Binary tense and modality

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Abstract The present paper adopts as its point of departure the claim by Te Winkel (1866) and Verkuyl (2008) that mental temporal representations are built on the basis of three binary oppositions: Present/Past, Synchronous/Posterior and Imperfect/Perfect. Te Winkel took the second opposition in terms of the absence or presence of a temporal auxiliary *zullen* 'will'. However, in a binary system Future looses the status it has in a ternary analysis as being at the same level as Past and Present. The present paper shows that Present and Past already may express posterior information, there being no temporal role for *zullen* 'will'. Grice's Maxim of Quantity determines which sort of interpretation (current or posterior) is to be associated with Present or Past. The infinitival form of *zullen* 'will' should be seen as an epistemic modal operator with a specific role in the interaction between speaker and hearer. This operator will be argued to be positioned between the first and the third opposition. The binary approach is not restricted to Dutch and so it points to a fundamental flaw in Kissine (2008) which proposed that the English auxiliary *will* is (only) temporal.

Keywords binary tense, epistemic modality, possible world semantics, Maxim of Quantity, indeterminacy, posteriority

1 Introduction

Germanic languages such as English, German and Dutch have modal auxiliaries. In many grammars, a subset of these verbs is treated as both modal and temporal, dependent on the contexts of use in which they occur.[1] The present paper will argue that the auxiliary *zullen* 'will' in a Dutch sentence like (1a), but also its English counterpart (1b), is not ambiguous between a temporal and a modal reading.

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[1] This has been proposed for English *will* and *shall* (e.g., Palmer 1974, Hornby 1975, Comrie 1985, Hornstein 1990); for German *werden* (e.g., Saltveit 1962, Dieling 1982, Ballweg 1988) and for Dutch *zullen* (e.g., Den Hertog 1903; Haeseryn et al. 1997).

(1) a. Elsa zal hem bellen
     b. Elsa will call him

In fact, the indeterminateness about whether Elsa's call is in the future or may be at the moment of speech will be argued to be a matter of the Present tense form in *zal* ('will-3sg'), so that the infinitival form of *zullen* 'will' is to be considered as carrying only the burden of expressing some form of modality, in particular epistemic modality.

In the linguistic literature, the claim that Dutch *zullen*, German *werden* and English *will* is only modal is not at all new.[2] After all, Ockham's razor has always been a helpful guide. But there is a difference between proposing that the meaning of a certain auxiliary is modal—with the help of examples supporting this sort of interpretation—and showing that such a position follows from a number of assumptions about the essential ingredients of the tense system. The present paper aims at denying a temporal role to *zullen* 'will' as a direct consequence of principles governing the binary system proposed by Te Winkel (1866) and modernized in Verkuyl (2008).

Section 2 will discuss the three tense oppositions making up Te Winkel's system: (i) Present/Past, (ii) Synchronous/Posterior and (iii) Imperfect/Perfect. Opposition (i) has as an immediate consequence that Future is removed from the equal position it has in the ternary temporal tripartition Past/Present/Future. A more neutral posteriority-relation appears in (ii) at a lower level. The next step is to show how this system can be modernized by applying tools from modern formal semantics and that this offers itself as an attractive alternative to the ternary system based on Reichenbach (1947). It will be shown that it is not *zullen* 'will' that provides for the sense of posteriority often associated with the sentences in (1), but that this sense is inherently present in the Present/Past-opposition. This is a correction on Verkuyl (2008), which maintained Te Winkel's distinction between *zullen* 'will' as a modal and as a temporal auxiliary.

Section 3 will argue that contrary to what has been proposed in Kissine (2008) for English *will*, both Dutch *zullen* and English *will* are only modal, the difference between English *will* and Dutch *zullen* being explained in terms of a different actualization of the binary opposition Present/Past. Thus, the present paper can be seen as relevant for the discussion on tense and modality in West-Germanic languages making different choices in their tense system.[3]

On the basis of a comparison with other modal auxiliaries like *moeten* 'must' and *kunnen* 'may', the verb *zullen* 'will' will be argued to express (only) a special way of informing the hearer about the speaker's state of mind with respect to the proposition being expressed. Our claim with regard to the purely modal nature of *zullen* 'will' in (1) makes it necessary to reconsider opposition (ii) in section 4: if posteriority can be shown to be provided by the first opposition itself, there is no need to maintain the second one. On the other hand, if modality can be shown to settle itself between the first and the third opposition, there is room for reconsidering (ii) in terms of modal notions. We will further show how the posterior interpretation of present or past tense forms can be made to follow from either the presence of carriers of temporal information (such as adverbials) or from the pragmatic principle

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[2] Dutch: Paardekooper (1957), Droste (1958), Kirsner (1969), Janssen (1988); German: Vater (1975), Erb (2001); English: Quirk and Greenbaum (1973), Huddleston and Pullum (1975), Palmer (2001), Stowell (2012), among others. The literature on German *werden* suggests that this verb comes close to Dutch *zullen* (cf. Janssen 1989).

[3] Verkuyl (2008) discusses in detail the tense systems of languages such as French, Chinese, Bulgarian, Georgian and English, arguing that the three binary oppositions occur in each of them albeit in different choices made by the languages in question.

known as the Maxim of Quantity (Grice 1975). This principle prohibits that speakers make their utterances more, or less, informative than required in the given context.

2 Binary tense theory

2.1 Introduction

Te Winkel's original system distinguishes eight Dutch tense forms on the basis of three binary oppositions given in (2).

(2) a. Present vs. Past
    b. Synchronous vs. Posterior
    c. Imperfect vs. Perfect

Typical of Te Winkel is that he was not so much concerned with the properties ascribed to time in the domain of physics, which has heavily influenced the ternary approach to tense, but rather with the properties of time as mentally encoded in the tense systems found in natural language. In that sense, Te Winkel's ideas reflect a quite modern mentalistic view on language. His idea was that in using the Past one shifts back mentally to a point t anterior to the speech time. At that point t, by (2b) another point t' is available either synchronous with t or posterior to t. At t', the next step (2c) is taken by considering the eventuality spoken about as being completed (perfect) or not (imperfect). The Present in (2a) also has the choice between t' as synchronous to t or later than t in (2b), in both cases t being at the point of speech. Then at the third step there is a choice between imperfect and perfect in (2c).

   The description in the preceding paragraph followed Te Winkel's way of presenting his system: top-down. From a modern semantic point of view, the opposite way is preferable. Verkuyl (2008) took the members of the three oppositions in (2) as tense operators, made visible in the last line of each of the cells in Table 1.[4] Starting with the tenseless predication

Table 1 The eight tense forms in Te Winkel's system

		PRES	PAST
SYN	IMP	1. *Simple Present* Elsa loopt Elsa walks PRES(SYN)(IMP)(p)	2. *Simple Past* Elsa liep Elsa walked PAST(SYN)(IMP)(p)
	PERF	3. *Present Perfect* Elsa heeft gelopen Elsa has walked PRES(SYN)(PERF)(p)	4. *Past Perfect* Elsa had gelopen Elsa had walked PAST(SYN)(PERF)(p)
POST	IMP	5. *Simple Future* Elsa zal lopen Elsa will walk PRES(POST)(IMP)(p)	6. *Future in the Past* Elsa zou lopen Elsa would walk PAST(POST)(IMP)(p)
	PERF	7. *Future Perfect* Elsa zal hebben gelopen Elsa will have walked PRES(POST)(PERF)(p)	8. *Future Perfect in the Past* Elsa zou hebben gelopen Elsa would have walked PAST(POST)(PERF)(p)

[4] The italicized labels in the cells of Table 1 are the ones that we will use in this study for the eight tense forms occurring in Dutch even though the terms used for the four posterior forms will turn out to be less felicitous due to our claim that *zullen* 'will' does not belong to the temporal system.

p one can define the contribution of each of the operators ending at the top with a tensed sentence S$'$. In this way, one obtains eight tense forms. For example, the Future Perfect sentence *Elsa zal hebben gelopen* in cell 7 has the semantic representation PRES(POST)(PERF)(p), which is derived in three steps: (i) the PERF-operator applies to the tenseless predication p *Elsa lopen* 'Elsa walk$_{inf}$' to form the tenseless form *Elsa hebben gelopen* 'Elsa have$_{inf}$ walked$_{pp}$'; (ii) application of POST yields the tenseless form *Elsa zullen hebben gelopen* 'Elsa will$_{inf}$ have$_{inf}$ walked$_{pp}$'; (iii) the PRES-operator, finally, takes this output and forms the tensed sentence *Elsa zal hebben gelopen* 'Elsa will$_{fin}$ have$_{inf}$ walked$_{pp}$'. In this way, the finite tense form *will$_{fin}$* may be seen as formed from PRES+*will$_{inf}$*, where PRES contributes the temporal and *will$_{inf}$* the purely modal part of the meaning.

The presence of tense operators raises questions about the underlying syntactic framework. At this stage of our exposition, we stay close to the categorial base of Verkuyl (2008) by taking Figure 1 as a point of departure.
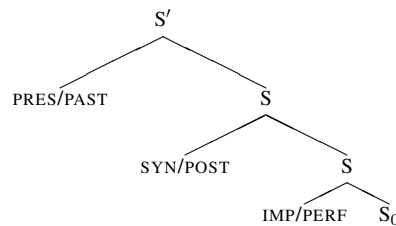

Fig. 1 The scope relations between the tense operators

This is because the operators in the eight configurations in Table 1 respect the scope relations between tense elements generally assumed in syntactic theory. In generative theories, the tenseless *p*—in Figure 1: S$_0$—can be identified as the syntactic projection VP or vP of the main verb, whereas the temporal operators PRES and PAST will be introduced by the functional projection TP. Note that S$'$ in Figure 1 is the only tensed S in the sequence of S's beginning with S$_0$. Placement of the PERF-operator between the temporal operator and the tenseless proposition corresponds to the many proposals since Borer (1994) that postulate an AspP between TP and VP. Similarly the fact that the verb *zullen* 'will' is normally higher in the structure than the perfect auxiliary can be used to argue that the POST-operator is situated between TP and PERF. After having argued in section 4 that the POST-operator is in fact a purely modal operator, we shall reconsider the architecture of Figure 1 in terms of the well-known Tense-Mood-Aspect tripartition.

At the semantic side, the use of tense operators makes the binary system more congenial to the tense system proposed in Prior (1967) than to Reichenbach's system, although Prior's system is not binary but ternary. Prior's tense system is less popular among linguists than Reichenbach's system because it suffers from the lack of points of reference, its operators being introduced by existential quantification over times. This prevents the eventuality from being located at a contextually determinate time. In order to overcome the lack of referential force in Prior's system, Blackburn (1994) took the domain introduced by a tense operator as a nominal element uniquely identifying a stretch of time. This can be done by the Montagovian technique for describing proper names in sentences like *Elsa is ill*, which receives the representation: $\exists x[\text{ILL}(x) \land x = \text{e}]$. In the same way, the meaning of e.g., PAST in the sentence PAST(ϕ) can be taken as contextually identifying a certain domain in the past in which the denotation of the tenseless predication ϕ is to be located: 'there is a temporal index i' to be associated with the (still tenseless) predication ϕ such that $i' = i$ and i is before n'. Here

i is the nominal element in question, behaving like a (temporary) proper name. In this way, Blackburn provides for referential force in Prior's system. His solution will be used below in defining the notion of present and past.

However, apart from accepting Prior's ternary tripartition, Blackburn also inherited a remarkable shortcoming of Prior (1967). Given a tenseless proposition *p*, Prior's system has an operator *F* for the future tense which makes *Fp* from *p* and it has an operator *P* for the past tense which makes *Pp* from *p*. There is no operator for the present: *p* itself is considered as sufficient. Te Winkel's system calls for an interpretation as an operator system with a PRES-operator. As we will point out below this makes it possible to strictly separate the shifting point *n* from the notion of present. We will avoid the use of S for the point of speech because in Reichenbach's system S is taken as the present, which crucially does not hold for *n* in the binary system.

