the bear (NP) presented itself.'

(98) Se ol-i tilaisuus ampu-a **karhu**.
it.NOM be-PAST.3P.SG opportunity.NOM shoot-1INF **bear.NOM**
'It (NP/E) was an opportunity (NP/E) to shoot a/the bear (NP).'

In both examples the internal argument *karhu* 'bear' is embedded inside an external argument. The result is an invariant NOM. This suggests that within an external argument UNIQ does not play its usual distinguishing role: arguments embedded inside an external argument are invisible to UNIQ. This is reflected in our definition of UNIQ given in (11): the external argument on the current cycle must be distinct in case from all other arguments outside the external argument. The details are shown in tableaux (99) and (100). All losers are harmonically bounded because the winner has no violations.

(99) 2nd cycle: 'The opportunity (NP/E) to shoot a/the bear (NP) presented itself.'

NP/E-[NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ NOM [NOM]						
(b) *NOM [GEN]			1		1	

(100) 2nd cycle: 'It (NP/E) was an opportunity (NP/E) to shoot a/the bear (NP).'

NP/E NP/E-[NP-**NOM**]	*MC/E	MAX/NP	DEP/NP	UNIQ	*MC	*∅C(CP)
(a) ☞ NOM NOM [NOM]						
(b) *NOM NOM [GEN]			1		1	

Finally, note that in (100) the subject 'it' and the predicative 'opportunity' do not incur UNIQ violations because they represent the same external argument.

4.3 Interim summary

The predictions of our analysis are summarized in Appendix B. The six constructions where variation is predicted to be possible are shown in (101). Five of them are Itkonen structures, one is an Ikola structure.

(101) Predicted cases of variation

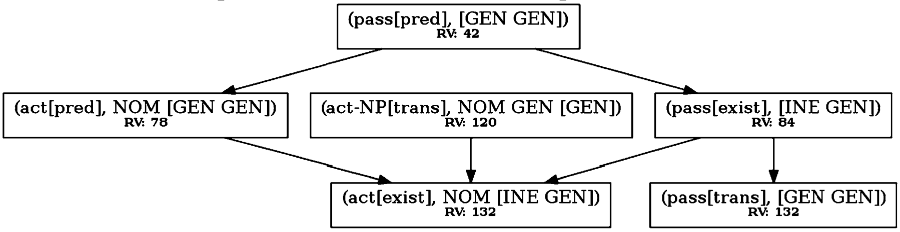
INPUT	CASE PATTERN	EXAMPLE
act[pred]	NOM [GEN **NOM∼GEN**]	Pekka uskoi Mati-n olevan **sotilas∼sotilaa-n**. ‘Pekka believed Matti to be **a soldier**.’
act[exist]	NOM [INE **NOM∼GEN**]	Pekka uskoi metsä-ssä olevan **karhu∼karhu-n**. ‘Pekka believed there to be **a bear** in the forest.’
pass[trans]	[GEN **NOM∼GEN**]	Mati-n uskottiin ampuneen **karhu∼karhu-n**. ‘Matti was believed to have shot **a bear**.’
pass[pred]	[GEN **NOM∼GEN**]	Mati-n uskottiin olevan **sotilas∼sotilaa-n**. ‘Matti was believed to be **a soldier**.’
pass[exist]	[INE **NOM∼GEN**]	Metsä-ssä uskottiin olevan **karhu∼karhu-n**. ‘There was believed to be **a bear** in the forest.’
act-NP[trans]	NOM GEN [**NOM ∼ GEN**]	Matti sai tilaisuude-n ampua **karhu∼karhu-n**. ‘Matti got an opportunity to shoot **a bear**.’

Our optimality-theoretic analysis does what any analysis must do: it declares some case patterns grammatical and others ungrammatical. It goes beyond this baseline in two respects. First, it predicts the environments where variation is possible, shown in (101). Second, it predicts particular quantitative preferences for NOM and GEN across the variable environments. These predictions arise because case patterns are connected by entailments and cannot vary or change independently of one another. Quantitative preferences in one construction are systematically related to quantitative preferences in another construction by the theory.

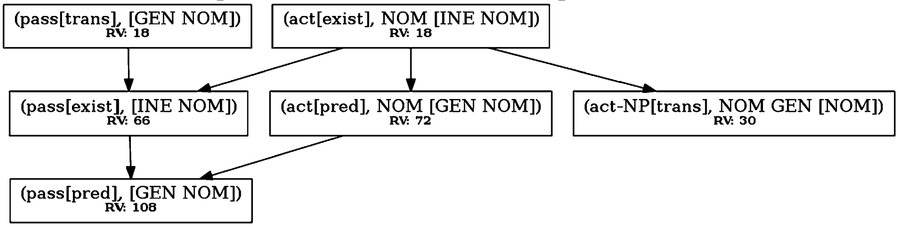
The entailments among the six variable patterns are summarized in (102). In addition to entailments, the graph also shows the *ranking volume* (RV) of each pattern: this is the number of total orders under which this particular pattern wins. To save space, we have left out case patterns with the ranking volume of zero, i.e., patterns that never win under any total ranking, and patterns with the ranking volume of 150, i.e., patterns that win under every total ranking and consequently show no variation. The graph was computed and visualized using OTOrder (Djalali and Jeffers 2015).

