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1 Introduction

It is a well known property of the Germanic languages that a class of verbs exhibits systematic stem vowel alternations. In Modern German, these alternations are generally classified into two groups: *ablaut* and *umlaut* phenomena. Ablaut is traditionally recognized as a context free vocalic alternation that expresses a grammatical opposition, in Modern German the tense opposition. To our knowledge, no such morphological function has been identified for verbal umlaut.

In this paper, we will investigate umlaut and argue that (i) one class of umlaut (Present Tense Umlaut *e-i* - PTU) has a morphological trigger, and that (ii) PTU follows the morphological pattern of ablaut: it can be derived by the same grammatical rule. Our analysis will be spelled out in the terms of apophony theory, which has been developed by Guerssel and Lowenstamm (1996) to account for the vocalic alternations in the verbal system of Classical Arabic. To the extent that our account is justified, it supports the assumption of morphologically contentful phonological processes.

2 Present Tense Umlaut in Standard Modern German

Standard German (SG) strong verbs are characterized by the fact that the tense opposition triggers stem vowel alternations known as *Ablaut*. An example of this is given in (1):

(1)	<i>Present (1sg)</i>	<i>Preterite (1sg)</i>	<i>Past Participle</i>
a.	<i>gebe</i>	<i>gab</i>	<i>gegeben</i>
	<i>give</i>	<i>gave</i>	<i>given</i>
b.	<i>singe</i>	<i>sang</i>	<i>gesungen</i>
	<i>sing</i>	<i>sang</i>	<i>sung</i>

In the sense of *apophony theory*, ablaut is the realization of a device of universal grammar, the Apophonic Path (cf. Guerssel and Lowenstamm 1996, Ségéral and Scheer 1998 and references therein).

(2) Apophonic Path (AP): $\emptyset \rightarrow I \rightarrow A \rightarrow U \rightarrow U$

Notice that in (2) an apophonic relation has the shape $a \rightarrow b$, i.e., an input element is mapped on one and only one output element. Accordingly, the derived vowel is predictable without ambiguity on the basis of the source vowel. Vocalic alternations which can be interpreted by the apophonic path (like (1b)) are said to allow for an *apophonic reading*. They are viewed as regular, and predicted to persist diachronically. Alternations which cannot be interpreted by the apophonic path are considered irregular. Some derivations are *partly apophonic*. An example of a partly apophonic derivation is (1a), where the past participle does not allow for an apophonic reading. For a detailed discussion of apophonic tense marking in SG we refer to Ségéral and Scheer (1998).

2.1 Present Tense Umlaut: Facts

Apart from the stem vowel alternation expressing the tense opposition, some classes of strong verbs exhibit stem vowel alternations internal to their present tense indicative paradigm. We observe two types of alternation: [e]-[i], exemplified with the verbs *geben* (to give) and *helfen* (to help) in (3a), and [a]-[e], exemplified with the verb *tragen* (to carry) in (3b):

(3)	a.	'geben'	'helfen'	b.	'tragen'
	1sg	ge <u>be</u>	he <u>lf</u> e		tra <u>ge</u>
	2sg	gi <u>b</u> st	hi <u>l</u> fst		trä <u>g</u> st
	3sg	gi <u>bt</u>	hi <u>l</u> ft		trä <u>gt</u>
	1pl	ge <u>ben</u>	he <u>lf</u> en		tra <u>gen</u>
	2pl	ge <u>bt</u>	he <u>l</u> ft		trä <u>gt</u>
	3pl	ge <u>ben</u>	he <u>l</u> fen		tra <u>gen</u>

A verb shows a stem vowel alternation in its present tense indicative paradigm if, and only if

- (i) it is a strong verb, and
- (ii) its infinitival stem vowel is [e] or [a].¹

Weak verbs (4a), and strong verbs with vowels other than [e] and [a] (4b) do not show stem vowel alternations:

¹Only three exceptions can be found: *stossen/stösst* (to push), *(v)erlöschen/(v)erlischt* (to go out/cease). These verbs behave like alternating [a]-verbs.