2.2 The present tenses

The basic problem of Reichenbach's approach to tense based on the ternary opposition Past/Present/Future is the identification of the notion of speech time with the notion of present. Keeping these notions strictly apart turns out to offer important advantages. For example, it allows us to treat tense as part of a developing discourse: shifting the speech time does not necessarily lead to shifting the present. In the binary system presented here, the PRES-operator is interpreted as pertaining to some temporal domain *i* containing *n*. The leading idea is that by the use of the present tense form speakers present eventualities as occurring in their present even though these eventualities need not occur at *n* itself. A speaker could utter a sentence like (3a) on Tuesday to express that Elsa is dedicating the whole week to writing the mentioned section on the tense system. It is further evident from the fact that (3a) can be followed in discourse by the sentences in (3b–d).

(3) a. Elsa <u>werkt</u> deze week aan de paragraaf over het tempussysteem.
     Elsa works this week on the section   about the tense system
     'This week, Elsa is working on the section on the tense system.'
   b. Gisteren <u>heeft</u> ze de algemene opbouw   vastgesteld.
     yesterday has   she the overall organization prt.-determined
     'Yesterday, she has determined the overall organization.'
   c. Vandaag <u>schrijft</u> ze   de inleiding.
     today   writes   she the introduction
     'Today, she is writing the introduction.'
   d. Daarna   <u>zal</u> ze de acht tempusvormen beschrijven en vrijdag <u>is</u> ze klaar.
     after.that will she the eight tense forms   describe   and Friday is she ready
     'After that, she will describe the eight tense forms and Friday she will be ready.'

The present tense forms in discourse (3) are underlined. Two of them, *werkt* 'works' in (3a) and *schrijft* 'writes' in (3c) are finite main verbs; the other three are finite auxiliary verbs: *heeft* 'has' in (3b), *zal* 'will' and *is* 'is' in (3d). The consistent use of the present tense form in this discourse makes it possible for the speaker to take the present as constituting a temporal domain consisting of several subintervals, each of them denoted by a temporal adverbial which locates the four eventualities expressed by (3) more precisely within the interval denoted by *deze week* 'this week' in (3a).

Following the notation in Verkuyl (2008), the global structure of a present domain *i* is depicted in Figure 2. The bottom line represents the time line, where *n* stands for the

speech time. The role of the shifting speech time n is to split the present i into an actualized part i_a (the present preceding n) and a non-actualized part $i_\diamond$ (the present following n; the subscript $\diamond$ informally invokes the presence of all sorts of possibilities available after n, in the sense of 'not yet actualized'). In this way, n maintains its importance as a factor in the interpretation of tense but it looses its role as the temporal unit standing for the present: it is a domain-splitter within the present. For the moment, we leave open the question of how much temporality and how much modality is to be associated with the non-actualized part $i_\diamond$ of i because that issue will be dealt with extensively in §3.
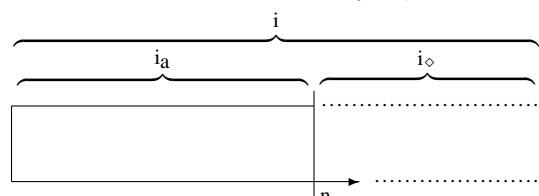

Fig. 2 The present tense domain i

The present tense domain i is contextually determined. In the discourse chunk (3), it may seem as if the present i is identified by the adverbial *deze week* 'this week', but (4) shows that the discourse in (3) may be part of a larger story in the present tense by the use of the adverbial *al jaren* 'for years'.

(4)   Elsa werkt nu al jaren aan een grammatica van het Nederlands. De eerste delen zijn al
      afgerond en deze maand is ze begonnen aan het werkwoord. [continue with (3a-d)]
      'Elsa has been working for years on a grammar of Dutch. The first volumes are already
      finished and this month she has begun with the verb.' [continue with (3a-d)]

Thus pragmatic information may lead to extending the present tense domain of the discourse chunk in (3). Sentence (5) in fact shows that i can be stretched indefinitely.

(5)   Sinds de oerknal breidt het heelal zich in alle richtingen uit en waarschijnlijk zal dat
      voortduren tot het einde der tijden.
      'Since the Big Bang the universe is expanding in all directions and probably that will
      continue until the end of time.'

Ultimately, it is the shared knowledge of the speaker and hearer that determines what counts as the present tense domain, and thus which eventualities preceding or following speech time n can be discussed by using present tense forms.[5]

One of the advantages of the binary system under discussion is that its three oppositions turn out to yield the appropriate amount of temporal units to express temporal relations that really matter linguistically. As in Verkuyl (2008), we will express these by means of the indices i and n already introduced above, and by the indices j and k, which pertain to the temporal location of the eventuality. The full set of connectives introduced by the operators is given in (6).

(6)   a. Present ($i \circ n$) - Past ($i < n$)
      b. Synchronous ($j \approx i$) - Posterior ($i_a < j$)
      c. Imperfect ($k \preceq j$) - Perfect ($k \prec j$)

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[5] Jespersen (1924:258f.) discusses the notion of present time along the same line but there is a crucial difference. Jespersen considers the present in sentences like (4) and (5) as an extension of the present 'now', which it is not in the binary system under discussion: n partitions the present domain i.

The ∘-connective between the present index i and n in (6a) expresses the relation of overlap but should be read as expressing that n is part of the i-domain. The connective $\approx$ in (6b) should be interpreted as expressing that the domain j has a sufficiently large overlap with i for it to be seen as synchronous with i. The precedence-connective $\prec$ in (6c) is chosen in order to express that α in $\alpha \prec \beta$ is an earlier part of β and contained in it, in the sense in which 3 precedes 4, because $\{1,2,3\}$ is contained in $\{1,2,3,4\}$ (cf. Partee et al.1990:75f.; see also footnote 9 on page 16). The $\preceq$-connective introduced bij IMP leaves indeterminate whether or not k is completed or not in j so IMP should be interpreted as non-PERF. The oppositions in (6) represent Te Winkel's view in a modernized version: (6a) and (6b) will be revised below.

The index j has an intermediate role between the index k of the eventuality and the index i of the present domain. An important consequence of the availability of j as an index presents is that j is to be taken as the present domain of the eventuality index k. In other words, every eventuality has not only its running time but also its own present j, which may vary dependent on the way we talk about it. In (3) and (4), the temporal adverbial phrases are not modifiers of i itself but of the present j of eventuality k. In (3d), for example, the adverbial phrase *daarna* 'after that' identifies j as some time interval between Tuesday and Friday in which k (= She describe eight tense forms) is to be located, and in the rest of (3d) Friday is identified as the j in which k (= She be ready) is to be located. In both cases, one cannot identify i and j, which provides important support for the postulation of j as being inextricably bounded with k.

2.2.1 Simple Present

The Dutch Simple Present expresses that the present domain j of the eventuality k is taken to be synchronous to the present domain i of the speaker/hearer ($j \approx i$). This formulation predicts that by the use of a present tense form k may be located in i_a or in $i_\diamond$, as shown in Figure 3.
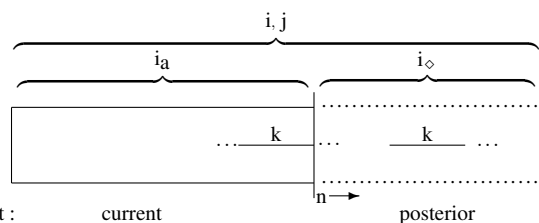

Fig. 3 Simple Present :   current   posterior

This prediction is borne out: the sentences in (7) may pertain to i_a (the current interpretation), but they may also pertain to $i_\diamond$ (the posterior interpretation).

(7) a. Elsa wandelt.
         'Elsa is walking.'
     b. Ik bel je (omdat ik zie dat je gebeld hebt).
         lit: I call you (because I see that you gave me a call.)
     c. We zijn thuis.
         'We are at home.'

Although the two locations—actualized or not-actualized—differ substantially so that we can clearly distinguish between current and posterior, there is no reason to call the present tense form itself ambiguous. The simple reason for this is that the sentences in (7) are so minimal (the more so in their written form) that they simply do not give the information necessary to locate k in one of the subdomains of i. In fact, we hit here upon an essential feature of the present tense form: it positions an eventuality k and its present j in i leaving its exact location in the dark in the absence of modifying material or some other sort of information. Even sentences like *Ik ben aan het wandelen* ('lit: I am walking') may be express posteriority, say in a context in which it is clear that we are talking about what people are going to do next Wednesday and I give my answer.

The Dutch sentences in (8) show that the Simple Present can also locate k in $i_\diamond$ without any overlap with the speech situation containing n.

(8)   a. Elsa wandelt dan.
          Elsa walks   then
          'Elsa will walk then.'
      b. Ik bel je.
          'I'll call you.'
      c. We zijn morgen   thuis.
          We are tomorrow at home
          'We'll be at home tomorrow.'

In (8a) the presence of *dan* 'then' is necessary for durative predications to express only posteriority, whereas for terminative predications such as (8b) no additional information is necessary to provide a posterior interpretation, under the guidance of Grice's Maxim of Quantity: it would sound quite stupid to tell someone at n that you are calling that person. Sentence (8c) is the most simple and usual way in Dutch to inform a hearer about the posterior location of k: the adverbial rules out a current interpretation.

The sentences in (8) are the Simple Present variants of (9). Children learn at school that these are Simple Future sentences because of the presence of *zal*. Their teachers and their parents have learned that also when they were young and in this long chain of generations one simple question has been constantly ignored: why does the present tense form of the underlined auxiliaries does not count here as a present?

(9)   a. Elsa <u>zal</u> dan wandelen.   a′. Elsa <u>moet</u> dan wandelen.
          Elsa will then walk   Elsa must then walk
          'Elsa <u>will</u> walk then.'   'Elsa <u>must</u> walk then.'
      b. Ik <u>zal</u> je bellen.   b′. Ik <u>ga</u> je bellen.
          I will you call   I go you call
          'I <u>will</u> call you.'   'I <u>am going to</u> call you.'
      c. We <u>zullen</u> morgen thuis zijn.   c′. We <u>kunnen</u> morgen thuis zijn.
          We will tomorrow at home be   We may tomorrow at home be
          'We <u>will</u> be at home tomorrow.'   'We <u>may</u> be at home tomorrow.'

All this is quite amazing because the sentences in (9a′-c′) display the same sort of posteriority as those in (9a-c). Without *dan* ('then') in (9a′), *gaan* ('go to') in (9b′) and *morgen* ('tomorrow') in (9c′), the sentences in (9a′-c′) would be indeterminate as to their current or posterior interpretation.

That the Gricean Maxim of Quantity plays an important role in determining whether there is a current or a posterior interpretation or not, can be shown by the following example. I am calling on the regular phone with some friend whose partner is called Fred. After the

usual introductory exchange Elsa then says (10a) to me taking a rest of some milliseconds in the form of breath.

(10) a. Fred belt je   op je mobiel.   …
          Fred calls you on your mobile phone …
          'Fred is calling you on your mobile. …'
      b. … kun je hem even opnemen?
          '… Can you take him just for a moment?'

Given the context up to the dots in (10a) there are two possibilities for me in interpreting my friend: (i) Fred will call later on; (ii) Fred is calling now via his mobile and I know I cannot hear that because my own mobile phone is still in the sleeping room. If my friend continues her sentence with (10b), she perfectly keeps in mind Grice's Maxim by giving sufficient information for me to understand that Fred is calling now by her use of *even* ('just for a moment').

There is a convincing test showing that the Simple Present may blur the current and the posterior interpretation, as shown in (11).

(11) We zijn vandaag en morgen thuis.
      We are today and tomorrow at home
      'We will be at home today and tomorrow.'

The adverb *vandaag* 'today' in (11) modifies the predication 'We are at home' but the same applies to the adverb *morgen* 'tomorrow'. Note that (11) may be said by a speaker who is at home at n. But this is not necessary: (11) may be said on the telephone by a speaker who is not yet at home and is only speaking about $i_\diamond$. Gricean information is necessary in (12) in order to determine whether or not *vandaag* ('today) is to be taken as 'the rest of today'. This example demonstrates that the Simple Present itself is not ambiguous but indeterminate about whether k is to be located in i_a or in $i_\diamond$ because the present itself contains two subdomains.

At this point it is necessary to add one more example:

(12) Het regent vanmiddag.
      'It is raining/will rain this afternoon.'