(102) Entailments among variable patterns (both Itkonen and Ikola structures)

a. Case patterns where the second noun phrase is GEN



b. Case patterns where the second noun phrase is NOM



What we have here is a system of implicational laws in the sense of Greenberg (1963). The location of a pattern inside the graph indicates its markedness. Patterns high in the graph have small ranking volumes, i.e., are generated by few total orders. They are more marked and therefore less frequent. Patterns low in the graph have large ranking volumes, i.e., are generated by many total orders. They are less marked and therefore more frequent.

These grammatical entailments hold true in the quantitative data with no exceptions.[22] A reviewer points out that the model also correctly predicts the GEN variant to be more frequent in pass[exist] than in act[pred], a systematic pattern we observed in Itkonen's data. This prediction is not an entailment, but based on the relative ranking volumes of GEN in pass[exist] (RV = 84) and act[pred] (RV = 78). What is particularly interesting about this quantitative prediction is that it depends on the ranking *MC/E ≫ *MC inferred from an invariant pattern in Ikola structures. Omitting this ranking wrongly predicts GEN to be more common in act[pred] (RV = 108) than in pass[exist] (RV = 96). In other words, a quantitative pattern in one construction (Itkonen structure) depends on an invariant pattern in another construction (Ikola structure). This is entirely expected in a theory where variation is not an isolated phenomenon, but embedded in a grammar where invariant and variable patterns interact seamlessly across constructions. This suggests that studying a variable construction in isolation may not be fruitful because the explanation for an observed quantitative

[22]The graph includes one prediction that cannot be tested given the available data: GEN should be less frequent in active-NP[transitive] (an Ikola structure) than in active[existential] (an Itkonen structure). Our data are not appropriate for checking this prediction: the Itkonen data come from an experiment conducted in the mid-1970's; the Ikola data come from a newspaper published a quarter century later.

pattern in that construction may not be found in the construction itself, but in other grammatically related constructions.

Finally, it would be tempting to go one step further and interpret the ranking volumes directly as observed frequencies (Anttila 1997). That would predict GEN at a frequency of 84/150 = 56 % in pass[exist] and at a frequency of 78/150 = 52 % in act[pred]. This interpretation faces a problem in Itkonen's data: the percentages vary widely across test sentences. It is therefore not clear which frequencies we should try to model. For the same issue in phonological variation, see Coetzee and Kawahara (2013). How can we explain such residual variation across sentences? Is it possible to say anything systematic about it? This is the question we will take up in the next section.

4.4 Are all NPs cyclic?

In a series of papers, Ikola (1950, 1957, 1964, 1989) studied variable Ikola structures where the matrix clause is active and the embedded VP transitive and suggested that the observed NOM∼GEN variation is not completely free. The essential content of his hypothesis is stated in (103):

(103) IKOLA'S HYPOTHESIS: The object of the infinitive prefers GEN if the matrix verb and matrix object form a closely knit unit, else it prefers NOM.

The following examples taken from Ikola (1964: 72–73) illustrate the hypothesis:

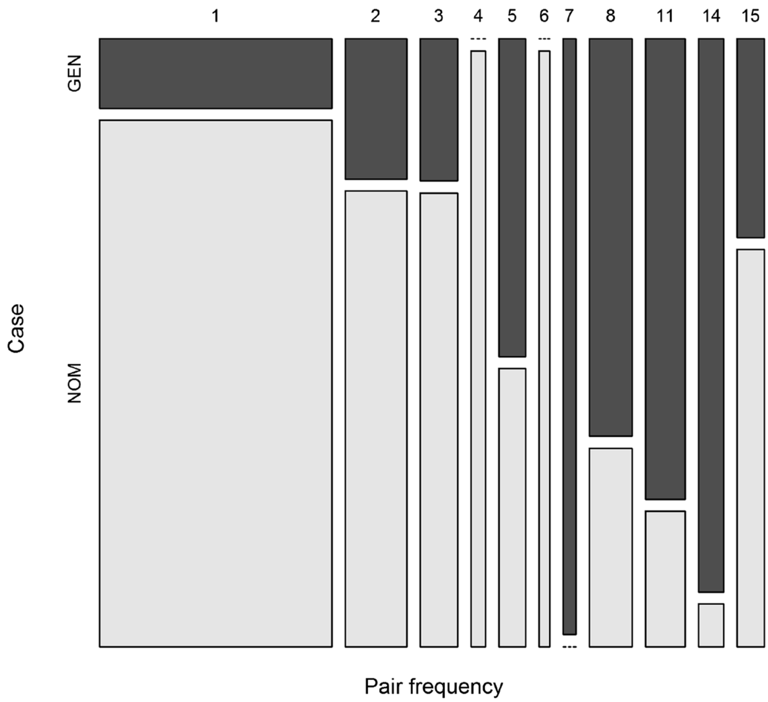
(104) Valtiosääntö myöntä-ä hallitukse-lle oikeude-n hajotta-a
const.NOM grant-3P.SG govmt-ALL right-GEN dissolve-1INF
eduskunna-n.
parliament-GEN
'The constitution grants the government the right to dissolve the parliament.'