(4)		<i>Infinitive</i>	<i>Present, 3sg</i>	<i>gloss</i>
a.	<i>weak</i>	reg <u>n</u> en	reg <u>n</u> et/*ri <u>n</u> et	<i>to rain</i>
b.	<i>strong, vowel u</i>	ru <u>f</u> en	ru <u>f</u> t/*ri <u>f</u> t/*r <u>ü</u> f	<i>to shout</i>

Abstracting away from ATR, which is not contrastive in German, we are dealing with the following alternations:

(5) Present tense alternations

- a. /A/ ↔ /E/
 b. /E/ ↔ /I/

If we represent the respective segments in terms of elements (cf. Kaye, Lowenstamm and Vergnaud 1985), we arrive at the following alternations:

- (6) a. A ↔ A.I (/A/ ↔ /E/, e.g. *tragen, er trägt*)
 b. A.I ↔ I (/E/ ↔ /I/, e.g. *geben, er gibt*)

While (5a) and (5b) may well form a natural class (both could be understood as rules raising the respective vowel) the formulation of the alternations in (6) does not allow for this intuitive generalization. (6a) and (6b) are asymmetric: while (6a) increases the complexity of the infinitival stem vowel (addition of an element), (6b) reduces it (suppression of an element).

Indeed we argue on morphological grounds that the A-E alternation is of a different type than the E-I alternation. First, the A-E alternation coincides with dental agreement suffixes, while the E-I alternation largely coincides with the number opposition: singular agreement is a necessary condition for [i] to appear:

(7)	a. A - E (<i>fahren - to drive</i>)	b. E - I (<i>geben - to give</i>)		
	sg	pl	sg	pl
1	f <u>ä</u> hre	f <u>ä</u> hren	g <u>e</u> be	g <u>e</u> ben
2	f <u>ä</u> hrst	f <u>ä</u> hrt/f <u>ä</u> hrt	g <u>i</u> bst	g <u>e</u> bt/*g <u>i</u> bt
3	f <u>ä</u> hrt	f <u>ä</u> hren	g <u>i</u> bt	g <u>e</u> ben
imp.	f <u>ä</u> hr(e)/*f <u>ä</u> hr	f <u>ä</u> hrt/f <u>ä</u> hrt	g <u>e</u> be/g <u>i</u> b	g <u>e</u> bt/*g <u>i</u> bt

Second, several colloquial variants of German lack the A-E alternation altogether, while the E-I alternation is found in all variants (cf. section 2).

In sum, a stable, morphologically definable opposition is introduced by the E-I alternation only. We therefore put aside the A-E verbs and concentrate on the E-I class.

Let us call the E-I alternation Present Tense Umlaut (PTU). We can now proceed to asking the following questions:

(8) PTU questions

- a. Which vowel is the lexical vowel in *e-i* verbs?
- b. What is the morphological role of the alternation?
- c. Why does PTU apply to (a subclass of) strong verbs only?

2.2 E-I verbs are I verbs

Let us start with (8a). The paradigm of an *e-i* verb, *geben* (*to give*), is repeated below in (9a). The internal structure of the stem vowel in each form of this paradigm is given in (9b).

(9) a.	<i>sg</i>	<i>pl</i>	b.	<i>sg</i>	<i>pl</i>
1	g <u>e</u> be	g <u>e</u> ben		A.I	A.I
2	g <u>i</u> bst	g <u>i</u> bt		I	A.I
3	g <u>i</u> bt	g <u>e</u> ben		I	A.I
<i>imp.</i>	g <u>e</u> be/g <u>i</u> b	g <u>e</u> bt		A.I / I	A.I

The immediate question raised by the paradigm in (9) is whether A.I or I is the underlying vowel. If we take the infinitival form as representing the most basic shape of a verb, the underlying vowel is A.I, and PTU subtracts the element A from the representation. This assumption is made by most, if not all traditional grammars (cf. Bittner 1996 for an overview).

Such an assumption faces several problems however, and we will take a different position. First, there is no compelling reason to assume that the infinitival form revealed an underlying configuration. Unlike English infinitives, German infinitives bear an infinitival suffix. Therefore, they are derived forms, and nothing in principle argues against the assumption that the addition of the element A to the stem vowel were not part of the derivation. Second, I is present in all forms, while A is not (see (9b)). The most natural conclusion from such a distribution is that I is the lexical element.

We therefore adopt the following assumption:

(10) E-I verbs are underlyingly I verbs.

