The ‘experiential’ as an existential past

Evidence from Javanese and Atayal

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Abstract Recent literature has debated the nature and robustness of distinctions between pronominal tenses and existential tenses, between absolute tenses and relative tenses, and between perfect aspects and relative tenses. In this paper, we investigate anteriority markers in Javanese and Atayal, two distantly related Austronesian languages. On the basis of a range of empirical diagnostics, we propose that the markers *tau* in Javanese and *-in-* in Atayal are relative past tenses with existential semantics. We demonstrate that plausible alternative analyses are not tenable: these markers do not have pronominal tense semantics and they are not perfect aspects despite their salient ‘experiential’ interpretation. Further, we claim that a single language can possess both pronominal and existential tenses. Our diagnostics show that while *tau* and *-in-* are existential past tenses, Javanese and Atayal each also have a pronominal tense morpheme which is phonologically null and which pragmatically interacts with *tau* and *-in-*.

Keywords Past tense · Existential tense · Pronominal tense · Relative tense · Perfect aspect · Austronesian

1 Introduction

Investigating the temporal/aspectual system of a language inevitably involves analyzing the semantics of individual tense/aspect markers in that language. Such investigations are not only empirically essential, especially for understudied languages, they also address our overarching goal of understanding the basic semantic building

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blocks in the area of tense and aspect cross-linguistically. Notably, markers of temporal anteriority in the world's languages present significant analytical challenges, and give rise to important theoretical questions. These include the following; all of these have been debated in the literature:

- (1)
 - a. Do both pronominal and existential past tenses exist?
 - b. If yes, how does one empirically distinguish them?
 - c. Can one language possess *both* a pronominal *and* an existential past tense?
 - d. What is the difference between an existential past tense and a present perfect?
 - e. What is the difference between relative tenses and perfect aspects?
 - f. Are 'experiential' readings always contributed by perfect aspects, or can they be contributed by past tenses?

Our goal in this paper is to answer all the questions in (1). Our discussion is based on original fieldwork on two (only distantly related) Austronesian languages: Javanese (Malayo-Polynesian; Indonesia) and Atayal (Formosan; Taiwan). We argue that both pronominal and existential past tenses exist, and moreover can exist within the same language. We provide and apply a range of diagnostics to distinguish the two types of past tense from each other, an existential past tense from a present perfect, and a relative tense from a perfect aspect. Finally, we propose that experiential interpretations are simply the result of existential quantification over past times: they can be *either* tenses *or* aspects, depending on the language, with predictable (though subtle) differences in semantic behaviour for each type.

The anteriority markers we examine here are the auxiliary *tau* in Javanese and the infix *-in-* in Atayal. These both have salient interpretations which can be characterized as EXPERIENTIAL: they talk about events that happened at some (unspecified) time in the past. Pragmatically, the emphasis is on the fact that the subject has had this experience at least once, rather than when exactly this happened. Representative examples are given in (2) and (3) (elicited using the storyboard 'Miss Smith's bad day,' Matthewson 2014).^{1,2}

- (2) Mrs. Sri: Sopo sing **tau** munggah gunung?
 who REL **tau** AV.ascend mountain
 'Who has ever climbed a mountain?'

Bambang: Aku **tau** munggah gunung.
 1SG **tau** AV.ascend mountain
 'I've climbed a mountain.' (Javanese)

¹We follow the Leipzig Glossing Rules (<https://www.eva.mpg.de/lingua/resources/glossing-rules.php>). Additional abbreviations used are: AV 'actor voice'; CONJ 'conjunction'; CV 'circumstantial voice'; DEP 'dependent mood'; E.PST 'existential past'; EMPH 'emphatic'; GEN 'generic'; LV 'locative voice'; PRT 'particle'; PV 'patient voice'; REP 'reportative'; VBLZ 'verbalizer'.

²We follow the convention of not capitalizing the first word in Atayal examples (L. Huang and Wu 2016:261). We assume an ergative analysis of Atayal (e.g., L. Huang 1994, cf. Starosta et al. 1982; Aldridge 2004) but remain agnostic on this debate; the ergative analysis is orthogonal to the discussion of the semantics of *-in-*.