(105) Tämä aiheutt-i huomattava-n vaikeude-n saa-da **virka**
this cause-PAST significant-GEN difficulty-GEN get-1INF **vacancy.NOM**
täytety-ksi.
filled-TRA
'This caused a significant difficulty in getting the vacancy filled.'

The embedded object is GEN in (104), but NOM in (105). Ikola suggested that this is because *myöntää oikeuden* 'grant the right' is a closely knit unit whereas *aiheutti vaikeuden* 'caused a difficulty' is a loosely knit unit. In other words, the choice of case on the embedded object depends on how closely the matrix verb and the matrix object are connected. Penttilä (1963: 596–598) notes the same generalization. This is an intriguing hypothesis that to the best of our knowledge has never been empirically tested.

The key question is how to operationalize Ikola's notion of "closely knit unit." One possibility is corpus frequency: if a verb and an object form a closely knit unit they should co-occur in the corpus at a high frequency. In our corpus of 295 examples that consist of the *Aamulehti 1999* examples of the variable contexts illustrated in (78), there are 167 distinct matrix verb + matrix object pairs. The most frequent pairs are *antaa* + *mahdollisuus* 'give + opportunity' (15 examples), *saada* + *tehtävä* 'get + task' (14 examples), *antaa* + *lupa* 'give + permission' and *saada* + *lupa* 'get + permission' (11 examples each). Taking high frequency as a proxy for Ikola's "closely knit unit" the hypothesis makes a clear prediction: the higher the frequency of a pair, the more GEN we should observe. The mosaic plot in (106) visualizes the relationship between the frequency of the matrix verb + matrix object pair and the frequency of the embedded object case in our corpus.

(106) The distribution of NOM vs. GEN by matrix verb + matrix object pair frequency



On the x-axis we have matrix verb + matrix object pairs ordered in terms of ascending frequency: the leftmost column contains the pairs that occurred only once in the corpus (the lowest frequency); the rightmost column contains the pairs that occurred 15 times in the corpus (the highest frequency). On the y-axis we have case: black represents genitive, gray represents nominative. Bin size is proportional to the number of observations. The mosaic plot shows that Ikola's hypothesis is on the right track: GEN tends to be more common with high-frequency pairs. The plot and all subsequent calculations were done in the R statistical computing environment (R Core Team 2014).[23]

In order to understand the quantitative data better we modeled it using logistic regression; see, e.g., Baayen (2008), Dalgaard (2008). The question is whether the choice between NOM vs. GEN depends on the matrix verb + matrix object pair frequency. Note that pair frequency is simply our operationalization of Ikola's notion of "closely knit unit." It does not entail the claim that construction frequency plays an explanatory role in the choice of case (cf. Coetzee and Kawahara 2013). The advantage of logistic regression is that it allows us to consider several predictors at once. In particular, Ikola briefly remarks that the matrix object and the embedded object might exhibit *attractio casus*, a tendency to share the same case (Kholodilova 2013). We therefore included the case of matrix object (ADV, GEN, NOM, PAR, where ADV includes all semantic cases) as a predictor in the model. A third predictor we included is the number of the matrix object (PL, SG).

A summary of the regression model is shown in (107). A positive estimate means that the predictor favors GEN. We find that Ikola's hypothesis is supported: the log frequency of the matrix verb + matrix object pair is significant in the expected direction. In contrast, no support is found for the *attractio casus* hypothesis: neither matrix object case nor number come out significant.

(107) A summary of the logistic regression model

```
                Estimate    Std. Error  z value  Pr(>|z|)
(Intercept)     -3.25804    0.53513     -6.088   1.14e-09 ***
Case = GEN      -0.04998    0.34057     -0.147   0.883
Case = NOM      -15.15894   819.30702   -0.019   0.985
Case = PAR      -0.68888    0.46502     -1.481   0.139
N num = SG      0.79221     0.48356     1.638    0.101
VN logfreq      1.32644     0.21506     6.168    6.93e-10 ***
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1
' ' 1
```

How should Ikola's hypothesis be interpreted in terms of our cyclic theory? The following interpretation suggests itself:

(108) IKOLA'S HYPOTHESIS INTERPRETED: There are two kinds of matrix verb + matrix object pairs. In a loosely knit (typically low-frequency) pair the object NP is cyclic; in a closely knit (typically high-frequency) pair the object NP is noncyclic.