Indeed our reasoning is not new. Comparable considerations have been applied by Halle (1953) in a different framework. Ségéral and Scheer (1998) adopt (10) quite literally. Let us digress a bit further into their line of argument.

Dealing with complex vowels in apophonic derivations, Ségéral and Scheer (1998) distinguish between parasitic and apophonic/entering elements. The entering element is a lexically determined element which is also a member of the apophonic path and thus acts as the input to an apophonic

derivation. An apophonic element is the output of an apophonic derivation. An element is called parasitic if it does not participate in the apophonic derivation. In (11a), infinitival I is an entering element, past A and participial U are apophonic elements, past U and participial A are parasitic elements.

(11)	<i>infinitive</i>	<i>past</i>	<i>past participle</i>	
a.	bieten	bot	geb ^o ten	<i>to offer</i>
	<u>I</u>	<u>A.U</u>	A. <u>U</u>	
b.	stechen	stach	gesto ^o chen	<i>to pinch</i>
	A. <u>I</u>	<u>A</u>	A. <u>U</u>	

Since E-I verbs behave like I verbs apophonically (they trigger A in the past tense and U in the past participle), Ségéral and Scheer (1998) analyze E-I verbs as I-verbs with a parasitic element A in their lexical representation. However, while they show that the parasitic elements of past and participle forms derive from the consonantal context of the respective vowels, they do not offer any clue as to the origin of parasitic A in the present tense forms of E-verbs.

In the following sections, we will identify a morphological trigger for the presence of the additional element A, and derive it applying the very tools of apophony theory.

2.3 Number agreement

Once we assume that the underlying vowel in E-I verbs is I, we can proceed to investigating the trigger for the presence of an additional A. Let us examine the morphological context of the distribution of bare I vs. A.I in detail. As it has been illustrated in (9b) bare I shows up in singular environments only. Non-singular environments all show the complex vowel A.I. However, the reverse is not true: [e] shows up not only in contexts of plural agreement, but also in the 1sg and in the infinitive.² Therefore, the additional A cannot itself be a marker of number agreement. Rather, we are dealing with a morpho-phonological marker which is constrained by number agreement. Let us call this marker F. The phonological exponent of F is the element A:

(12) F-marking

Add the element A to the lexical vowel.

² The present participle triggers [e] instead of [i] too. We do not deal with present participles here, because they arguably embed an infinitival verb such that everything said about the infinitive holds for the present participle too, cf. Haiden (to appear).

F-marked stems are selected by plural agreement suffixes, by the infinitival suffix and by the 1sg. This might not appear to be a very natural class, although it has been argued by Kayne (2000) that 1sg is not a genuinely singular form, and the same argument might be applied to the infinitive. In the following section, we will turn to the Bavarian dialect spoken in the Austrian Province Oberösterreich, *Upper Austrian German* (UAG) which provides more robust data on the relation between F and number agreement.

3 PTU in Upper Austrian German

UAG has lost its simple past tense paradigms. All non present tenses are expressed by auxiliary-verb constructions in UAG. This amounts to a breakdown of the apophonic system in the language: the second step of the apophonic derivation being lost, there is no apophonic reading for the remaining pair <infinitive, past participle>. Nevertheless, we do find stem vowel alternations in UAG: they occur in the present tense paradigms of verbs which, in SG, are apophonic verbs.³ We find three major types of alternation:³ E-I (13a), Ö-Ü (14b) and EA-IA (13c):

(13) Stem vowel alternation in UAG.

	a. <u>e</u> ssn (<i>eat</i>)	b. h <u>ö</u> ffa (<i>help</i>)	c. steabm(<i>die</i>)
sg:	I	U.I	I ... A
1	<u>i</u> s	hyf	st <u>i</u> ab
2	<u>i</u> st	hyfst	st <u>i</u> abst
3	<u>i</u> st	hyft	st <u>i</u> abt
pl:	A.I	A.U.I	A.I ... A
1	<u>e</u> ssn	h <u>ö</u> effan	steabm
2	<u>e</u> ssts	h <u>ö</u> effts	steabts
3	<u>e</u> ssn	h <u>ö</u> effan	steabm

F-marking as defined in (12) correctly derives the difference between singular and plural forms in UAG: plural forms contain an A element that is absent in all singular forms, including the 1sg.