The above examples in the present subsection all concern situations in which the sentences may be seen as expressing some sort of planning. In (12) this is excluded. Yet, the indeterminacy about what is being expressed by the finite tense form *regent* 'rains' can only be solved if one knows at which moment (12) is said. In the morning (12) inevitably pertains to a prediction, in the afternoon (12) may give a description of what is going on at n.

In the present subsection, we have shown that the Simple Present in Dutch has the full capacity of providing a current interpretation and a posterior interpretation of sentences having this tense form. Dependent on the context the two ways of locating k in a present domain i may be blurred as in (11), or one of the two subdomains of i is chosen by additional information. This implies that ambiguity is not the right term for characterizing the indeterminateness of the PRES-operator.

2.2.2 Present Perfect

Since the Dutch perfect tenses can be described in the binary tense approach without appealing to the internal temporal structure of the event, we consider the contribution of the PERF-operator as what is shared by the durative sentence (13a) and the terminative sentence (13b) in terms of expressing completion of k in j.

(13) a. Elsa heeft gewandeld.
    Elsa has   walked
    'Elsa has walked.'
   b. Elsa heeft zes kilometer gewandeld
    Elsa has   six kilometer walked
    'Elsa has walked six kilometres.'

Independent of the 'Aktionsart' both sentences locate k as completed within j. We will not go into aspectual matters here because we are focussed on the interaction between the Present tense form in sentences like (13) and the infinitival auxiliary *hebben* 'have' and not so much on the aspectual properties of the tenseless predication.

The default interpretation of the Dutch Present Perfect locates k as a discrete unit in the actualized part of the present tense interval i_a before n. Discreteness is represented in the left part of Figure 4 by the absence of dots after k.
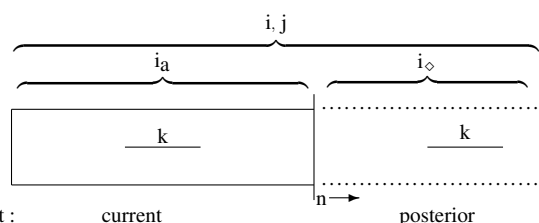

Fig. 4 Present Perfect :   current   posterior

A sentence like (14) can now be fully understood. In definition (6c) the discrete nature of k is made visible by the notation $k \prec j$. The adverbial *gisteren* 'yesterday' identifies j as the present domain of the completed k on the assumption that by the SYN-operator yesterday is an earlier part of a larger present tense domain i because it is a proper part of j.

(14) Elsa heeft gisteren   gewandeld.
    Elsa has   yesterday walked
    'Elsa walked yesterday.'

As i just includes n (and is not identical to it), the present tense form *heeft* 'has' may combine with the adverbial *gisteren* 'yesterday' which refers to a time interval preceding n.[6]

That the Present Perfect is formed by the PRES-operator on top of SYN and PERF predicts that the Present Perfect has also the possibility to locate k in $i_\diamond$. Sentences like (15) make it true:

(15) a. Vanavond heb ik hem die email gestuurd.
    Tonight   have I him that email sent
    'Tonight I will have sent him that email.'
   b. Om vijf uur   is   Peter vertrokken.
    At five o'clock has Peter gone
    'At five o'clock Peter will have left.'

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[6] The binary analysis solves the problem for Lekakou and Nilsen (2008) raised by the principle proposed in Giorgi and Pianesi (1997) which says that a closed event may not be simultaneous with a punctual event. Lekakou and Nilsen take n as the present and so the Giorgi/Pianesi-principle excludes the Present Perfect from pertaining to n. By separating the notion of present from the notion of shifting point, the binary approach does not have any problem in (14) with locating k in i_a up to and including n.

If (15a) is said in the morning or in the afternoon, (15a) counts as saying that something that still has to be done. This is analogous to our observation that the Simple Present takes over the duty of the Simple Future by skipping *zullen*. Sentence (15b) looks backward if the speaker talks at noon about what happened at 5 o'clock in the morning, in which case Peter has left, or forward if the speaker talks at noon about 5 o'clock in the afternoon, in which case the sentence gives the information that the end of j is 5 o'clock.

By comparing Figure 4 with Figure 3 one can easily see that the posterior interpretation of the Present Perfect is similar to the posterior interpretation of the Simple Present except for the fact that the presence of the PERF-operator requires $k \prec j$, that is that k be completed before the time interval j has come to an end. This holds independently of the aspectual nature of the predication.

2.2.3 Simple Future and Future Perfect

Table 1 contains the sentences (16a) and (16b) with their analysis in terms of the tense operators.

(16) a. Zij   zal lopen.
        'She will walk'
        PRES(POST)(IMP)(She walk)
    b. Zij   zal hebben gelopen.
        'She will have   walked'
        PRES(POST)(PERF)(She walk)

The Dutch standard descriptive grammar ANS (= Haeseryn et al. (1997)) continues to call these forms Simple Future and Future Perfect and school grammars still follow the practice to associate the occurrence of *zal* in sentences with these two tense forms. Not being able to escape from the established use of the two terms we will continue to use the names Simple Future and Future Perfect now and then, but in those cases we will have in mind the posterior part of the Simple Present configuration in Figure 3 and the posterior part of the Future Perfect configuration in Figure 4. In this connection, we underline once again the importance of seeing that *zal* in (16) is a Present tense form. The PRES-operator provides room for uncertainty as to the exact location of k because indeterminateness is an essential part of it.

(17) Joyce zal haar baas ongetwijfeld bellen om haar ontslag in te dienen.
     'Joyce will call her boss most certainly to quit her job.'

This sentence may pertain to a situation in which the speaker sees Joyce calling and derives from her attitude that she is telling her boss that she will quit, but it may also apply to a situation in which Joyce has a call with a friend so that the speaker concludes from what is heard on Joyce's side that she will call her boss later on to tell her that she will quit. Without *zal* 'will' (17) would express exactly the same, but with more firmness. It is only contextual or additional material that determines i_a or $i_\diamond$ as the proper place for k.

The underlying issue here is that it is the PRES-operator which accounts for the posterior interpretation rather than the lexical content of *zullen*. This has been almost totally suppressed in the literature on the relation between tense and modality, a large majority of scholars being only interested in the presence of a modal auxiliary as a whole, not in its complexity as a PRES+MOD-combination.[7]

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[7] One of the few to discuss a present tensed form of a modal auxiliary in terms of tense morphology is Sarkar (1998:92f.). See also Kirsner (1969:119f.), Janssen (1988:119).

2.3 The past tenses

Present and past tenses share important properties, as is clear from the fact that the present tenses in discourse (3) can all be replaced by corresponding past tenses. A speaker can utter (18a) to report on Els' activities during the week preceding speech time, say n'. Sentence (18a) can be followed in discourse by (18b-d), in which the past tense domain in (18a) is divided in smaller subparts in a fashion parallel to the way in which the present tense sentences (3b-d) subdivide the present domain i evoked by (3a).

(18) a. Elsa <u>werkte</u> vorige week aan de paragraaf over het tempussysteem.
          Elsa worked last week   on the section about the tense system
          'Last week, Elsa was working on the section on the tense system.'
      b. Op maandag <u>had</u> ze   de algemene opbouw   vastgesteld.
          on Monday   had she the overall organization prt.-determined
          'On Monday, she had determined the overall organization.'
      c. Op dinsdag <u>schreef</u> ze   de inleiding.
          on Tuesday wrote   she the introduction
          'On Tuesday, she was writing the introduction.'
      d. Daarna   <u>zou</u>   ze de acht temporele vormen beschrijven.
          after that would she the eight tense forms   describe
          'After that she would describe the eight tense forms.'
      d'. En vrijdag <u>was</u> ze klaar / <u>zou</u>   ze klaar zijn.
          And Friday was she ready / would she ready be
          'On Friday she would be ready'

Assume that the speaker of the discourse chunk in (18) is telling about a conversation he had with Elsa. One may then identify n' with the time at which that conversation took place. The striking parallelism between the four present tense forms and the four past tense forms in (3a-d) and (18a-d) make the past tenses similar to the present tenses, except for the position of n. In order to account for the parallelism, past tenses are given a virtual speech time in the past, which we will refer to as n', which is like n but in the past and which is also a domain-splitter of the then-present i'. It should be observed that the parallelism between the past domain i' and the present domain i is not complete with respect to (18d') because for the past tense to express posteriority the Simple Past form in (18d') is less suitable than its present counterpart unless modifiers such as *dan* 'then' are added. We will come back to this point shortly.

  In order to distinguish the now-present i from its counterpart in the past i', we will temporarily adapt the first opposition in (6) into the one in (19).

(19) Present (i ∘ n) - Past (i' < n)

In §2.4, (19) will be replaced in view of some empirical arguments.[8]

2.3.1 Simple Past

The Simple Past in sentences like (20) expresses that k is located in past tense domain i'.

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[8] It is not possible to render the present tensed sentence *Vrijdag is ze klaar* in (3d) into the past sentence *Vrijdag was ze klaar* in (18d') without losing its posterior sense. It is a factual statement about the past with no posteriority expressed. However, it suffices to add *dan* 'then' to obtain the posterior: *Vrijdag was ze dan klaar* (lit: Friday she was then ready) may pertain to an expectation expressed at n'.

(20) Elsa wandelde.
    'Elsa walked.'

In Figure 5, k is included in its domain j, which stands for the then-present of k. By the absence of POST, i' and j are taken as synchronous. The (then-)current interpretation of (20) is the one in which k took place preceding and possibly going on at n' in a way comparable with what is expressed in Figure 3 for the Simple Present in its current interpretation. Figure 5 pictures the present domain i as containing n and the then-present domain i' as
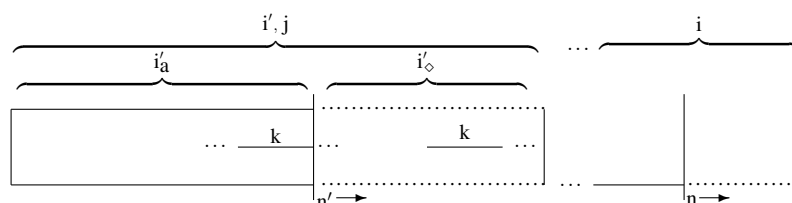

Fig. 5 Simple Past :   current   posterior

containing n', so the Simple Past creates a situation in the past parallel to the situation in which the Simple Present is being used in Figure 3.

    Parallel to what is expressed by the posterior use of the present tenses, the Simple Past can also locate forward as demonstrated by sentences like (21).

(21) a. Volgens plan   wandelde Elsa dan al   in de bergen.
      According to plan walked   Elsa then already in the mountains
      'According to plan, Elsa would walk already in the mountains by then.'
    b. Ze vertelde me woensdag dat ze 's avonds   naar het theater ging.
      She told me Wednesday that she that evening to the theatre   went
      'She told me (last) Wednesday that she would go to the theatre that night.'

Figure 5 shows that the configuration around n' is part of a larger complex. Past finite tense forms are suitable for expressing a posterior interpretation, but it should be observed that compared with the present finite form of a main verb, its past counterpart needs more context to express it, as already noted with respect to (18d′). In (21a) the modifiers *according to plan* 'in her thoughts' and *dan* 'then' provide a clear context for a look forward; in (21b) the past tense *vertelde* 'told' gives an anchorpoint on last Wednesday from which the k of her theater going is projected into $i'_\diamond$.

    As said earlier, (20) is quite hard to interpret as expressing posteriority in the absence of the right contextual material. Even with appropriate modifiers, it is more usual than in the case of the Simple Present to make use of the auxiliary *zullen* 'will' in its past finite form, as in (22).

(22) a. Elsa zou op dat moment wandelen.
        'Elsa would walk at that moment.'
    b. Elsa zou op dat moment de tien kilometer wandelen.
        'Elsa would walk the ten km at that moment.'

This might be seen as a sort of rehabilitation of *zullen* 'will' as a temporal auxiliary. But this is not the case. Parallel to the double use of the Simple Present the sentences in (22) may pertain to a situation in i'_a (current interpretation) or they may pertain to $i'_\diamond$ (posterior interpretation). In the latter case, the modifier *op dat moment* 'at that moment' denotes a

temporal part of $i'_\diamond$. In this way one obtains the indeterminateness analogous to that characteristic for the present tenses. The role of *zullen* 'will' is restricted to modal information, as in the Simple Present. The need to use *zullen* 'will' in Simple Past sentences to get a posterior interpretation can be explained by assuming that the speaker has generally less certain information about the actualization of a past k in i'. We will come back to this point in §3.