Ikola's generalization can now be understood as follows. In a closely knit pair the object NP is not a cycle: the sentence is evaluated in one pass and we get invariant GEN. As Ikola (1964: 70–71) insightfully notes, closely knit pairs are analogous to simple

[23] We also tested Ikola's hypothesis by defining pair frequency as the frequency of the 167 adjacent verb + noun pairs in the full *Aamulehti 1999* corpus. The results were similar. The advantage of this alternative measure is the larger spread of frequencies; the disadvantage is that the full *Aamulehti 1999* corpus was not manually checked and the data contain plenty of noise due to homonymy and ambiguity.

verbs: one can substitute *haluta* 'desire' for *osoittaa* + *halua* 'show + desire', suggesting that the pair is akin to a single predicate. In a loosely knit pair the object NP is a cycle: the sentence is evaluated in two passes, allowing faithfulness to NOM to play a role, and we get NOM ∼ GEN variation. Since the structure is in diachronic flux the cyclic status of a particular verb + object pair may well vary across and even within individuals. It is possible that the sentence-specific differences in Itkonen's data reflect analogous differences between cyclic vs. non-cyclic predicate + complement combinations.

We started from the assumption that all NPs are cyclic. We now revise this assumption by allowing both cyclic and noncyclic NPs. In terms of our model, noncyclic NPs ignore faithfulness (MAX/NP, DEP/NP). The predictions for the two types of NPs are identical except in one case: if the matrix clause is active, i.e., has a nominative subject, and the embedded predicate is transitive, i.e., has an internal argument, only invariant GEN is predicted if the NP is noncyclic. This is exactly the variation environment.

Finally, Ikola (1964: 71) suggests that there may even be phonological evidence for two kinds of NPs: "The object of a sentence [a cyclic NP] is in a stressed position whereas in fixed phrases [noncyclic NPs] it is often relatively unstressed." This suggests that cyclic NPs receive phrasal stress whereas noncyclic NPs do not. The stress patterns of the two types of NPs in Finnish would thus parallel the stress patterns of phrases vs. compounds in English (*blàck bóard* vs. *bláckbòard*, Chomsky and Halle 1968). More evidence for a distinction between cyclic and noncyclic structures emerges in other complex constructions. This is the topic of the next section.

5 Other constructions

In the previous sections, we have seen that CPs and NPs may be cyclic categories in Finnish. In this section, we will briefly discuss a number of other nonfinite constructions. The key observation is that only some embedded structures are cyclic. Two additional types can be identified: *precyclic* structures that form a single cycle with the matrix clause and *postcyclic* structures that form a separate cycle, but do not feed subsequent cycles. We will focus on the constructions discussed in Vainikka and Brattico (2014) and use their nomenclature that originates in Vainikka (1989), but we will postpone the evaluation of Vainikka and Brattico's solution until the following section.

Precyclic structures are part of the matrix clause for purposes of case: if the matrix clause has an external argument the embedded object is GEN; if not, the embedded object is NOM. In other words, the two form a monoclausal structure. An example of a precyclic structure is the *A-infinitive*, traditionally known as the first infinitive, which Vainikka and Brattico (2014: 93) call "the least clause-like of the non-finite forms in Finnish." The nonfinite VP embedded in Ikola structures is an A-infinitive. Examples of A-infinitives as complements of verbs are shown in (109) where the matrix verb is active and in (110) where the matrix verb is passive. There is no variation.

(109)	Matti	yritt-i	ampu-a	***karhu/karhu-n**.
	Matti.NOM	try-PAST	shoot-1INF	***bear.NOM/bear-GEN**
	'Matti tried to shoot a/the bear.'			

(110) Kylä-ssä yritet-tiin ampu-a **karhu/*karhu-n**.
village-INE try-PASS.PAST shoot-1INF **bear.NOM/*bear-GEN**
'In the village, one tried to shoot a/the bear.'

Another precyclic structure is the *MA-infinitive*, traditionally known as the third infinitive, illustrated with an active matrix clause in (111) and with a passive matrix clause in (112). Note that in the active both internal arguments 'contest' and 'bear' take the marked GEN; in the passive both revert to the unmarked NOM because there is no external argument present.

(111) Matti voitt-i **kilpailu-n** ampu-ma-lla
Matti.NOM win-PAST **contest-GEN** shoot-3INF-ADE
***karhu/karhu-n**.
***bear.NOM/bear-GEN**
'Matti won the contest by shooting a/the bear.'

(112) **Kilpailu** voitet-tiin ampu-ma-lla **karhu/*karhu-n**.
contest.NOM win-PASS.PAST shoot-3INF-ADE **bear.NOM/*bear-GEN**
'The contest was won by shooting a/the bear.'

The analysis is straightforward: A-infinitives and MA-infinitives are not cycles, but form a single case assignment domain with the matrix clause. Nothing else needs to be said.

Two cyclic structures have already been discussed in detail: Itkonen and Ikola structures. An additional example of a cyclic structure is the *rationale adjunct*, traditionally known as the translative form of the first infinitive, or the purpose clause. This structure shows NOM ∼ GEN variation parallel to Itkonen structures. The same analysis applies. If the matrix clause has an external argument the object in the embedded clause is GEN, as illustrated in (113). The fact that Finnish allows optional pro-drop in first and second person is immaterial (Vainikka and Levy 1999; Holmberg 2005).