In contrast to SG, where the imperative sg. allows for optional F-marking, the F-marked form unambiguously corresponds to plural in UAG:

³ Two verbs show an [e]-[ia] alternation. We turn to these in section 2.1.

- | | | |
|------|-----------------------|-----------------------|
| (14) | <i>imperative sg.</i> | <i>imperative pl.</i> |
| a. | is / *esse | ests |
| b. | hyf / *höff(a) | höffts |
| c. | stiab / *steab(a) | steabts |

Answering (8b), we conclude that the morphological function of PTU is number agreement in UAG. We return to the issue in section 4.

3.1 Unifying PTU in UAG

In (15), we give an exclusive list of alternations in UAG, with the number of verbs affected by them. Admittedly, the numbers are small. It is all the more intriguing however, that their behavior is fully predictable and regular.

(15) Alternations in UAG:

	<i>pl/inf.</i>	<i>2sg</i>	<i>SG</i>	<i>gloss</i>	<i>number</i>
a.	essn	isst	essen	<i>eat</i>	11
b.	beagn	biagst	bergen	<i>bear</i>	7
c.	höffa	hyfst	helfen	<i>help</i>	7
d.	se:ŋ	siaxst	sehen	<i>see</i>	2

Of these alternations, only (15a) can be found in SG. We will now show that the three other classes of UAG are all instances of an underlying E-I alternation: the remaining elements of the complex vowels in (15b-15d) derive from adjacent consonants and do not take part in the relevant derivation.⁴

⁴ Here is the exhaustive list of alternating verbs in UAG:

(i) [e]-[i] verbs:

dreschn/drischst (*dreschen, thresh*), brecha/brichst, (*brechen, break*), stecha/stichst (*stechen, pinch*), treffa, triafst, (*treffen, hit/meet*), nemma/nimmst, (*nehmen, take*), kemma, kimmst, (*kommen, come*), essn/isst, (*essen, eat (by humans)*), fressn/frisst, (*fressen, eat (by animals)*), vageesn/vagisst, (*vergessen, forget*), geemngibst, (*geben, give*), tretn/trittst, (*treten, kick*)

(ii) [ea]-[ia] verbs

beagn/biagst (*bergen, bear*), beagn/biagst (*bersten, explode*), steam/stiabst (*sterben, die*), vadeam/vadiabst (*verderben, rot*), weam/wiabst (*werben, court*), wean/wiast (*werden, become*), weaffa/wiafst (*werfen, throw*)

(iii) [oe]-[y] verbs.

befön/befyst (*befehlen, order*), götn/gytst (*gelten, be valid*), höffa/hyfst (*helfen, help*), schötn/schytst (*schelten, scold*), schmötsn/schmytst (*schmelzen, melt*), schwön/schwyytst (*schwellen, swell*), stön/styst (*stehlen, steal*)

(iv) [e]-[ia] Verbs

se:ŋ/siaxst (*sehen, see*), kfε:ŋ/kfjiaxst (*geschehen, happen*)

Class (15b) comprises verbs with postvocalic [rC] clusters in their SG counterparts. Post-vocalic [r] has changed to [a] in UAG, as exemplified in (16). The off-glide in the diphthongs of (15b) is thus accounted for, leaving us with [i] vs. [e].

(16) $r \rightarrow a/V_$

SG	UAG	<i>gloss</i>
fvert	fveat	<i>sword</i>
hirt	hiat	<i>shepherd</i>
mord	moad	<i>murder</i>
gern	gean	<i>with pleasure</i>

Class (15c) verbs alternate between [y] and [œ], phonologically U.I vs. A.U.I. We claim that U is parasitic: all verbs of class (15c) have SG counterparts with postvocalic [I], and in UAG, postvocalic [I] has been lost, leaving as a trace the element U on the preceding vowel:

(17)

<i>example</i>			<i>internal structure of the vowel</i>
SG	UAG	<i>gloss</i>	SG UAG
fi:l	fy:	<i>much</i>	I U.I
milx	my:x	<i>milk</i>	I U.I
bild	by:d	<i>picture</i>	I U.I

(15d) comprises two verbs: $se:\eta$ (to see) and $k\text{f}e:\eta$ (to happen). In these verbs a postvocalic velar element has segmental status in 2sg, but not in the infinitive, where it links up with the infinitival suffix. We assume that postvocalic *schwa* is triggered by the phonotactic configuration, and that, once more, we are dealing with a genuine /E/-I/ alternation.