- (3) Miss Ciwas: kya ima' m-<n>wah m-karaw rgyax wah?
 exist who AV-<in>go AV-climb mountain PRT
 'Who has climbed a mountain?'
 Tali': m-<n>wah=saku'.
 AV-<in>go=1SG.ABS
 'I have climbed a mountain.' (Atayal)

A marker with this interpretation could in principle either be an aspect or a tense; indeed, Atayal *-in-* has independently been described as both, while Javanese *tau* has been described as an aspect. In order to uncover their semantics within the typology of anteriority markers, we use a range of diagnostics to distinguish pronominal tenses from existential tenses, absolute tenses from relative tenses, and past tenses from perfect aspects. We argue that both markers share the semantics of EXISTENTIAL, RELATIVE PAST TENSES—a striking result considering their different etymology and that these languages are only distantly related within Austronesian.

In languages like English, it is difficult to determine whether tenses are best analyzed as pronominal (e.g., Partee 1973) or as existentially quantified (e.g., Ogiwara 1996); in fact, some argue that the English past tense is ambiguous between these two analyses (Grønn and von Stechow 2016). We use the following diagnostics to empirically distinguish these two types of tense: while pronominal tenses are scopeless, have deictic, anaphoric, and bound uses, and are infelicitous without a salient contextual reference time, quantificational tenses behave in the opposite way. They have scopal interactions, lack deictic, anaphoric, or bound uses, and are felicitous without a salient contextual reference time. We show that Javanese *tau* and Atayal *-in-* behave only as existential past tenses.

We further propose that each language also possesses a phonologically null pronominal tense (cf. Matthewson 2006) in addition to the overt quantificational past tense marker (*tau/-in-*). We argue that the available readings of *tau* and *-in-* fall out from the expected pragmatic interactions of a quantificational tense with a pronominal one. The upshot of our proposal is that a single language can have both types of tenses, suggesting that pronominal and quantificational tenses are distinct types within the inventory of semantic building blocks and that no economy principle rules out this type of language.

Another important contrast among anteriority markers is that between relative tenses and perfect aspects. We provide evidence that *tau* and *-in-* are relative tenses: they obligatorily back-shift the reference time in embedded contexts, and in general place the reference time prior to some contextually salient evaluation time, rather than necessarily to the utterance time. We argue that relative tenses do not combine with a clause-mate tense, and that this property crucially distinguishes them from perfect aspects. Our analysis of *tau* and *-in-* as relative pasts ties into the ongoing debate about what the difference is between the perfect and relative tense, adding support for Bohnemeyer (2014) and contra e.g., Klein (1994).

Our investigation of Javanese and Atayal also bears on the nature of experiential readings. In English, the experiential is well known as one of the prominent readings of the present perfect (e.g., McCawley 1971; Leech 1971; Comrie 1976, 1985; Binnick 1991). And in Dahl's (1985) typological study, he classifies morphemes

in eight languages—including Javanese *tau*—as purely experiential aspectual categories. However, we show here that *tau* and *-in-*, despite having salient experiential interpretations, cannot be analyzed as perfect aspects, nor as a special type of ‘experiential’ aspect. We hypothesize that cross-linguistically, all that elements with prominent ‘experiential’ interpretations have in common is that they denote existential operators over times, but they can be either aspects *or* tenses. Despite existential tenses and existential aspects both being existential quantifiers over times, there are systematic and testable semantic and pragmatic differences between them due to the different contributions tense and aspect make to the overall compositional semantics as well as their interactions with the rest of the tense/aspect system.

The paper is structured as follows. In Sect. 2 we provide background on the theoretical framework we adopt, the languages investigated, previous literature on *tau* and *-in-*, and our methodology. Section 3 presents the core shared empirical properties of these morphemes in matrix and embedded contexts: *tau* and *-in-* both mark anteriority, have experiential readings but lack resultative ones, and obligatorily back-shift the reference time in embedded contexts. In Sect. 4, we provide evidence that *tau* and *-in-* behave as quantificational past tenses, and compare their behaviour with pronominal tenses. Section 5 details our formal analysis of *tau* and *-in-*. In Sect. 6, we propose that Javanese and Atayal possess both an existential past tense and a null pronominal one, based on pragmatic competition effects between *tau*/*-in-* sentences and superficially tenseless sentences. Section 7 provides evidence against a potential analysis of *tau*/*-in-* as perfects; we then argue in Sect. 8 that relative tense and perfect aspect can be distinguished and that *tau* and *-in-* are relative tenses. In Sect. 9, we point to future steps for our hypothesis that experiential operators can be either aspects or tenses, and touch on some differences between the remarkably similar *tau* and *-in-* morphemes in Javanese and Atayal.