(113) (Minä) paino-i-n nappi-a
(1.SG) press-PAST-1.SG button-PAR
'I pressed the button.'

[käynnistä-ä-kse-ni ***ohjelma/ohjelma-n**]
[start-INF1-TRA-PX.1P.SG ***program.NOM/program-GEN**]
'in order to start the program'

If the matrix clause does not have an external argument, as in passive and necessive clauses, we get the familiar NOM ∼ GEN variation, as illustrated in (114).

(114) Minu-n täyty-i paina-a nappi-a
I-GEN must-PAST press-1INF button-PAR
'I had to press the button.'

[käynnistä-ä-kse-ni **ohjelma ∼ ohjelma-n**]
[start-INF1-TRA-PX.1P.SG **program.NOM ∼ program-GEN**]
'in order to start the program'

Finally, the *temporal adjunct* provides an example of a postcyclic structure. Here the embedded object is not sensitive to the matrix clause at all (Hakulinen et al. 2004: Sect. 543). Instead, it is strictly faithful to the first cycle GEN, with no alternation or variation. This is illustrated in (115) for active matrix clauses and in (116) for passive matrix clauses.

(115) Pekka itk-i [Mati-n ammu-ttu-a **karhu-n**].
Pekka cry-PAST [Matti-GEN shoot-PASS.PERF-PAR **bear-GEN**]
'Pekka cried after Matti had shot the bear.'

(116) Metsässä juhli-ttiin [Mati-n ammu-ttu-a **karhu-n**].
forest-INE celebrate-PASS.PAST [Matti-GEN shoot-PASS.PERF-PAR **bear-GEN**]
'It was celebrated in the forest after Matti had shot the bear.'

Under our analysis, the temporal construction constitutes a cycle of its own, but is not visible on the matrix cycle. This correctly predicts that the matrix clause has no chance to influence its case pattern, which thus remains faithful to the first cycle.

Is the three-way cyclic typology of clauses (precyclic, cyclic, postcyclic) only relevant for case or is it also reflected in other syntactic processes? The possible identity of case domains and extraction domains is discussed in Vainikka and Brattico (2014), Sect. 4.2, with negative results. Toivonen (1995) convincingly argues that extraction is possible out of nonfinite complements, but not out of nonfinite adjuncts, suggesting that the complement/adjunct distinction coincides with extraction domains; see Huhmarniemi (2012) for a detailed discussion as well as some cases of variation. It seems clear that the cyclic status of a clause is independent of its status as complement vs. adjunct and hence independent of extraction domains. Precyclic structures can be complements or adjuncts: the A-infinitive in (109)–(110) is a complement, but the MA-infinitive in (111)–(112) is an adjunct. Similarly, cyclic structures can be complements or adjuncts: Itkonen structures are complements, but rationale adjuncts are adjuncts. Finally, postcyclic structures can be complements or adjuncts: temporal adjuncts are adjuncts, but embedded finite clauses, which must be postcyclic as their case pattern is independent of the matrix clause, can be complements of verbs like 'say', 'think', 'want', and 'believe' and seem to allow extraction (Huhmarniemi 2012: 96–97; Vainikka and Brattico 2014: 104).

At this point, our cyclic typology is a descriptive one. We have no particular theoretical reasons to expect some categories to function as cyclic domains. However, we have seen evidence that the choice does not depend entirely on the category: some CPs are cyclic (Itkonen structures), others are postcyclic (embedded finite clauses); some NPs are cyclic (the "loosely knit" Ikola structures), others are precyclic (the "tightly knit" Ikola structures). It also remains to be seen whether the cyclic typology of clauses has reflexes in Finnish syntax beyond structural case.

6 Case and agreement

An interesting agreement-based analysis of Finnish structural case is offered in Vainikka and Brattico (2014). Their analysis provides a useful comparison to ours because it covers many of the same nonfinite structures from a sophisticated alternative perspective. Vainikka and Brattico put forward two main claims. First, the NOM/GEN alternation is argued to be genuinely long-distance: the case assigner may be situated arbitrarily far from the assignee. On this point we are in complete agreement. Second, the NOM/GEN alternation is argued to depend on subject-verb agreement higher in the clause. It is on this point that we disagree. We will now show that Vainikka and Brattico's agreement analysis covers the core cases, but falls short in a number of respects, and that our cyclic analysis goes further.

Vainikka and Brattico assume a strict correlation between agreement and GEN: agreement implies GEN and GEN implies agreement. This accounts for a number of core cases. Consider the simplex clauses in (117) and (118).[24]

(117) Active transitive

Matti ampu-i **karhu-n**.
Matti.NOM shoot-PAST.3P.SG **bear-GEN**
'Matti shot a/the bear.'

(118) a. Imperative
Ammu **karhu**.
shoot.IMP **bear.NOM**
'Shoot a/the bear!'

b. Passive
Karhu ammu-ttiin.
bear.NOM shoot-PASS.PAST
'The bear was shot.'