2.3.2 Past Perfect

The default interpretation of a Past Perfect sentence like (23) made visible in Figure 6 is that k is located before n', that is, k is included in the actualized past tense interval i'_a.

(23) Elsa had gewandeld.
      'Elsa had walked.'

In addition, the Past Perfect presents k then as a discrete unit fully completed within time interval j by the clause $k \prec j$. In that case, j appears to be restricted to i'_a.
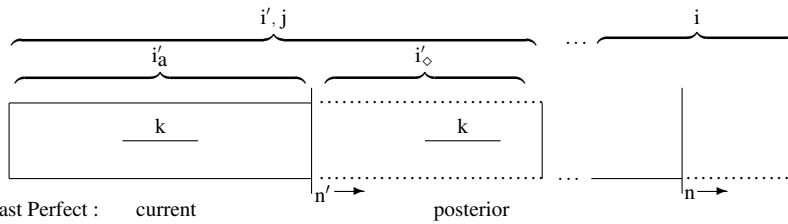

Fig. 6 Past Perfect :   current   posterior

As pointed out in §2.2.1, the Present Perfect may locate k in $i_\diamond$ because it allows the speaker to make a firm promise. In the Past Perfect an equivalent way of expressing posteriority is also possible.

(24) Ze belde me om 12 uur en   zei   dat ze   het probleem die avond   wel opgelost had.
      She called me at noon   and said that she that night   the problem prt solved   had
      'She called me at noon and said that she would have solved the problem that night.'

Analogous to what was said about the Present Perfect, the Past Perfect often uses the auxiliary *zullen* 'will' in the form known under the label of Future Perfect in the Past.

(25) a. Elsa zou op dat moment hebben gewandeld.
          'Elsa would have walked at that moment.'
      b. Elsa zou op dat moment de tien kilometer hebben gewandeld.
          'Elsa would have walked the ten km at that moment.'

Sentence (25a) may pertain to a situation in i'_a (current interpretation) or it may pertain to $i'_\diamond$ (posterior interpretation). Sentence (25b) is about an uncertainty at n' at what had happened in i'_a, but it may also pertain to $i'_\diamond$, because *op dat moment* 'at that moment' denotes a certain time in $i'_\diamond$. As in §2.3.1, the role of *zullen* 'will' is again restricted to modal information. We will come back to this point in §3.

2.3.3 Future in the Past and Future Perfect in the Past

What we said about the use of the terms Simple Future and Future Perfect in §2.2.3 also applies to the Future in the Past and the Future Perfect in the Past: what generally falls

under these labels in traditional and school grammar is now given its proper place under the labels of the posterior interpretation of the Simple Past and Past Perfect, respectively. In other words, sentences like (26) should strictly be regarded as expressing Simple Past rather than Simple Future. For convenience, we will continue to use the traditional labels if it is more easy to use them.

There turns out to be an interesting problem with the Future in the Past requiring a closer inspection of the definition of the PAST-operator in terms of the definition $i' < n$ in (19).

(26) a. Elsa zou gisteren bellen.
          Elsa would call yesterday   [i' precedes n]
      b. Elsa zou morgen bellen.
          Elsa would call tomorrow   [i' does not precede n]

The adverb *gisteren* 'yesterday' in example (26a) locates k in i_a clearly before n and so (26a) is compatible with the definition of PAST as $i' < n$ in definition (19). Sentence (26b), however, is a counterexample against the claim that a past tense domain i' always precedes n. In (26b) a part of i' follows n because the adverbial *morgen* 'tomorrow' modifies j and so k is to be located in $i_\diamond$. This runs counter to the definition of PAST in terms of $i' < n$ because k is now later than n itself. On the position that *zullen* 'will' is both a temporal and a modal auxiliary (26b) would not count as a counterexample because one could simply attribute a modal interpretation to it. But in a binary system in which *zullen* 'will' is taken to be modal only, $i' < n$ raises a problem for an adequate account of (26b). The same problem shows up in the use of the Future Perfect in the Past in (27).

(27) Jan zou   morgen   gekomen zijn.
      Jan would tomorrow come   be
      'Jan would have come tomorrow.'

The present domain j of k is located after n such that k is completed in j. But j synchronizes with i' and hence i' is also to be located after n. On the other hand, n' lies before n: it is the point at which in the past several possibilities were available. We will come back to this in the next section.

2.4 Truth conditions for the present and past tense forms

In terms of the sequence of three operators in front of a proposition p the PRES-operation ends as PRES(ϕ), where ϕ is a complex tenseless proposition containing p preceded by two operators. For example, sentence (13a) *Elsa heeft gewandeld* 'Elsa has walked' is analyzed as PRES(SYN)(PERF)(p), where ϕ is the underlined part. In non-binary analyses, the semantics of the PRES-operator crucially assumes the point of speech n as the decisive part of the truth conditions with respect to which the truth is determined, as in (28). The same applies to the standard non-binary truth definition of the PAST-operator in (29), which also hinges on the assumption that n is to be taken as the present.

(28) $[\![\text{PRES}(\phi)]\!]_{M,n} = 1$ iff $\exists t[t = n \ \& \ [\![\phi]\!]_{M,t} = 1]$

(29) $[\![\text{PAST}(\phi)]\!]_{M,n} = 1$ iff $\exists t[t < n \ \& \ [\![\phi]\!]_{M,t} = 1]$

In the binary tense system presented so far, the truth definition for the present tense forms runs differently:

(30) $[\![\text{PRES}(\phi)]\!]_{M,i} = 1$ iff $\exists i'[i' = i \ \& \ [\![\phi]\!]_{M,i'} = 1 \ \& \ i \circ n]$

This definition ensures that n is removed from its key contribution to the truth of a sentence, because in (30) the truth of a sentence is made dependent on the contextual identification of a temporal domain i containing n, the truth of ϕ being stated with respect to the whole domain i. The condition in (30) that i overlaps with n provides a sort of freedom lacking in (28). In order to prepare for a closer analysis of the role of the other tense operators it will be helpful to provide the derivation of sentence (31) in (32). The derivation in (32) may put off some readers but to them it should be pointed out that it is only the last line of the derivation that counts.

(31) Mary heeft de brief geschreven.
   'Mary has written the letter.'

(32) $\text{PERF}(\text{Mary write the letter}) \rightsquigarrow \lambda\phi\lambda\alpha\exists k[\phi[k] \wedge k \prec \alpha](\lambda\alpha'.\text{WL}(\alpha')(m))$
   $= \lambda\alpha\exists k[\lambda\alpha'.\text{WL}(\alpha')(m)[k] \wedge k \prec \alpha]$
   $= \lambda\alpha\exists k[\text{WL}(k)(m) \wedge k \prec \alpha]$
   $\text{SYN}(\text{PERF}(\text{Mary write the letter})) \rightsquigarrow$
   $\lambda\phi\lambda i\exists j[\phi[j] \wedge j \approx i](\lambda\alpha\exists k[\text{WL}(k)(m) \wedge k \prec \alpha])$
   $= \lambda i\exists j[\lambda\alpha\exists k[\text{WL}(k)(m) \wedge k \prec \alpha][j] \wedge j \approx i]$
   $= \lambda i\exists j\exists k[\text{WL}(k)(m) \wedge k \prec j \wedge j \approx i]$
   $\text{PRES}(\text{SYN}(\text{PERF}(\text{Mary write the letter}))) \rightsquigarrow$
   $\lambda\phi\exists! i[\phi[i] \wedge i \circ n](\lambda i'\exists j\exists k[\text{WL}(k)(m) \wedge k \prec j \wedge j \approx i'])$
   $= \exists! i[\lambda i'\exists j\exists k[\text{WL}(k)(m) \wedge k \prec j \wedge j \approx i'][i] \wedge i \circ n]$
   $= \exists! i\exists j\exists k[\text{WL}(k)(m) \wedge k \prec j \wedge j \approx i \wedge i \circ n]$

In the first line of (32), the tenseless p = 'Mary write the letter' is taken by the PERF-operator forming the set of indices in the third line of the derivation. $\text{PERF}(p)$ is taken by the SYN-operator yielding again a set of indices, which is the input to the PRES-operator. The last line says that there is a uniquely defined present domain i such that there is a k which is completed in j and there is a temporal domain j synchronous to i and i contains the shifting point of speech n.[9]

   To keep things simple in view of our discussion on modality in the next sections, we restrict ourselves to the past tense of simple sentences and therefore we propose (33) as the definition of the PAST-operator as an alternative to (29).

(33) $[\![\text{PAST}(\phi)]\!]_{M,i} = 1$ iff $\exists i'\exists n'[[\![\phi]\!]_{M,i'} = 1$ & $i' \circ n'$ & $n' < n$ & $i \circ n]$.

Definition (33) runs parallel to (30) in identifying the then-present nominal element i' as including the shifting point n' ($i' \circ n'$), but it also relates n' as anterior to the present shifting point n which is contained in i. It follows that $i' \leq i$ which is correct because the equal-sign in $\leq$ is necessary in view of counterfactual sentences such as (27) which contain modifiers locating j and hence i' in $i_\diamond$. In fact, the effect of (33) can be seen in the last line of the derivation (35) representing what is expressed by sentence (34).

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[9] The type-logical conventions are borrowed from Verkuyl (2008). For example, the POST-operator introduced in the fourth line of (32) is of type $\langle\langle i,t\rangle,\langle i,t\rangle\rangle$, taking the formula of type $\langle i,t\rangle$ in the third line in order to yield an expression of type $\langle i,t\rangle$ in the fifth line, where i is the type of indices. This representation is close to event-semantics but the indices i, j and k are all taken as numbers standing for temporal units, much in the way in which 23 in March 23 stands for a natural day. Thus, k corresponds closely to the e of event semantics, but the representation in (32) abstracts from ontological (naive physical) considerations. Hence the possibility of using $\prec$ for the relation 'earlier than but contained in' much in the way in which 3 precedes 4 but is also included in 4. $\exists! i$ is short for: $\exists i'[i' = i\ldots$ along the lines of Blackburn (1994) discussed earlier. The present analysis remains neutral with regard to a presuppositional or assertive approach to tense.

(34) Mary zou de brief schrijven.
'Mary would write the letter.'

(35) IMP(Mary write the letter) $\rightsquigarrow \lambda\phi\lambda\beta\exists k[\phi[k] \wedge k \preceq \beta](\lambda\alpha.\text{WL}(\alpha)(\text{m}))$
$= \lambda\beta\exists k[\lambda\alpha.\text{WL}(\alpha)(\text{m})[k] \wedge k \preceq \beta]$
$= \lambda\beta\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq \beta]$
POST(IMP(Mary write the letter)) $\rightsquigarrow$
$\lambda\phi\lambda\alpha\exists j[\phi[j] \wedge \alpha_a < j](\lambda\beta\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq \beta])$
$= \lambda\alpha\exists j[\lambda\beta\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq \beta][j] \wedge \alpha_a < j]$
$= \lambda\alpha\exists j\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq j \wedge \alpha_a < j]$
PAST(POST(IMP(Mary write the letter))) $\rightsquigarrow$
$\lambda\phi\exists!i\exists i'\exists n'[\phi[i'] \wedge i' \circ n' \wedge n' < n \wedge i \circ n](\lambda\alpha\exists j\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq j \wedge \alpha_a < j])$
$= \exists!i\exists i'\exists n'[\lambda\alpha\exists j\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq j \wedge \alpha_a < j][i'] \wedge i' \circ n' \wedge n' < n \wedge i \circ n]$
$= \exists!i\exists i'\exists j\exists k[\text{WL}(k)(\text{m}) \wedge k \preceq j \wedge i'_a < j \wedge i' \circ n' \wedge n' < n \wedge i \circ n]$

The last line of (35) says that there is a past domain i' such that i' harbours the present j of k in $i'_\diamond$, which is that part of i' that follows n', with n' preceding n.