2 Background

2.1 Theoretical framework

Grammatical elements which convey some notion of anteriority can be of at least three major types: (i) pronominal past tenses (e.g., Partee 1973; Heim 1994; Kratzer 1998), (ii) existentially quantified past tenses (e.g., Ogihara 1996; von Stechow 2009; Sharvit 2014; Mucha 2017), or (iii) perfect aspects (e.g., McCawley 1971; Leech 1971; Comrie 1976, 1985; Binnick 1991; Portner 2003; Mittwoch 2008; among many others). In this sub-section, we situate our proposal within the conceptual space of possibilities for anteriority operators proposed in the literature, and highlight the contributions our paper makes to the ongoing debate about these issues.

In Reichenbach’s (1947) original conception, the present perfect differs from the (simple) past in the location of the reference time: with the present perfect, the reference time is the present moment, and with past tense, the reference time is in the past. This is illustrated in (4), where E is the event time, R is the reference time and S is the speech time.

- (4) a. E__R,S (Reichenbachian present perfect)
 b. E,R__S (Reichenbachian simple past)

Klein (1994) refined and generalized Reichenbach's ideas by proposing that aspects relate R to E whereas tenses relate R to S; the Kleinian difference between perfect and past is given in (5). In this system, perfect aspect places the event time before the reference time, and in the present perfect, it is present tense which makes the reference time coincide with the speech time. As in much neo-Reichenbachian work, we will use the abbreviations ET (event time), RT (reference time) and UT (utterance time) instead of E, R and S respectively.³

- (5) a. Kleinian perfect: ET < RT
 b. Kleinian past: RT < UT

There are two main ways that (absolute) past tenses have been analyzed in recent decades. One is to treat them as free variables over times parallel to pronouns; the other is to treat them as existentially bound variables.⁴ (6)a,b give semi-formal representations of the proposition denoted by a simple sentence in each of the analyses. Interpretations are relative to a variable assignment g and an utterance context C ; the utterance time is represented by t_C , the time of context C .

- (6) John left.
 a. $\llbracket \text{John PAST}(t_i) \text{ leave} \rrbracket^{g,C} = \lambda w. \text{John left in } w \text{ at } g(t_i),$
 where $g(t_i)$ is a time that is salient in context C and $g(t_i) < t_C$
 (pronominal analysis)
 b. $\llbracket \text{John PAST leave} \rrbracket^{g,C} = \lambda w. \exists t [t < t_C \ \& \ \text{John left in } w \text{ at } t]$
 (existential analysis)

The empirical argumentation required to distinguish these two types of past tense is subtle, and the English past has been analyzed both ways.⁵ This disagreement about the proper analysis of tense even for a well-studied language like English raises important theoretical and typological questions. Is the choice between pronominal and existential past tense a matter of cross-linguistic variation? Can both types of tense coexist within a single language? Can a language have a single tense morpheme that is ambiguous between the two types (as argued for English by Grønn and von Stechow 2016)? This paper contributes to this debate by testing the empirical predictions of each analysis in two understudied languages. The results of our diagnostics

³Klein himself uses TSit ('time of situation'), TT ('topic time') and TU ('time of utterance').

⁴There are (at least) two different variants of the second (existential) approach to past tense, depending on whether the existential quantifier is part of the lexical meaning of the past-tense morpheme, or whether this morpheme just introduces a time variable which is bound by existential closure at a higher level. In our discussion we gloss over this difference between the two subtypes of the existential analysis, because our argumentation is based on whether the past time variable is existentially bound or not, abstracting away from the question of how this existential binding is derived compositionally. A third influential line of analysis (which we don't discuss here) holds that tenses denote operators which relate two time intervals given in the syntax (Stowell 1995; Demirdache and Uribe-Etxebarria 1997, 2014; inter alia).