According to Vainikka and Brattico, GEN arises from the presence of agreement and NOM arises from its absence. In active transitive clauses, agreement (3P.SG) assigns GEN to the object. Since imperatives and passives have no agreement, so goes the argument, the object gets NOM from the c-commanding C as a last resort. This rules out two kinds of phenomena: presence of agreement with NOM and absence of agreement with GEN. Let us call the first *underapplication* because GEN is expected, but fails to appear, and the second *overapplication* because GEN is not expected, but appears nevertheless. Both are ruled out, but both are found in Finnish.

In simplex clauses imperatives exhibit underapplication: they are overtly inflected in both number and person, but the object is always NOM, as shown in (119).

(119) Ampu-kaa-mme **karhu/*karhu-n**.
shoot.IMP-PL-1P.PL **bear.NOM/*bear-GEN**
'Let us shoot a bear!'

In complex clauses we find both underapplication and overapplication. According to Vainikka and Brattico the object of a nonfinite clause can receive GEN from two sources: the primary source is the agreement on the nonfinite verb realized as the possessive suffix (PX); the secondary source is agreement on the matrix verb. If neither clause has agreement, the embedded object receives NOM from the c-commanding C

[24] Vainikka and Brattico assume that Finnish has an abstract accusative with three morphological variants: the /-t/-accusative which only occurs on human pronouns (ACC/t), the zero accusative which is homophonous with the nominative (ACC/∅), and the /-n/ accusative which is homophonous with the genitive (ACC/n). In keeping with our usage in the present paper, we will call the latter two NOM and GEN, respectively.

as a last resort. Summarizing, the system has four ways to assign case to the object of a nonfinite clause:

(120) Embedded object case by agreement (Vainikka and Brattico 2014)

MATRIX	EMBEDDED	CASE
+AGR	[+AGR]	→ GEN
+AGR	[−AGR]	→ GEN
−AGR	[+AGR]	→ GEN
−AGR	[−AGR]	→ NOM

Vainikka and Brattico's analysis correctly predicts the case of the embedded object in control sentences. In (121) the possessive suffix (PX) in the embedded clause assigns GEN to the object:

(121) Minä muista-n PRO tavan-nee-**ni**
I remember-1P.SG PRO meet-ACT.PERF-GEN.1**P.PX**
*Matti/Mati-**n**.
*Matti.NOM/Matti-**GEN**
'I remember having met Matti.'

If the embedded clause has an overt subject, as in Itkonen structures, the PX is absent. Under active matrix clauses the embedded object is GEN. This is also correctly predicted under Vainikka and Brattico's analysis: here the source of GEN is the matrix clause agreement.

(122) Minä muista-**n** Peka-n tavan-nee-n
I remember**-1P.SG** Pekka-GEN meet-ACT.PERF-GEN
*Matti/Mati-**n**.
*Matti.NOM/Matti-**GEN**
'I remember Pekka having met Matti.'

However, problems arise under passive matrix clauses. The embedded object should be NOM because passive has no agreement, but as Vainikka and Brattico note, we get variation NOM ∼ GEN. The GEN variant is unexpected, an instance of overapplication.

(123) Mati-n luul-tiin [ampu-nee-n karhu ∼ karhu-**n**].
Matti-GEN think-PASS.PAST [shoot-ACT.PERF-GEN bear-NOM ∼ **GEN**]
'Matti was thought to have shot a/the bear.'

Where does the GEN variant come from? Under our analysis it is optionally inherited from the first cycle through faithfulness. Vainikka and Brattico propose that it comes from agreement on the participle. On the surface this is plainly not the case: there is no PX when the embedded clause has an overt subject, as shown in (122). Following their hypothesis to its logical conclusion, Vainikka and Brattico conclude that the PX is optionally present, but inaudible. The postulation of an inaudible suffix is not in itself objectionable, of course. The problem is that there is no independent evidence for it.

The same problem arises in temporal constructions where PX is not possible, but the embedded object is invariably GEN under passive matrix clauses:

(124) Metsässä juhli-ttiin [Mati-n ammu-ttu-a
forest-INE party-PASS.PAST [Matti-GEN shoot-PASS.PERF-PAR
karhu-n].
bear-GEN]
'It was celebrated in the forest after Matti had shot the bear.'

In these examples, GEN has no plausible agreement source. However, it is entirely expected under the cyclic analysis: GEN is assigned to objects of transitive clauses on the first cycle and preserved intact because the structure is postcyclic.

However, for the sake of the argument, let us follow Vainikka and Brattico in assuming that the case variation in fact does reflect optional inaudible agreement on the participle. This results in the following predictions:

(125) a. Active matrix clause (agreement):
+AGR [+AGR] → GEN
+AGR [−AGR] → GEN
b. Passive matrix clause (no agreement):
−AGR [+AGR] → GEN
−AGR [−AGR] → NOM

This predicts invariant GEN under active matrix clauses and variation NOM ∼ GEN under passive matrix clauses. This is correct for embedded transitive clauses. The problem is that the analysis does not generalize to embedded existentials or predicatives which show NOM ∼ GEN variation even under active matrix clauses:

(126) Pekka luul-i [talo-ssa ole-va-n
Pekka.NOM think-PAST [house-INE be-ACT.PRES-GEN
?karhu ∼ karhu-n].
?bear.NOM ∼ GEN]
'Pekka thought there to be a bear in the house.'