This allows for the impressive conclusion that 100 per cent of the alternating verbs of UAG strictly abide by the rule of F-marking.

3.2 F-marking by apophony

We have seen above that only strong verbs with lexical vowel I ever undergo F-marking. F-marking itself consists in the addition of A to the lexical vowel. Put together, these two properties allow us to assign an apophonic reading to F-marking, thereby predicting its melodic content: A is the apophonic output of I. We modify (12) accordingly:

(18) F-marking

Add the apophonic output of the lexical vowel.

(18) answers question (8c): If PTU is an apophonic derivation, it requires a templatic verbal structure as it is provided by strong verbs only.

4 Extensions: Diachrony and Mood

We have argued in section 2 that PTU *can* be analyzed as a manifestation of templatic morphology, *i.e.*, as the phonological realization of a morphological feature. However, the existence of a morphological feature F has not been firmly supported so far.

In this section, we will turn to Middle High German (MHG), the common ancestor of both UAG and SG. We will observe (i) that F-marking existed in MHG, (ii) that its scope was larger than in SG or UAG, extending across both present and past tense paradigms and including several allomorphic variants. We will therefore conclude that the existence of F is well motivated, and finally trace it in the past tense paradigm of SG.

4.1 F-marking and number agreement

As far as number agreement in the present tense paradigm is concerned, MHG behaves exactly like UAG. Singular requires unmarked F, plural and infinitive require marked F. Notice that MHG possessed an additional class of F-marked verbs (19b), which has lost F-marking in both SG and UAG.

(19) MHG, present⁵

a. *geben* (to give)

b. *biegen* (to bend)

indicative:

<i>1sg</i>	<i>gibe</i>	<i>1pl</i>	<i>ge:ben</i>	<i>1sg</i>	<i>by:ge</i>	<i>1pl</i>	<i>biegen</i>
<i>2sg</i>	<i>gibest</i>	<i>2pl</i>	<i>ge:bet</i>	<i>2sg</i>	<i>by:gest</i>	<i>2pl</i>	<i>bieget</i>
<i>3sg</i>	<i>gibet</i>	<i>3pl</i>	<i>ge:bent</i>	<i>3sg</i>	<i>by:get</i>	<i>3pl</i>	<i>biegent</i>

imperative:

<i>sg</i>	<i>gip</i>	<i>pl</i>	<i>ge:bet</i>	<i>sg</i>	<i>by:c</i>	<i>pl</i>	<i>bieget</i>
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Additionally, strong verbs in MHG show a full-fledged system of non-concatenative number agreement in the past tense (20). Notice that non-concatenative plural agreement in MHG is more complex than the above rule of F-marking and MHG strong verbs can be divided into three groups according to the strategy of number marking they use (21).⁶

⁵ We use non-standard orthography in the MHG examples in order to represent the phonological configurations.

⁶ Jacob Grimm's classification of strong verbs distinguishes 4 classes (I-IV) of purely apophonic verbs, as defined by the Indo-European infinitival vowel and its

(20)MHG, past tense paradigms:	<i>sg</i>	<i>pl</i>
a. <i>helfen</i> (to help)	1 half	hulfen
	2 ⁷ hylfe	hulfet
	3 half	hulfen
b. <i>geben</i> (to give)	1 gap	ga:ben
	2 gae:be	ga:bet
	3 gap	ga:ben
c. <i>reiten</i> (to ride)	1 rejt	riten
	2 rite	ritet
	3 rejt	riten

(21)MHG, past tense overview

<i>example</i>	<i>strategy</i>	<i>Grimm</i>	<i>paradigm</i>
a. <i>helfen</i>	apophonic alternation	II, III, VI	(20a)
b. <i>geben</i>	length alternation	IV, V	(20b)
c. <i>reiten</i>	non apophonic alternation I		(20c)

All of the alternations in (21), plus the *add A* strategy of the present tense, coincide with the number opposition. This might still be an artifact of our description. In the following subsection we will show that exactly the same set of stem vowel alternations is triggered by the mood opposition. Such a further coincidence would be highly surprising, unless we can identify a common property linking number agreement and mood. We claim that this common property is the morphological category F.