⁵For discussion of the distinction in other languages, see for example Sharvit (2014) and Mucha (2015, 2017).

show that *tau* and *-in-* are existential past tenses, but Javanese and Atayal each also have a pronominal tense morpheme which is phonologically null, and which pragmatically interacts with *tau/-in-*. The upshot is that both pronominal and quantificational tenses exist in natural language, and furthermore can both occur in a single language.

The perfect is also typically analyzed as involving existential quantification; for instance, a simple “Kleinian” analysis of the perfect is given in (7). Here PERFECT is an operator which takes a predicate over events, and turns it into a predicate over times. In effect it states that the reference time (*t*) is preceded by at least one event of the relevant type:

- (7) $[\text{AspP John have left}]$
 $\llbracket \text{John PERFECT leave} \rrbracket^{\text{g,C}} = \lambda t. \lambda w. \exists e [\tau(e) < t \ \& \ \text{John.left}(e)(w)]$
 (adapted from Kratzer 1998)

For the sake of clarity, (7) represents the meaning of a tenseless Aspect Phrase with perfect aspect; to get a finite clause, this will be combined with a (past or present) tense, which saturates or existentially binds the time argument (depending on the analysis of tense). Note that the semantics of the perfect in (7) is very similar to the existential analysis of the past tense in (6)b, since both involve existential quantification (over events or times). The main difference is in the semantic type, which reflects the architecture of the tense-aspect system we assume: aspects (such as the perfect) map predicates of events onto predicates of times (and hence are of type $\langle\langle l, \langle s, t \rangle \rangle, \langle i, \langle s, t \rangle \rangle \rangle$), whereas tenses take a predicate of times and saturate or existentially quantify over the time variable (and are of type $\langle\langle i, \langle s, t \rangle \rangle, \langle s, t \rangle \rangle$ in the simplified version in (6)).^{6,7} For more discussion, see our formal analysis in Sect. 5 and subsequent sections.

This similarity raises the question of what the empirical difference is between a perfect and an existential past tense, and how it can be diagnosed. We will argue that *tau* and *-in-* are not perfects but existential past tenses. However, since the main focus of our paper is not the perfect as such, we will not give or defend an explicit formal analysis of the perfect, let alone solve the empirical and theoretical debates about that issue (see e.g., Ritz 2012, and references therein; see also the discussion of alternative analyses of the perfect in Sect. 7).

The question of the difference between perfect aspect and existential past tense is sharpened by another distinction, that between absolute and relative tense. Whereas an absolute past tense always situates the reference time before the utterance time ($RT < UT$), a relative past tense locates the reference time of an embedded clause before the event time of the matrix verb. In anticipation of our findings for *tau/-in-*, we will refer to the evaluation time (EvalT) instead of the utterance time (UT); relative

⁶Basic types are *t* (truth values), *e* (entities), *w* (worlds), *i* (temporal intervals), and *l* (events). For readability, we use abbreviations such as *st* for $\langle s, t \rangle$ within complex types.

⁷In other analyses, the perfect may take predicates of times as its argument (and hence be of type $\langle\langle i, \langle s, t \rangle \rangle, \langle i, \langle s, t \rangle \rangle \rangle$), in which the perfect would make no reference to event times and look more similar to the existential analysis of the past tense in (6)b. However, as we will show in Sect. 8, (perfect) aspect and (relative) tense exhibit a crucial difference in that only the former can (and often must) co-occur with a tense in the same clause.

past tense locates the reference time before the evaluation time ($RT < EvalT$). In monoclausal sentences this distinction cannot be detected since the evaluation time is the utterance time. In Sect. 3.2 we show that in embedded clauses *tau* and *-in-* situate RT before EvalT rather than before UT. On the issue of relative past tense vs. the perfect (for instance, Comrie 1985; Klein 1992, 1994; Bohnemeyer 2014), we thus agree with Bohnemeyer, who argues that relative past tense and the perfect cannot be identified with each other cross-linguistically. New data from Javanese and Atayal shed light on this distinction, which we discuss in Sect. 8.