(127) Pekka luul-i [Mati-n ole-va-n
Pekka.NOM think-PAST [Matti-GEN be-ACT.PRES-GEN
sotilas ∼ ?sotilaa-n].
soldier.NOM ∼ ?GEN]
'Pekka thought Matti to be a soldier.'

This variation cannot be derived from optional inaudible agreement in the embedded clause because matrix agreement will always be available to assign GEN to the embedded NP. This time the NOM variant is unexpected, an instance of underapplication. The upshot is that optional agreement does not predict enough variation.

As for Ikola structures, Vainikka and Brattico (2014: 93–94) give examples of NOM objects, suggesting that GEN objects are ruled out because an infinitive inside the complement of a noun is independent of the matrix verb and does not support GEN. However, GEN is robustly attested in such examples in our corpus. This is unexplained under the agreement analysis which has no plausible source for the GEN variant. Under our analysis the variation is correctly predicted.[25]

More problems emerge if we try to generalize the agreement analysis to predicatives. Consider Ikola structures with matrix transitives (NOM ~ GEN) and matrix predicatives (NOM):

(128) Matti sa-i tilaisuude-n ampu-a
Matti.NOM get-PAST opportunity-GEN shoot-1INF
karhu ~ karhu-n.
bear.NOM ~ bear-GEN
'Matti (NP/E) got an opportunity (NP) to shoot a/the bear (NP).'

(129) Se ol-i tilaisuus ampu-a **karhu**.
it.NOM be-PAST.3P.SG opportunity.NOM shoot-1INF **bear.NOM**
'It (NP/E) was an opportunity (NP/E) to shoot a/the bear (NP).'

This case difference is not explained by agreement: the agreement patterns are identical, but the case patterns are different. The correct empirical generalization refers to argument structure: the alternating NP is embedded inside an internal argument (NP) in (128), but inside an external argument (NP/E) in (129), hence the difference in case patterns.

In sum, Vainikka and Brattico's analysis posits a strict correlation between agreement and GEN: agreement implies GEN and GEN implies agreement. This works well in a number of cases, but not all: sometimes GEN does not appear in the presence of agreement (underapplication) and sometimes GEN appears in the absence of agreement (overapplication). This suggests that agreement is not responsible for structural case assignment in Finnish. In contrast, a theory where structural case distinguishes the external argument from other arguments in a cyclic fashion gets the facts right.

7 Conclusion

We have proposed a new solution to two outstanding problems in Finnish structural case: non-locality and free variation. The solution builds on two assumptions: (i) structural case distinguishes the external argument from other arguments and (ii) structural case assignment is cyclic. Formulated in terms of Stratal Optimality Theory (Kiparsky 2000) and Partial Order Optimality Theory (Anttila 1997; Anttila and Cho 1998/2003; Djalali 2014) the analysis correctly predicts a wide range of case patterns in both simplex and complex clauses, including intermediate well-formedness judgments in complex clauses (Itkonen 1976, 1981). More generally, the analysis illustrates the intimate relationship between categorical and quantitative patterns: as Itkonen (1981, 1976) demonstrates, quantitative patterns are just as systematic as categorical patterns and both are conditioned by the same grammatical factors.

[25]The variation in Ikola structures is noted by Brattico (2012: 277): "if the matrix verb shows full phi-features, both the n-accusative [= GEN] and ∅-accusative [= NOM] are possible inside the object NP." Here Brattico invokes a TELESCOPIC OBJECT PRINCIPLE: "Long distance case assignment between a probe and a goal takes place only if the goal is a direct object."

We have shown that it is possible to derive both types of patterns from one and the same grammar in terms of a conservative generalization of classical Optimality Theory, without any numerical parameters.

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Appendix A: The Ikola corpus

The Ikola corpus contains 1,577 sentences extracted from *Aamulehti 1999*, an electronic document collection of the Finnish language containing 16.6 million words, available through CSC IT Center for Science Ltd (csc.fi), administered by the Finnish Ministry of Education, Science and Culture. For more information, see kielipankki.fi/language-bank.

The corpus was built by the first author in three steps: (i) by extracting the trigrams NOUN + INFINITIVE + {NOM, GEN} from the corpus using the Lemmie interface (3,814 sentences), replaced since by the Korp interface (korp.csc.fi); (ii) by narrowing down the result to sentences that exemplify the structure under study (1,577 sentences); (iii) by annotating the result for several variables. The trigram was selected to maximize the number of desired hits and to minimize the number of spurious hits, while keeping the result small enough for human inspection. Two steps in the process involved human judgment: in step (ii) the result of the automatic search was narrowed down to sentences that exemplify the structure under study; in step (iii) the examples were annotated for eleven variables deemed relevant: matrix subject, matrix voice, matrix polarity, matrix verb, noun case, noun number, noun stem, infinitive stem, embedded object/predicative case, syntactic ambiguity, and argument structure. The annotated corpus, the exclusion criteria used in step (ii), and the annotation guidelines used in step (iii) are available from the authors upon request.