At this point, we have to look forward, because the main point of the present paper is that the POST-operator should disappear from this derivation as it is defined on the basis of Te Winkel's oppositions in (6) which take POST as a temporal operator. On the other hand, the second opposition appears to be necessary for connecting the present j of an eventuality k with the present domain i of the speaker/hearer. The question that will have to be discussed in §4 amounts to considering the possibility of replacing POST by MOD without losing the appropriate compositional derivation. Condoravdi (2002:60) raised the question: do modals contribute to temporal interpretation directly? The present analysis may turn this question into: do modals contribute to temporal interpretation at all? If PRES and PAST provide for posteriority, why should one attribute temporality to modal operators? In other words, what is the status of the second opposition?

3 *Zullen* and *will* as (only) modal auxiliaries

3.1 Introduction

Te Winkel's approach is fundamentally mentalistic in that the speaker decides on the choice of a past or present domain of interpretation, thus determining the perspective in which the eventuality talked about should be given its place. The division of the present into an actualized part i_a and a non-actualized part $i_\diamond$ with speech time n as a (dynamic) domain splitter makes the binary system suitable for modal considerations: n can be taken as the point where branching of possible worlds begins by default. In a parallel way, n' may be seen as the point at which branching of possible worlds in the then-present i' begins.

In the second part of the 20th century formal modal logic developed as an extension of propositional logic by the introduction of two operators: $\square$ (Necessity) and $\diamond$ (Possibility). Given a proposition p, the notions of 'It is necessarily true that p' ($\square p$) and 'It is possibly true that p' ($\diamond p$) are central to propositional logic enriched with metaphysical modality. If $\square p$ is true, p does not only hold in the actual world w but p also holds in every possible world accessible to w, whereas for the truth of $\diamond p$ it is necessary that there be at least one possible world making p true in the set of worlds W accessible to w. In formal semantics, a possible world is generally characterized as the set of propositions holding in that world.

Specific forms of modality have been studied in the last quarter of the 20th century, such as epistemic and doxastic modality. Here the notion of objective truth is relativized to, respectively, the knowledge and belief systems of individual speakers/hearers. They concern the degree of certainty assigned by an individual to the knowledge on which a proposition is based. It is this form of modality that turns out to be relevant for the interaction between speaker and hearer in which the use of *zullen* 'will' in Dutch will be argued to be determined.[10] Epistemic modality concerns the degree of certainty assigned to the truth of a proposition by an individual on the basis of his or her knowledge state.

It is impossible for us to argue that the Dutch *zullen* 'will' is purely modal and to ignore the discussion about English *will* in Kissine (2008), which argues that the English auxiliary *will* should be regarded as purely temporal. His proposal is in clear contrast with the quite influential proposal by Enç (1996), which considers *will* both as modal and temporal. In rejecting Kissine's thesis we cannot return to Enç's position because it is based on a ternary approach to tense. So in §3.2, Kissine's ternary analysis will be argued to be wrong and Enç (1996) will be shown to have a more adequate binary alternative. In §3.3, the range of the analysis of §2 is extended to English and so the question arises of how universal the binary tense oppositions may be claimed to be.

3.2 A binary view on the semantics of the English *will*

The first step in making modal sytems suitable for the study of natural language is to think in terms of the knowledge of individual speakers/hearers and in terms of their belief, as in e.g., Kratzer (1991b), Zimmermann (1999;2000), Geurts (2005) and Kissine (2008). Knowledge can be seen as a set $K_{w,i}$ of propositions known by a speaker in w at i; in that case one is in the domain of epistemic modality. In the same way, one can speak about $B_{w,i}$ as the set of propositions believed to be true in w at i; this set belongs to the domain of doxastic modality. Often one writes $wR_E w'$ for a situation in which w' is epistemically accessible to w and w' is consistent with $K_{w,i}$. We will not make a distinction between the $K_{w,i}$ and $B_{w,i}$ by treating doxastic modality as a form of epistemic modality, there being no technical reasons for choosing between them in the present analysis. In the literature just mentioned, the accessibility relation R is made up by the properties in (36) which are considered to be epistemically suitable.[11]

(36) a. R is transitive: if wRw' and $w'Rw''$, then wRw''
      b. R is euclidean: if wRw' and wRw'', then $w'Rw''$
      c. R is self-reflexive: if wRw', then $w'Rw''$ if and only if wRw''

This has to do with the fact discussed in Geurts (2005:388f.) that knowledge has not only the property of Positive Introspection as expressed by (36a): if $\Box p$, then $\Box\Box p$ (if you know something you know that you know that). Knowledge has (not uncontroversially, but accepted by Geurts and by Kissine) also the Euclidean property of Negative Introspection: if $\neg\Box p$, then $\Box\neg\Box p$ (if there is something you do not know, then you know that you do not know it). Self-reflexivity follows from (36a) and (36b).

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[10] This places our research in a tradition in which Kratzer (1991a;1991b), Enç (1996), Zimmermann (2000), Condoravdi (2002), Geurts (2005), Kissine (2008), Sarkar (1998), Nauze (2008) among many others are guided by the seminal work by Kripke (1963) and Lewis (1979) and made available technicallly in works like Hughes and Cresswell (1968), Thomason (1984), Gabbay and Guenthner (1984:Vol. II).

[11] Metaphysical modality plays no role in our analysis except as the background for all more specific sorts of modality. Only if different sorts of modality need to be kept apart, will we use the three terms or subscripts available.

3.2.1 Kissine's plea for a temporal *will*

The properties in (36) play an important role in Kissine's attack on *will* as a modal auxiliary. This attack is directed towards Enç (1996:354f.), whose proposal on the treatment of *will* in English has been quite influential in linguistic work on modality.

Enç's proposal consists of two ingredients shown in (37): (a) she first defines *will* as a modal operator; and (b) she defines the present tense.[12]

(37) a. $[\![\text{WILL}(\phi)]\!]_{\langle w,n\rangle} = 1$ iff $\forall w' \in W[w\text{R}w' \rightarrow \exists t[n < t \ \& \ [\![\phi]\!]_{\langle w',t\rangle} = 1]]$
      b. $[\![\text{PRES}(\phi)]\!]_{\langle w,n\rangle} = 1$ iff $\forall w' \in W[w\text{R}w' \rightarrow \exists t[n = t \ \& \ [\![\phi]\!]_{\langle w',t\rangle} = 1]]$

In particular, definition (37a) contains two elements that are relevant at this stage of our analysis. The first is that *will* expresses posteriority by the clause $n < t$ and the second is that its modality involves universal quantification over possible worlds (by the clause: for all $w' \in W$). Hence (37a) expresses epistemic necessity.

The elimination of *will* as a modal auxiliary by Kissine (2008) is based on his criticism of the phrase for all $w' \in W$ in (37a). His first step is to consider the sentences (38a) and (39a) in terms of Enç's proposal.[13]

(38) a. Elsa will sing.
      b. $[\![(38a)]\!]_{\langle w,n\rangle} = 1$ iff $\forall w' \in W[w\text{R}w' \rightarrow \exists t[n < t \ \& \ [\![\text{Elsa sing}_{\text{inf}}]\!]_{\langle w',t\rangle} = 1]]$

(39) a. It is not the case that Elsa will sing.
      b. $[\![(39a)]\!]_{\langle w,n\rangle} = 1$ iff $\exists w' \in W[w\text{R}w' \ \& \ \exists t[n < t \ \& \ [\![\text{Elsa sing}_{\text{inf}}]\!]_{\langle w',t\rangle} = 0]]$

Kissine takes (39b) as the truth-functional negation of (38a) and then shows that sentence (40a) can be true in a model in which (39a) is true in *w*.

(40) a. (For all that we know) it is possible that Elsa will sing.
      b. $[\![(40a)]\!]_{\langle w,n\rangle} = 1$ iff $\exists w'[w\text{R}w' \ \& \ \forall w'' \in W[w'\text{R}w'' \rightarrow \exists t[n < t \ \& \ [\![\text{Elsa sing}_{\text{inf}}]\!]_{\langle w'',t\rangle} = 1]]]$

According to him, the truth of both (39a) and (40a) leads to the incompatibility in (41).

(41) ?It is not the case that Elsa will sing and (for all we know) it is possible that she will sing.

An appeal to the property of transitivity in (36a) so that R allows for $will(p) \rightarrow \Box will(p)$, solves this problem because it predicts this outcome correctly. However, Kissine continues by observing that transitivity is not enough. The relevant sentences for this are (42a) and (43a). Given a transitive R, it is possible in *w* that the sentence (43a) is true on the basis of the definitions in (42b) and (43b).

(42) a. Elsa will not sing.
      b. $[\![(42a)]\!]_{\langle w,n\rangle} = 1$ iff $\forall w' \in W[w\text{R}w' \rightarrow \exists t[n < t \ \& \ [\![\text{Elsa sing}_{\text{inf}}]\!]_{\langle w',t\rangle} = 0]]$

(43) a. (For all that we know) it is possible that Elsa will not sing.
      b. $[\![(43a)]\!]_{\langle w,n\rangle} = 1$ iff $\exists w'[w'\text{R}w'' \ \& \ \forall w' \in W[w'\text{R}w'' \rightarrow \exists t[n < t \ \& \ [\![\text{Elsa sing}_{\text{inf}}]\!]_{\langle w'',t\rangle} = 0]]]$

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[12] The rather informal notation of Enç is adapted to our notation. $[\![\alpha]\!]_{\langle w,n\rangle} = 1$ means that α is true given a pair $\langle w,n\rangle$, which indicates that *w* is a world with a history in which *n* is a time. The variable *t* ranges over times taken as intervals.

[13] Kissine's verb *come* is replaced here to evade the implicit deixis of this verb as well as it implicit appeal to its being actualized in the future, *sing* being a more neutral alternative.

This leads to the truth of sentence (44) on the basis of (38a) and (43a).

(44) ?Elsa will sing and (for all that we know) it is possible that she will not sing.

For Kissine, the only way to account for the incompatibility in (44) is to assign the Euclidean property (36b) to R so that $\neg will(p) \rightarrow \Box[\neg will(p)]$ holds. But this makes R self-reflexive and so (38a) and (40a) are equivalent on the basis of the validity of $\Diamond\Box p \Leftrightarrow \Box p$. Kissine (2008) concludes that this is fatal for Enç's approach and the situation does not improve if one would replace $\forall w' \in W$ by the existential quantification $\exists w' \in W$ in Enç's (37a).

3.2.2 A rejection of Kissine's analysis

There are two reasons for having laid out Kissine's argument in some detail. The first is that if his analysis is right, it blocks the way for Enç and would indeed justify a proposal in which the approach to tense in Abusch (1998) may be combined with the modal approach advocated in Kratzer (1991a;1991b) in which every asserted sentence falls under the scope of a covert necessity operator. But his analysis is not right because there is a fatal flaw in the argument. The second reason is that the Ençian elements in Kissine's definitions above can be taken as showing that the definition (37a) expresses a crucial property of the modality in *will* in spite of the ill-chosen use of the universal quantifier over worlds. What is important in (37a) turns out to be the scope behaviour of *will*: it does not occur in the scope of negation.

That (39a) features here as the truth-functional negation of (38a) is amazing in view of the existence of sentence (42a). One can clearly trace back what must have happened. Kissine saw a sentence like *Elsa will sing* as ϕ and so the negation of that proposition is $\neg\phi$. Translating that back into natural language yields (39a). However, that is not a natural language sentence negating (39a). Speakers who say (39a) in a real life situations will use it at best to correct someone who just said: *Elsa will sing* as an alternative to the option of using (42a) with heavy stress on *not*. Sentences like (39a) are not about Elsa, they are about the correction on the form of the information just obtained.[14] Given definition (37a), Enç would simply have to see the unstressed (42a) as the truth-functional negation of (38a).

Kissine fundamentally ignores the specific role of *will* as a modal auxiliary, the proper paraphrase of (42a) being: 'It will be the case that Elsa does not sing'. In other words, *will* has $\neg$ in its scope rather than being in its scope. And this can be explained by the special role that *will* has as a modal auxiliary. Someone who says (42a) expresses the same amount of uncertainty or certainty about $\neg p$ as the one who says *Elsa will sing*, does express about p. In that respect, *will* should be compared with the auxiliaries (*may*, *must*) or adverbials (*possibly*, *necessarily*) as to possible differences in their occurrence with negation. This point will be discussed in more detail in §4.