2.2 Javanese and Atayal and previous literature on *tau* and *-in-*

Javanese is mainly spoken in central and eastern Java, Indonesia, and is classified under the Malayo-Polynesian subgroup of Austronesian. Some of its closest relatives have been proposed to be Sundanese, Malay, and Madurese (e.g., Nothofer 1975), while Adelaar (2005) argues that Javanese branched off earlier and formed its own subgroup apart from a Malayo-Sumbawan subgroup. Javanese has well-defined speech levels, including *ngoko* 'low', *madya* 'mid', and *krama* 'high Javanese' (e.g., Poedjosoedarmo 1968; Errington 1988); as well as rich dialectal variation, with three main groupings: West, Central, and East Javanese (Hatley 1984). Most Javanese speakers today are at least bilingual, also speaking Indonesian, the national language (Sneddon 2003). The data presented here are in *ngoko* and from the dialects spoken in Semarang city, Central Java, and Paciran village, East Java.

Atayal is spoken in the mountainous areas of northern and northeast Taiwan. It is considered to belong to one of the direct subgroups of Austronesian (Blust 1999; Ross 2009, 2012) and is often referred to as a Formosan language, an areal term for Indigenous languages of Taiwan. Most Atayal people are bilingual, speaking Atayal and also being fluent in Mandarin Chinese (and/or Hokkien, Hakka, or Japanese). Atayal is divided into two major dialects, Sqliq and C'uli' (Li 1985). The data presented in this paper are from the Sqliq dialects spoken in Taoshan Village, Wufeng Township of Hsinchu County, Taiwan, and Songluo Village, the north of Datong Township of Yilan County, Taiwan.

The basic word order of Javanese is SVO, and that of Atayal VOS. As they are both Austronesian languages, voice is a prominent grammatical feature. 'Voice' is the traditional term used in the Austronesian literature to refer to the verbal affixes which mark the subject (i.e., the absolutive/nominative case-marked argument). Atayal has a four-way voice system with actor voice, patient voice, locative voice, and circumstantial voice.⁸ Javanese has a reduced voice system, with only actor voice (a homorganic nasal prefix) and a morphologically unmarked patient voice (restricted to 1st and 2nd person), as well as passive (*di-*; restricted to 3rd person) and applicative morphology.

In previous literature, Javanese *tau* is classified by Dahl (1985) as an 'experiential' aspect, related to the perfect. Beyond his typological survey, no other research has specifically addressed *tau*, as far as we know. Translations offered for *tau* include the

⁸Circumstantial voice is also often called beneficiary voice or instrumental voice in Atayal reference grammars; we use 'circumstantial' because the voice marker *s-* can mark peripheral arguments with various thematic roles.

existential temporal adverbials ‘ever, once’ in Horne’s (1961) student grammar; ‘ever, at any time’ in Robson and Wibisono’s (2002) dictionary; ‘ooit, eens’ [ever, once] in Arps et al.’s (2000) pedagogical grammar written in Dutch; and ‘ever’ (or ‘never’ in the scope of negation) in Robson’s (2002) student grammar. Surprisingly, Wedhawati et al. (2006), considered to be the most comprehensive Javanese reference grammar written in Indonesian, does not discuss *tau*.⁹

In Atayal, the marker *-in-* has been described or glossed as a past tense (Rau 1992; L. Huang 1993; Yeh 2013), a perfective (Zeitoun et al. 1996; S. Huang 2017), or a perfect (Egerod 1965, 1966), showing the need to identify robust diagnostics to empirically tease apart types of anteriority markers. Additionally, Gorbunova (2015) presents a focused discussion of the properties of *-in-* in the Sqliq dialects spoken in Yilan County, Taiwan. She proposes that *-in-* is a discontinuous past tense (glossed ‘DP’), as defined by Plungian and van der Auwera (2006), which describes a situation that occurred in the past and no longer holds, as shown in (8).

- (8) m-<in>smoya=ku tiqah gal-an pbaq biru.
 AV-<DP>like=1SG.ABS a.little take-LV teach.AV book
 ‘I wanted to be a teacher (now I don’t).’ (Gorbunova 2015; glosses modified)
 (Atayal)

Gorbunova, however, shows that the discontinuity effect is only an implicature; in this sense her proposal deviates from the way Plungian and van der Auwera define discontinuous past, which semantically encodes “past and not present.” In Sect. 6.3, we will discuss this cessation effect of *-in-* (which Javanese *tau* also has), and show that it can be derived by our analysis of *tau/-in-* without postulating a special tense category (cf. Cable 2017).