Examples of search commands are given in (130); examples of search results (slightly simplified) are given in (131) and (132).

(130)	[bf="lupa"][modality="Iinf"][case="Nom"]	Hits: 134
	[bf="lupa"][modality="Iinf"][case="Gen"]	Hits: 130

(131) Oikeus o-n myöntä-nyt kaupungi-lle **luva-n**
court.NOM have-3P issue-PCP city-ALL **permit-GEN**
rakenta-a silta.
build-INF bridge.NOM
'The court has issued the city a permit to build a bridge (NOM).'

(132) Merita sa-i **luva-n** **osta-a** **osa-n** puolalaispanki-sta.
Merita get-PAST **permit-GEN** **buy-INF** **part-GEN** Polish.bank-ELA
'Merita has obtained a permit to buy a part (GEN) of the Polish bank.'

In the seach trigram NOUN + INFINITIVE + {NOM, GEN} the term NOUN targets a noun lexeme, e.g., *lupa* 'permit', in any of its inflectional forms. We focused on the 28 noun lexemes mentioned in Ikola (1964) of which 24 occurred in our search results: *aie* 'intention', *aihe* 'topic', *aika* 'time', *ajatus* 'thought', *halu* 'desire', *himo* 'lust', *käsky* 'command', *kyky* 'ability', *lupa* 'permit', *lupaus* 'promise', *mahdollisuus* 'possibility', *oikeus* 'right', *onni* 'luck', *päätös* 'decision', *pyrkimys* 'aspiration', *suunnitelma* 'plan', *tahto* 'will', *tapa* 'manner', *tarve* 'need', *tehtävä* 'task', *vaara* 'danger', *vaikeus* 'difficulty', *velvollisuus* 'obligation', *yritys* 'attempt'. The search term INFINITIVE targets any 1st infinitive immediately following the noun, e.g., *rakentaa* 'build'. Finally, the search term {NOM, GEN} targets any word in the nominative or genitive case immediately following the infinitive.

Appendix B: Summary of predicted case patterns

trans	NOM **GEN**	Matti ampui **karhu-n**. 'Matti shot **a bear**.'
pred	NOM **NOM**	Matti on **sotilas**. 'Matti is **a soldier**.'
exist	INE **NOM**	Metsässä on **karhu**. 'There's **a bear** in the forest.'
act[trans]	NOM [GEN **GEN**]	Pekka uskoi Matin ampuneen **karhu-n**. 'Pekka believed Matti to have shot **a bear**.'
act[pred]	NOM [GEN **NOM∼GEN**]	Pekka uskoi Matin olevan **sotilas∼sotilaa-n**. 'Pekka believed Matti to be **a soldier**.'
act[exist]	NOM [INE **NOM∼GEN**]	Pekka uskoi metsässä olevan **karhu∼karhu-n**. 'Pekka believed there to be **a bear** in the forest.'
pass[trans]	[GEN **NOM∼GEN**]	Matin uskottiin ampuneen **karhu∼karhu-n**. 'Matti was believed to have shot **a bear**.'

pass[pred]	[GEN **NOM∼GEN**]	Matin uskottiin olevan **sotilas∼sotilaa-n**. ‘Matti was believed to be **a soldier**.’
pass[exist]	[INE **NOM∼GEN**]	Metsässä uskottiin olevan **karhu∼karhu-n**. ‘There was believed to be **a bear** in the forest.’
act-NP[trans]	NOM GEN [**NOM ∼ GEN**]	Matti sai tilaisuuden ampua **karhu∼karhu-n**. ‘Matti got an opportunity to shoot **a bear**.’
act-NP[pred]	NOM GEN [**NOM**]	Matti sai tilaisuuden olla **sankari**. ‘Matti got an opportunity to be **a hero**.’
pass-NP[trans]	NOM [**NOM**]	Saatiin tilaisuus ampua **karhu**. ‘An opportunity to shoot **a bear** was obtained.’
pass-NP[pred]	NOM [**NOM**]	Saatiin tilaisuus olla **sankari**. ‘An opportunity to be **a hero** was obtained.’
subj-NP[trans]	NOM-[**NOM**]	Tilaisuus ampua **karhu** tarjoutui. ‘An opportunity to shoot **a bear** presented itself.’
pred-NP[trans]	NOM NOM-[**NOM**]	Se oli tilaisuus ampua **karhu**. ‘It was an opportunity to shoot **a bear**.’
subj-NP[pred]	NOM-[**NOM**]	Tilaisuus olla **sankari** tarjoutui. ‘An opportunity to be **a hero** presented itself.’
pred-NP[pred]	NOM NOM-[**NOM**]	Se oli tilaisuus olla **sankari**. ‘It was an opportunity to be **a hero**.’

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