4.2 Subjunctive Mood

Standard text books (*e.g.*, Weinhold, Ehrismann and Moser, 1986) acknowledge the fact that *past* subjunctive demands a plural stem in MHG. The discussion above allows us to extend this generalization to *present* subjunctives. Consider the paradigms of a representative verb:

consonantal context, two classes of length contrast verbs (V-VI) and one class of originally reduplicating verbs (VII). Only class VII fails to make a distinction between singular and plural stems in its past tense paradigm.

⁷ Notice that 2nd.sg. patterns with the plural. We do not take this as a counterexample to our generalization, since 2sg often behaves in this way cross linguistically.

(22)MHG, biegen (to bend)

	<i>ind. pres.</i>	<i>subj. pres.</i>	<i>ind. pastsubj. past</i>	
<i>1sg</i>	by:ge	biege	bouc	by:ge
<i>2sg</i>	by:gest	biegest	by:ge	by:gest
<i>3sg</i>	by:get	biege	bouc	by:ge
<i>1pl</i>	biegen	biegen	bugen	by:gen
<i>2pl</i>	bieget	bieget	buget	by:get
<i>3pl</i>	biegen	biegen	bugen	by:gen

This pattern generalizes over all strong verbs. If a verb makes a vocalic distinction between singular and plural in the indicative, then its subjunctive forms require the vowel of the indicative plural. Now, if the vocalic alternations that we have called F-marking were the spell-out of readjustment rules triggered by number-agreement suffixes, then it would come as a complete surprise (i) why the very alternations are triggered by the subjunctive, and (ii) why the same agreement-suffixes triggering an alternation in the indicative fail to do so in the subjunctive.

If by contrast F, and the alternations realizing it, are morphological markers in their own right, we can state the following generalization:

(23)F in MHG

- If a verb allows for F-marking, its subjunctive forms are [+F].
- If a verb allows for F-marking, its plural forms are [+F].

4.3.2 F in SG

Let us finally add some speculations on the morphological nature of F in SG. We have noted in section 1 that the 1st person singular of the present tense is F-marked obligatorily, and that the imperative singular is optionally. Additionally, number agreement is no longer marked on the stem vowel of the past tense. This rules out an analysis of F in terms of number agreement for SG. However, the morpho-phonological nature of past subjunctives offers a tempting perspective.

In (22) above we can observe that MHG past subjunctives all have fronted stem vowels. Historically, this feature derives from a palatal suffix, which had already been lost in MHG. In the framework adopted here, fronting of a vowel is represented by the addition of an I element (24). In present subjunctives, such a marker was not present, and the stem vowels are not fronted.

- (24)a. bugen – buegen U - U.I
 b. ga:ben – gæ:ben A - I.A

Now consider the subjunctive paradigms of SG in (25). It appears that F-marking and floating I are in a complementary distribution: present subjunctive consistently requires marked F; past subjunctive requires floating I, and apparently no F:

(25) SG, geben (*to give*)

	<i>ind. pres.</i>	<i>subj. pres.</i>	<i>ind. past subj. past</i>	
<i>1sg</i>	gebe	gebe	gab	gäbe
<i>2sg</i>	gibst	gebest	gabst	gäbest
<i>3sg</i>	gibt	gebe	gab	gäbe
<i>1pl</i>	geben	geben	gaben	gäben
<i>2pl</i>	gebt	gebet	gabt	gäbet
<i>3pl</i>	geben	geben	gaben	gäben

Let us follow up on this complementarity and assume that floating I is a marker of F in the past subjunctives of SG. F will then have the following spell-out:

(26) F-marking in SG, tentative

present: add the apophonic output of the lexical vowel

past: add I

Especially the second part of (26) is interesting: the addition of I is equal to the first step of an apophonic derivation ($\emptyset \rightarrow I$). Since F-marking in the present tense paradigms of SG is a clearly apophonic derivation, we might want to argue that the same holds for the past tense and that, in the absence of a lexical vowel, the input element is zero. Thus, we have indeed found independent support for our initial version of F-marking, repeated here:

(27) F-marking in SG

Add the apophonic output of the lexical vowel.

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