Let us return to Enç's analysis of the modal operator *will*. Her proposal in (37a) rests on the assumption that MOD(ϕ) is true in a given world w if and only if (i) ϕ is true in every accessible world w'; and (ii) ϕ is true in w' at a time later than n. In defense of (37a) one could replace the universal quantifier $\forall w'$ in $\forall w' \in W$ by a generalized quantifier GQw' allowing different sorts of accessibility to subsets of W, dependent on the lexical semantics of the modal auxiliary in question. This is what we call *modal shading*. In the binary approach, this idea would lead to (45), in which (37b) is dropped in favour or the binary tense definitions in (30) and (33).

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[14] Apart from that it is also puzzling why (39b) has 'not all w' ($\sim$ there is a w') as the negation of 'all w'' rather than 'no w''. In other words, why does Kissine choose here for the external negation of the all-quantifier rather than for internal negation as would be in the line of Enç?

(45) $[[\text{MOD}(\phi)]]_{\langle w, \alpha \rangle} = 1$ iff for $\text{GQ}w' \in W$ s.t. $w\text{R}w'$: $[[\phi]]_{\langle w', \alpha \rangle} = 1$ $\quad\quad \alpha \in \{i, i'\}$

Here GQ is short for quantifiers denoted by the determiners *some*, *few*, *many*, *60%*, etc.[15] The metavariable α is used in order to let MOD apply both to the present domain i and the past domain i'. In this way, it is possible to define *zullen* 'will' in terms of a generalized quantifier Q_{SM}, which could be defined as covering sufficiently many (= SM) possible worlds.

(46) $[[\text{WILL}(\phi)]]_{\langle w, \alpha \rangle} = 1$ iff for $Q_{\text{SM}}w' \in W$ s.t. $w\text{R}w'$: $[[\phi]]_{\langle w', \alpha \rangle} = 1$ $\quad\quad \alpha \in \{i, i'\}$

The reformulation of Enç's (37a) in terms of a binary equivalent, reveals a serious problem. Both (45) and (46) require that the modal operator take a tensed predication ϕ with respect to w and looks for worlds w' in which ϕ is true in i or in i'. However, if modality is to be located between the topmost operator PRES (or PAST) and the tenseless predication PERF(p) or IMP(p), then the interpretation of WILL(ϕ) in (46) and MOD(ϕ) in (45) cannot yield a truth value. In that sense, (46) will need some sort of modification so as to yield the proper derivation. That matter will be settled in the discussion of the morphosyntactic architecture of the binary tense system in §4. But prior to this is the question of what sort of consequence the rejection of Kissine's proposal should have for the analysis of the Dutch counterpart of *will*. Suppose both English *will* and Dutch *zullen* are only modal: how can the obvious differences between the two be explained so as to obtain a unified account?

3.3 Comparing *will* and *zullen* 'will'.

There are two important differences between the ways in which the opposition between the PRES- and PAST-operator takes its form in Dutch and in English.

1. English uses the Progressive Form in cases where Dutch uses a non-Progressive Simple Form, both in the Simple Present and Simple Past .
2. English uses the auxiliaries *will* or *shall* in order to express posteriority in cases where Dutch generallys use the Simple Present or the Simple Past .

Both differences have to do with proximity: the Progressive Form brings k near to n thus activating the current interpretation, the English *will* can be seen as a natural way to locate k not in the proximity of n. When speaking about ongoing situations, English speakers make far more use of the Progressive Form than Dutch speakers do with forms that can be considered equivalent. It is normal for Dutch to use the Simple Present or Past tense form in all sentences of (47), whereas English has different tense forms as shown in the glosses.

(47) a. Ik kook nu.
      lit: I cook now
      'I am cooking now'
   b. Ik kook vandaag.
      lit: I cook today
      'I'm cooking/I'll cook today.'

a'. Ik kookte toen
   I cooked then
   'I was cooking then.'
b'. Ik kookte gisteren
   Ik kookte yesterday
   I was cooking/I cooked yesterday

Certainly, one may say in Dutch *Elsa is aan het koken* (lit: Elsa is at the cooking, 'Elsa is cooking') instead of *Elsa kookt* (lit: Elsa cooks) in order to focus on the ongoing process. However, Dutch speakers generally will use the Simple Present when talking about ongoing situations for which their English counterparts have to use the Present Progressive Form, as

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[15] The literature on generalized quantification is abundant. We restrict ourselves here to Keenan and Westerståhl (1997), Peters and Westerståhl (2006).

in *Ik kom er aan* (lit: I come) 'I'm coming', *Ik bel nu vanaf Schiphol* (lit: I call now from Schiphol) 'I'm calling now from Schiphol', *Zij rijden nu tussen Den Haag en Rotterdam* (lit: They drive now between The Hague and Rotterdam) 'They are driving now between The Hague and Rotterdam', etc. Forms like *Zij is aan het wonen in New York* (lit: She is living in New York), *Zij is naast hem aan het zitten* (lit: She is sitting next to him), *Hij is in bed aan het liggen* (lit: He is lying in bed) are even excluded in Dutch. Moreover, *Elsa is aan het koken* ((lit: Elsa is at the cooking) can easily be used in Dutch to pertain to a posterior situation: *Elsa is dan aan het koken* (lit: E. is then at the cooking, E. will be cooking then).

The difference between the Dutch and the English Simple Present finds a parallel in the difference between the English Simple Past in (48a) and the Dutch Simple Past in (48b).

(48) a. John said that Elsa read *Middlemarch*.
      b. John zei dat Elsa *Middlemarch* las.
      c. John said that Elsa was reading *Middlemarch*.

The use of the Progressive Form for expressing that John's utterance about Elsa is cotemporal with her reading Middlemarch in (48c), ensures that Mary's reading Middlemarch in (48a) will be located before John's utterance in spite of the $k \preceq j$-information provided by the IMP-operator. That is, due to the availability of the Progressive Form in English for expressing a current interpretation lined up with the shifting n', it is natural to reserve the $k \prec j$ option of IMP for the non-Progressive (48a). In (48b), the $k \preceq j$-information expressed by IMP remains so until other information such as contributed by adverbials is added in order to distinguish between the $k \prec j$- and the $k = j$-option of $\preceq$.

In English, the Progressive Form takes over a large part of the duties of the Simple Present and what is left for the latter is the expression of scheduled events and general statements. English uses the Progressive Form abundantly as a way for signaling proximity to n. This has nothing to do with the formal semantics involved, because Dutch has an equivalent construction for talking about ongoing situations but its use is scarce: the Simple Present performs all duties unless a speaker wants to focus on some aspect of the eventuality in question such as in *Zij is nu aan het fietsen* (lit. She is now at the biking; she is biking now) as opposed to *Zij fietst nu* (She bikes now). Both sentences may be said at the moment she is really biking, the former focusing slightly more on the physical activity going on now, but the difference is quite subtle.

One step further is to see that if English has a Progressive Form with such a heavy load, a more marked opposition between proximate and non-proximate is a quite natural thing to have: if there is a special form for the proximate part of i_a up to and including n, why not a special form for $i_\diamond$? This can be provided by *will*. That many grammarians have taken this form as a future tense form is unfortunate, but understandable in the light of the conceptual opposition proximate/non-proximate. We have argued above that the finite tense form of *will* is modal and that it can also be used to pertain to an ongoing situation, as in *Elsa will be at home (now)*. So, English has exactly the same formal semantic mechanism for providing indeterminateness between a current and posterior interpretation as Dutch and this holds for other Germanic languages as well.

Summarizing, what English distinguishes from Dutch is that English has two operators in full use in order to locate eventualities in i:

(a) PROG in order to express ongoing activity near the moving n up to and including n in i_a.
(b) MOD in order to express information about k as being possibly located in $i_\diamond$ as from n.

The information under (b) should be seen in terms of *will* systematically informing a hearer about the epistemic modal status of the proposition in the scope of *will*, whereas posteriority

is provided by the use of the PRES-operator. This explains why *will* is not used in scheduled events as in *The train leaves at 6.15 tonight* and announcements such as *The Oscar goes to ... Argo* (cf. Comrie (1985:47). In other words, the present tense of *will* in (42a) *Elsa will not sing* may be seen as providing the forward movement into $i_\diamond$, whereas the modal content of the infinitival *will* can be seen as providing some sort of purely modal information for the hearer, in this case a certain degree of firmness about what will not happen.

4 Modality between temporality and aspect

In §4.1, it will be shown with the help of the machinery discussed in §3.2 what it means to say that *moeten* 'must' (= $\square$), *kunnen* 'may' (= $\diamond$) and *zullen* 'will' all have a current and a posterior interpretation when they occur in their finite tense form. This enhances our earlier conclusion that the Simple Present and the Simple Past provide these interpretations. We will also consider the question: what sort of modality does *zullen* 'will' contribute as compared to the modality of *moeten* 'must' and *kunnen* 'may'? The differences between the modal auxiliaries under analysis also concern their behaviour with respect to negation. That point will be discussed in §4.2. In the final §4.3, the leading question will be how the three oppositions can be given a place in the morphosyntax of tensed sentences. Is there a scopal order PRES/PAST > MOD > PERF/IMP? And if so, how does MOD find its place between the operator at the left and at the right of it?

4.1 What modal auxiliaries do share and where they differ

The present subsection provides evidence for the fact that "regular" modal auxiliaries such as *moeten* 'must' and *kunnen* 'may' behave in the same way as *zullen* 'will' in a number of contexts. In view of our wish to flesh out the different roles of PRES and MOD in the complex PRES+MOD, it should be pointed out that the sentences (49a) – (49c) have exactly the same sort of indeterminateness as to the location of k in i_a or in $i_\diamond$.

(49) a. Mischa moet spelen.
     'Mischa must play'
     ' = $\square$(that Mischa is playing now or is going to play)
    b. Mischa kan spelen.
     'Mischa may play'
     = $\diamond$(that Mischa is playing now or is going to play)
    c. Mischa zal spelen.
     'Mischa will play'
     = WILL(Mischa is playing now or is going to play)

Excluding the root interpretation of (49a) – (49c), we interpret the $\square$-interpretation in (49a) and the $\diamond$-interpretation of (49b) as epistemic. Without additional information, the sentences in (49) may all locate Mischa's playing at *n* or later on as is clear from the fact that one may readily add adverbial phrases like *op dit moment* 'at this very moment' or *straks* 'later' determining more precisely his playing in i_a or in $i_\diamond$. All three finite modal auxiliary forms in (49) express this now-or-later interpretation due to the PRES-operator and they do that in the same way irrespective of the modal content (MOD) expressed by the infinite form of the auxiliaries.

The interpretation of the durative sentences in (49) does not depend on predicational aspect (Aktionsart), as shown by comparing them to the terminative sentences in (50).

(50) a. Dat huis op de hoek moet instorten.
          'That house at the corner must collapse'
          = □(that house at the corner is collapsing now/ is going to collapse)
      b. Dat huis op de hoek kan instorten.
          'That house at the corner may collapse'
          = ◇(that house at the corner is collapsing now/is going to collapse)
      c. Dat huis op de hoek zal instorten.
          'That house at the corner will collapse'
          = WILL(that house at the corner is collapsing now/is going to collapse)

In uttering one of the sentences (50) the speaker provides an estimation of the likelihood that k is occurring or will occur later. The posterior interpretation of (50a) is that, as far as the speaker can foresee, the collapse will take place in all conceivable situations in $i_\diamond$, there being no possible world in which the house would not collapse, whereas *kunnen* 'may' in (50b) expresses that k occurs in at least one imaginable situation in $i_\diamond$. However, in both cases, the sentence may also pertain to i_a: the speaker of (50a) may conclude on the basis of evidence of some sort (sound, movement of parts) that the house is actually collapsing and (50b) is a possible explanation for an unexpected noise in terms of a current collapse. In the current interpretation, (50c) is a reasonable hypothesis for what is going on at n, given the enormous noise and rumble, whereas in the posterior interpretation it expresses sufficient confidence in the prediction that the house will collapse in due time. All sentences in (50) express a prediction of some sort based on the knowledge of the speaker with (50a) counting as the firmest prediction, (50b) as the weakest one and (50c) with the intermediate one grounded in evidence of some sort.

Figure 7 makes (49b) and (50b) true, because it shows that p is true in at least one possible world in W. For convenience we assume that there are just five worlds in W. There are three worlds that make the sentences with *kunnen* 'may' true: w_1, w_2 and w_5. The sentences in (49a) and (50a) are false given Figure 7 because k does not occur in w_3 and w_4.
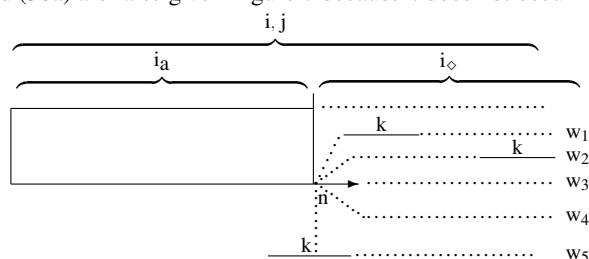

Fig. 7 Present tense and epistemic modality

Figure 7 also shows how the current interpretation in w_5 and the posterior configurations go together by the lack of information which makes it impossible to choose between current or posterior interpretation. The past tense of the sentences in (49) and (50) should show a similar pattern except for the fact that the branching in i' starts at n' rather than at n.[16]

Figure 7 not only illustrates the way in which the possible world semantics analyzes modality in terms of quantification over possible worlds, it also shows that in a binary anal-

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[16] As observed earlier, *Mischa moest spelen* (Mischa PAST+must play) and *Dat huis op de hoek stortte in* 'That house at the corner collapsed' are less suitable for a posterior interpretation because Dutch prefers to use *Mischa zou moeten spelen* (lit: Mischa would must play) and *Dat huis op de hoek zou instorten* 'That house at the corner would collapse'.

ysis the present domain $i_\diamond$ can be identified with the set W of possible worlds w that are accessible. The shifting point n provides the point of perspective which forms the point of departure for a "visit" to accessible worlds. We venture to say that a binary approach to tense is a very natural way of integrating the notion of possible worlds into the domain of temporality. If i is to be seen as a temporal domain containing $i_\diamond$, there is no objection against saying that access to a world w requires some form of linearity harmonizing with the sense of posteriority expressed by the PRES- (or PAST)-operator. In this respect, we deviate from Condoravdi (2002) in that we do not speak about a direct contribution of modals to temporal interpretation. We would say that the modal accessibility relation R appears to fit into the structure underlying temporal interpretation rather than that it contributes to it.

There is even a more fundamental way of showing that the modal auxiliaries in (49) and (50) share an important meaning element. We will do this by a comparison between *moeten* 'must' and *zullen* 'will' in (51) and (52).

(51) a. Het huis van Joyce moet   deze week instorten.
          Joyce's house   PRES+MUST this week   collapse
          'Joyce's house must collapse this week.'
      b. Het huis van Joyce moest   deze week instorten.
          Joyce's house   PAST+MUST this week   collapse
          'Joyce's house must collapse this week.'

(52) a. Het huis van Joyce zal   deze week instorten.
          Joyce's house   PRES+WILL this week   collapse
          'Joyce's house will collapse this week.'
      b. Het huis van Joyce zou   deze week instorten.
          Joyce's house   PAST+WILL this week   collapse
          'Joyce's house should collapse this week.'

Suppose that Elsa is talking with Sue on Tuesday and that Elsa knows that Joyce's house is still standing at speech time n. Then for Elsa the collapse of the house will take place in the non-actualized part of the present tense interval $i_\diamond$. This is, however, not a matter of semantics but of pragmatics. The infelicity of (51a) in a world in which Elsa already knows that the house has collapsed, follows from Grice's Maxim of Quantity given that the speaker could describe that situation more accurately by means of the perfect tense construction in (53), which places the eventuality in the actualized part of the present tense interval i_a.

(53) Het huis van Joyce is   deze week ingestort.
      Joyce's house   has this week   prt-collapsed
      'Joyce's house has collapsed this week.'

From this point of view, there is no difference between (51a) and (52a). In both cases, Sue may locate k in $i_\diamond$, but if she does not share Elsa's knowledge about the state of the house on Tuesday, she is allowed to think that someone had predicted the collapse a couple of days ago to Elsa so that Joyce's house may already have collapsed before the conversation between Sue and Elsa.

Suppose now that earlier in the conversation of which (51a) or (52a) is a part, Elsa told Sue that two days ago she had talked with Joyce and that Joyce had told her that a construction expert had just said that her house would collapse within a week. Elsa uses the time structure of the present domain i aware of the fact that Sue knows about the information she got from Joyce. By the use of the present tense form, both (51a) and (52a) may be

interpreted by Sue as looking forward in the sense that she locates k in $i_\diamond$ on the assumption that the house did not yet collapse in the meantime.

However, the Simple Present in (51a) and (52a) may also be interpreted as locating k before n when Sue thinks that Elsa may be under-informed as to the actual collapse. She may derive this from the fact that the most appropriate tense form for describing the location of k in i_a is the Simple Past of *moeten* 'must' in (51b) and *zullen* 'will' in (52b). It follows that the tense forms in (51a) and (52a) do not primarily provide temporal information concerning the collapse but inform Sue about Elsa's knowledge of the necessity or possibility of a collapse this week.

In (51b) and (52b), Elsa takes as anchor-point the moment n' at which she spoke with Joyce about her house. At n, Elsa has a gap in her knowledge about the actual world and she knows that Sue has the same gap. She simply does not know at n whether the house is still standing. We assume here the same situation as for the backward interpretation of the a-sentences: (51b) or (52b) uttered on Tuesday looks back to some virtual speech-time-in-the-past n' at which something was said amounting to the information that the house would collapse during the time interval referred to by the adverbial phrase *deze week* 'this week', that is, a time interval including speech time n. Given that Elsa is under-informed about the actual state of Joyce's house, what counts is not the actual eventuality of a collapse but the necessity of this eventuality in (51b) or the predictive value of the modal auxiliary in (52b). Note that for all four sentences under discussion it is possible for Elsa to continue with (54).

(54) … Misschien is het al   gebeurd. Of niet
      … maybe   is it   already happened or not
      'Maybe it has already happened. Or not.'

This means that in all cases the anchor-point for the inspection of all possible worlds is or may be located earlier than n. It is as if Elsa implicitly has in mind a point in time at the prediction about Joyce's house was made.

The present analysis of the sentences in (51) and (52) indicates that the use of an epistemic modal shifts the attention from the actual location of eventuality k within the interval j to epistemic information; the speaker primarily focuses on the necessity, probability, likelihood, etc. of the occurrence of eventuality k within j. Information about the precise location of k is of a secondary nature and depends on contextual information determining the split-off point of possible worlds as well as information about the knowledge state of the speaker. Our findings are summarized as follows.

1. If the split-off point of the possible worlds is located at speech time n, eventuality k cannot be situated in the actualized part i_a of the present/past tense interval because the Maxim of Quantity would then favor a present/past perfect construction, as in (53).
2. If the split-off point of the possible worlds precedes speech time n, the temporal interpretation depends on the knowledge state of the speaker:
    (a) when the speaker is under-informed, that is, not able to immediately observe whether eventuality k has taken place, eventuality k can be situated in i_a.
    (b) when the speaker is not under-informed, that is, able to immediately observe whether eventuality k has taken place, eventuality k cannot be situated in i_a because the Maxim of Quantity favors a present/past perfect construction, as in (53).

There is an issue that we did not properly discuss so far. The past tense sentences in (51b) and (52b), repeated here in (55), normally do not have a temporal, but a counterfactual (irrealis) interpretation for Sue if she knows that at speech time n in saying (51b) or (52b) Elsa is fully informed about the state of the house .

(55) a. Het huis van Joyce moest   deze week instorten.
          Joyce's house   PAST+MUST this week   collapse
          'Joyce's house must collapse this week.'
      b. Het huis van Joyce zou   deze week instorten.
          Joyce's house   PAST+WILL this week   collapse
          'Joyce's house should collapse this week.'

The reason for this crucially lies in Grices Maxim of Quantity. When Elsa wants to express that the house already collapsed before n, the Maxim of Quantity prohibits that she uses (55a) or (55b) given that she can convey this information much more precisely by using Present Perfect *is ingestort* 'has collapsed' because this excludes the location of k in $i_\diamond$ under the default interpretation. When Elsa wants to express that the house did not yet collapse at speech time n, but that she still has reason to believe that the house must or will collapse in the time interval indicated by the adverbial phrase *deze week* 'this week', the Maxim of Quantity again prohibits that Elsa uses (55a) or (55b) given that she can convey this information much more precisely by using Simple Present forms *moet/zal instorten* 'must/will collapse' because this excludes the location of k in the actualized part of the present tense domain i_a under the default interpretation. Consequently, the responsibility for the truth of the claim expressed by (55a) or (55b) can only be attributed to some speaker-in-the-past with the implication that Elsa believes that this speaker-in-the-past was wrong in locating k in the time interval referred to by *deze week* 'this week'. That the counterfactual interpretation is a matter of pragmatics and not semantics is evident from the fact that it can readily be overruled by the addition of more syntactic (or contextual) information: addition of the empathic affirmative marker *wel* to example (55a), for example, cancels the counterfactual reading in favor of a reading that expresses that the house did already collapse in the actualized part of the present domain and that this was inevitable according to our speaker-in-the-present Elsa.

(56) Het huis van Joyce moest   deze week wel instorten.
      Joyce's house   PAST+MUST this week   AFF. collapse
      'Joyce's house had to collapse this week, it was inevitable.'

That the counterfactual interpretation is a matter of pragmatics is also clear from the fact that this interpretation is entirely lacking when Elsa is underinformed about the current state of the house; this follows immediately because the Maxim of Quantity is not operative in that case.

   What has been said about the meaning of *moeten* 'must' in sentence (51) and *zullen* 'will' in (52) also applies to the same sentences with *kunnen* 'may', of course, taking into account the difference in the sort of modality being expressed.

4.2 How *zullen* 'will' differs from *moeten* 'must' and *kunnen* 'may'

There are two sorts of arguments for setting *zullen* 'will' apart from the others: the first one concerns the co-occurrence of epistemic modal verbs with modal adverbials; the second has to do with negation.

   To begin with, *zullen* 'will' may combine with any modal adverbial, whereas there are restrictions for *moeten* 'must' and *kunnen* 'may', as shown in (57), where the $-sign indicates some form of redundancy.[17]

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[17] In spoken language, it often happens that speakers will utter (57a) or (57b), but they are always prepared to admit that what they just said, has an air of saying it twice or of strengthening the modal content.

(57)   a. $Het huis moet noodzakelijk instorten.
           'The house must necessarily collapse.'
       b. $Het huis kan mogelijk instorten.
           'The house may possibly collapse.'
       c. Het huis zal X instorten.
           'The house will X collapse.'

That is, it is impossible to find a value for X in (57c) originating from the set of modal adverbials that is not combinable with *zullen* 'will'. This sets *zullen* apart from the other two: there is some sort of redundancy in (57a) and (57b), which is totally absent in (57c) in any of the combinations with modal adverbials, among which *noodzakelijk* 'necessarily' and *mogelijk* 'possibly'.

Secondly, there is a difference between epistemic *moeten* 'must' and *kunnen* 'may', on the one hand, and *zullen* 'will', on the other hand, demonstrated by the comparison in (58).

(58)   a. $De avondster moet vanavond wel te zien zijn.
           'The evening star must be WEL visible tonight.'
       b. $De avondster kan vanavond wel te zien zijn.
           'The evening star may be WEL visible tonight'
       c. De avondster zal vanavond wel te zien zijn.
           'The evening star will be WEL visible tonight.'

The use of the particle *wel* (in the English equivalent rendered as WEL) brings in the element that it is reasonable to expect that the evening star shows up tonight. In (58a) the speaker clearly appeals to public knowledge supported by scientific precision in order to expect 100% visibility tonight, in (58b) the speaker also appeals to public knowledge but, given some contextually given knowledge about the situation, leaves open the possibility that something will prevent a direct view, whereas in (58c) the speaker being more directly responsible for its predicted truth value, hopefully but also with some confidence predicts that the evening star will be visible.

Thirdly, the most important argument for the unique position of *zullen* 'will' in the set of modal verbs can be made visible by negation. Consider the sentences in (59).

(59)   a. Het huis moet instorten.   a′. ?Het huis moet niet instorten.
           'The house must collapse.'   '?The house must not collapse.'
       b. Het huis kan instorten.   b′. Het huis kan niet instorten.
           'The house may collapse.'   'The house cannot collapse.'
       c. Het huis zal instorten.   c′. Het huis zal niet instorten.
           'The house will collapse.'   'The house will not collapse.'

Let us take the positive sentences in (59) as purely epistemic excluding any form of deontic modality.[18] Let us then call each of these sentences minus the modal auxiliaries in (59) p, so that we have $\Box p$, $\Diamond p$ and WILL(p), respectively in (59a–c). The first observation to make is that the default interpretation of (59a′) has nothing to do with the content of (59a). In fact, (59a′) is only acceptable as a way to correct a speaker having said (59a) on his or her use of the verb *moeten* 'must'. The stress on *moet niet* 'must not' gives (59a′) the appearance of a sort of echoing. This form of metalinguistic negation is absent in (59c). The only acceptable formulation for the negation of (59a) in natural Dutch is *Het huis hoeft niet in te storten* ('The house need not collapse').

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[18]   Iatridou and Zeijlstra (to appear) observe that the deontic *moeten* 'must' scopes over negation as in *Mischa moet niet spelen* (Mischa must not play). They explain this by assuming that *must* is a positive polarity item. We are not sure whether this carries over to the epistemic modal *zullen* 'will'.

The correct paraphrase of the negative sentence (59b′) is: 'It is not the case that the house may collapse', which amounts to $\neg\Diamond p$. In other words, negation outscopes the modal operator: (59b′) says that it is not possible that the house is collapsing in i_a or will collapse in $i_\Diamond$. This makes *kunnen* 'may' an ideal verb for modal logicians investigating the properties of $\Diamond p$ in (59b) as opposed to $\neg\Diamond p$ in (59b′).

As to (59c′) it turns out to be impossible to paraphrase its meaning as 'It is not the case that the house is collapsing or will collapse', in other words as $\neg\text{WILL}(p)$. Such a paraphrase would ignore the key element of the presence of *will* in (59c) and (59c′), namely that it expresses some modal judgment about p and $\neg p$, respectively. This amounts to saying that $\text{WILL}(\neg p)$ is to be seen as the proper analysis of modality expressed by (59c′).[19] Exactly the same applies to the negation of (49c) *Mischa zal spelen* 'M. will play' in (60):

(60) a. Mischa zal niet spelen.
     'Mischa will not play.'   WILL(NOT(49c))
   b. Mischa zal zeker niet spelen.
     'Mischa will certainly not play.'   WILL(CERTAIN(NOT(49c)))

Sentence (60a) expresses that the speaker is sufficiently confident about her or his claim that (49c) cannot be made true so as to feel justified in the use of *will* independent of whether (60a) applies to i_a or to $i_\Diamond$, witness (60b), said by someone seeing the precipitation radar on the internet. One look at the screen suffices to see that it is virtual impossible for Mischa to play at the scheduled time because of the heavy shower that inevitably will arrive then.

The above analysis of how modal verbs behave under negation in purely epistemic cases strongly suggests that each of them has its own contribution to make to modal shading. In fact, *kunnen* 'may' is the only one in which negation "behaves properly", that is, follows the modal logical textbooks by taking negation in its scope and by occurring in the scope of negation. The fact that *zullen* 'will' turns out to be neutral with respect to $\neg p$ and p is indicative for its role in dealing with information. We take it as an indication that the information contributed by WILL in WILL(ϕ) is to be detached from the content of ϕ irrespective of the question of whether $\phi = \neg p$ or whether $\phi = p$. This indifference is a direct signal from the speaker to the hearer that there is sufficiently reliable evidence for the hypothesis or expectation that ϕ is in the process of being actualized or that it will be actualized.

4.3 On the morphosyntactic architecture of the binary tense system

At this point, it is necessary to consider what we have obtained by rejecting Te Winkel's second opposition as a temporal one. Presumably, Verkuyl (2008) accepted *zullen* 'will' as a temporal auxiliary because it made it possible for him to formalize Te Winkel's system compositionally, as is clear from derivations such as (32) and (35). The least one should do is to show that the loss of the second opposition in the Dutch tense system is compensated in such a way as to warrant compositionality. One would not like to throw away the compositional baby with Ockham's bathwater. Moreover, one may simply observe that in many situations posteriority and modality go hand in hand. and therefore one should not exclude the possibility that in the tense system of some languages the room between the first opposition and the third one is a sort of area in which posteriority may indeed occur.[20]

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[19] It is interesting to see that the addition of *niet* 'not' to (59c) neutralizes as it were the difference between a current and posterior interpretation: collapsing is easier to locate as an eventuality either in i_a or in $i_\Diamond$ than not collapsing as a non-event. This leads to a sort of neutrality with respect to where to locate k.

[20] For example, in his discussion of the Chinese tense system Verkuyl (2008:162-179) suggests that the SYN/POST-opposition may occur in order to compensate for the absence of an (overt) PRES/PAST-opposition.

The second point to be made is that our analysis is in line with what is generally assumed about Tense, Mood and Aspect (TMA), namely that there is a certain order in their occurrence: Tense > Mood > Aspect. Dutch certainly does not belong to the set of languages where TMA-particles are inflectional, but it is striking to see that in the binary system presented here—i.e. without SYN and POST—the scopal behavior of the operators involved maintain the TMA-order. This makes it possible to drop POST in favor of locating the expression of posteriority in the PRES-operator itself and positioning the MOD-operator in the scope of it, in a position before the PERF- or IMP-operator.[21] Parallel to it, this would also apply to the PAST-operator and MOD. Technically, this is not a simple change, because there is a dominant tradition in which a modal operator is interpreted as yielding a truth value, as in (45). Type-logically this cannot be allowed in the formal characterization of the binary system because POST and hence MOD is to be defined as a function having as its input a set of indices and yielding a set of indices. From that point of view an appropriate adaptation of what is conveyed by (45) is to be made.

As remarked earlier it is attractive to consider $i_\diamond$ as the set of accessible worlds compatible with what the speaker knows at i_a, where n is the point at which the branching of possible worlds starts. Such a viewpoint has consequences for the notion of present domain as used so far because we have taken i as standing for a temporal unit. One could, of course, say that in the non-actualized part of i there is no temporality, so that there should be room for considering it simply as a set of possible worlds. However, we will appeal here to the notion of Modal Base (in the derivation: MB) as used in the literature since Kratzer (1991b) to characterize information available to a speaker and which in the present context crucially makes use of pairs, in our case world-index pairs.[22] In other words, the Modal Base incorporates n (and n') from which branching begins into $i_\diamond$ (and $i'_\diamond$).

Derivation (35) in §2.4 shows how the POST-operator does its job in the version of the binary system given in Verkuyl (2008). With an eye on what was said about the type-logical requirements, it seems reasonable to take (35) as a point of departure in order to replace POST by MOD. Consider therefore (61) in which the differences between the three modal auxiliaries are neutralized under the label MOD, and the derivation (62).

(61) Mary zal/kan/moet de brief schrijven.
       'Mary will/may/must write the letter.'

(62) IMP(Mary write the letter) $\rightsquigarrow \lambda\phi\lambda\alpha\exists j\exists k[\phi[k]\wedge k\preceq j\wedge j\approx\alpha](\lambda\alpha'.WL(\alpha')(m))$
       $= \lambda\alpha\exists j\exists k[\lambda\alpha'.WL(\alpha')(m)[k]\wedge k\preceq j\wedge j\approx\alpha]$
       $= \lambda\alpha\exists j\exists k[WL(k)(m)\wedge k\preceq j\wedge j\approx\alpha]$
       MOD(IMP(Mary write the letter)) $\rightsquigarrow$
       $\lambda\phi\lambda\beta Qw[w\in MB(w,\beta)\wedge\phi[\beta]](\lambda\alpha\exists j\exists k[WL(k)(m)\wedge k\preceq j\wedge j\approx\alpha])$
       $= \lambda\beta\exists j\exists kQw[w\in MB(w,\beta)\wedge(\lambda\alpha\exists k[WL(k)(m)\wedge k\preceq j\wedge j\approx\alpha][\beta])]$
       $= \lambda\beta\exists j\exists kQw[w\in MB(w,\beta)\wedge WL(k)(m)\wedge k\preceq j\wedge j\approx\beta]$
       PRES(MOD(IMP(Mary write the letter))) $\rightsquigarrow$
       $= \lambda\phi\exists!i[\phi[i]\wedge i\circ n](\lambda\beta\exists j\exists kQw[w\in MB(w,\beta)\wedge WL(k)(m)\wedge k\preceq j\wedge j\approx\beta])$
       $= \lambda\phi\exists!i[\lambda\beta\exists j\exists kQw[w\in MB(w,\beta)\wedge WL(k)(m)\wedge k\preceq j\wedge j\approx\beta][i]\wedge i\circ n]$
       $= \exists!i\exists j\exists kQw[w\in MB(w,i)\wedge WL(k)(m)\wedge k\preceq j\wedge j\approx i\wedge i\circ n]$

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[21] This is in line with Abusch (1997), Von Stechow (1995), Condoravdi (2002), Homer (2010), among others.

[22] Condoravdi (2002:71) defines it as "a function, fixed by the context of use, from world-time pairs to sets of worlds", namely those worlds compatible with the knowledge of the speaker.

In (62), the IMP-operator is now defined as containing the information that each predication is embedded in its present domain j and j is in want for an index which is going to synchronize with it. This information occurs in the third line of (62). The MOD-operator is defined so as to ensure that the Modal Base contains the index β going to synchronize with j. This obtained in the seventh line of (62). The last line says that there is a uniquely identified temporal present domain i such that there is a j and a k where j is the present domain of k and such that there are Q worlds in the Modal Base accessible from i. Here Q ranges over the generalized quantifying spectrum going from zero to all (No w, some w, … more than half of w in MB, many w, …, sufficiently many w, …, nearly all w, all w), but in all cases $Qw\phi$ pertains to a truth value.

The bottom line of (62) is not sensitive to predicational aspect (Aktionsart), in particular not to the predicational opposition durative vs. terminative. There is no difference between the terminative predication in (61) and the durative predication in (63) as to the current or forward interpretation of the modal operator in question.

(63) a. Mary zal/kan/moet schrijven (durative)
          'Mary will/may/must write.'

For Dutch, there are many reasons to call the opposition between IMP and PERF purely temporal. This does not exclude the possibility of considering the opposition between PERF and IMP as a matter of grammatical aspect in other languages. In the present context, however, a debate about whether the opposition is aspectual or temporal does not contribute anything to the main theme of the present paper.[23]

We conclude the present subsection by observing that a tense system with binary oppositions provides a solid architecture for the structure necessary to handle information regarding tense, mood and aspect. In terms of the universality of the system discussed in the present paper, it appears to us that a binary organization quite naturally fits the main TMA-partition allowing for all sorts of language-specific adaptations. Languages without the first opposition have to find ways of expressing the same information as languages in which the first opposition plays a prominent role. Differences in the articulation of the opposition in question, such as between the use of the Dutch and English present tense forms, can be explained without doing away with the binary oppositions. We also think that the present analysis is a structural improvement of Verkuyl (2008).

5 Conclusion

What does WILL contribute to a sentence? We think that the best way to describe the meaning of WILL(p) is to say that speakers using this modal verb feel sufficiently confident to say p is true at n or is to be made true in $i_\diamond$. This confidence is based on information judged as reliable and well-founded. It may take all sorts of form dependent on the situation: as a hypothesis, a confident expectation, a reassurance, etc. What these circumscriptions have in common is that the speaker has entrance to sufficiently many worlds to be able to pick out the ones that seem convincing. In this way, the interpretation of *sufficiently many* as a generalized quantifier is plausible, but a qualitative characterization of the sort of epistemic

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[23] The distinction made by Condoravdi (2002) between stative and eventive predicates seems to be a different one than between durative and terminative. In terms of the well-known tripartition between aspectual classes—States, Processes and Events—Condoravdi seems to make an opposition between States on the one hand, and Processes + Events on the other. Unfortunately she uses the verb *get* in demonstrating her point. Thus *get sick* is opposed to *be sick*.

modality expressed by *zullen* 'will' is also appropriate. Further research is necessary to make a choice between these options.

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