2.3 Methodology

The data presented in this paper are from fieldwork conducted by Sihwei Chen and Jozina Vander Klok with Atayal and Javanese speakers respectively. We use a variety of fieldwork methods, including recordings of natural conversation, grammaticality and acceptability judgment tasks, and translation tasks (both to and from the contact language, which is English or Indonesian for Javanese and Mandarin Chinese for Atayal). Importantly, our judgment and translation stimuli are typically embedded within specific discourse contexts. As discussed by Matthewson (2004), Krifka (2011), Bohnemeyer (2015), and Deal (2015), among others, tasks involving judgments or translation of utterances without contexts are problematic as a means for establishing meaning. Translations provide an especially poor guide to meaning in

⁹A note is necessary on possible dialectal variation. It seems that all Javanese dialects have some form of this marker (ngoko: *tau*, krama: *naté*). In addition to the Semarang and Paciran dialects discussed here, *tau* is noted in Standard Javanese as spoken in Yogyakarta and Solo (Horne 1961; Sudaryanto 1991; Robson and Wibisono 2002) and Surabayan Javanese (Hoogervorst 2010). In Peranakan Javanese (spoken by ethnic Chinese), the Indonesian borrowing *pernah* is used (Cole et al. 2008). Dahl (1985) spells the Javanese morpheme under discussion as *tahu*. It is not known whether this is a dialectal difference or perhaps due to influence from the Indonesian/Malay verb *tahu* ‘to know’. No other Javanese reference spells *tau* this way.

the areas of tense and aspect (e.g., Cover 2015:233). For example, if an English translation uses the perfect, this cannot be taken as evidence that the form in the original language is a perfect; this problem is exacerbated if there is an intermediate language (like Mandarin), which has a tense/aspect system that differs from both the source and the target language.

Vander Klok and Chen worked with a number of language consultants in Indonesia and Taiwan respectively. Vander Klok conducted elicitation in both individual and group sessions with two female speakers in Semarang, Central Java in 2014–2015; and with three female and two male speakers in Paciran, East Java, from 2011–2019. The data from elicitation thus represent judgments of at least 2–5 speakers. Dahl's questionnaire was translated into Javanese from English by two other female Paciran Javanese speakers. The age range of the Javanese consultants is 20–35 years old. Chen elicited Atayal data in Taiwan with one male speaker from Taoshan, Wufeng Township of Hsinchu County, in 2013–2020; another male speaker from Songluo, Datong Township of Yilan County, in 2016–2020; and another male speaker from Changxing, Fuxing District of Taoyuan City, in 2018–2020. These speakers are all over 60 years old.

One additional method used in our research is targeted storyboards (Burton and Matthewson 2015). In investigating *tau/-in-*, we primarily used the storyboard 'Miss Smith's bad day' (Matthewson 2014), conducted with one female speaker for Javanese and with one male speaker for Atayal; see (2) and (3). In a storyboard task, language consultants narrate a story based on a set of pictures which are designed to elicit specific linguistic phenomena; for example, 'Miss Smith's bad day' targets different perfect readings. All forms are therefore embedded in a rich discourse context and follow-up elicitation is used to create minimal pairs and potentially provide negative data.

3 Shared empirical properties of Javanese *tau* and Atayal *-in-*

Javanese *tau* and Atayal *-in-* have different syntactic properties; the former is an auxiliary and the latter is an infix in the first verbal element of the sentence.^{10,11} But *tau* and *-in-* share a number of semantic properties, some of which have been associated in the literature with aspect and others with tense. In Sect. 3.1, concentrating on monoclausal sentences, we show that *tau* and *-in-* express anteriority and have dominant experiential readings but lack resultative readings. An additional property is revealed when we look at embedded contexts in Sect. 3.2: *tau* and *-in-* obligatorily back-shift the interpretation of the embedded predicate relative to the time of

¹⁰For arguments that *tau* is an auxiliary (and not a verb or an adverb), see Vander Klok (2012). *Tau* may be historically derived from Proto Malayo-Polynesian **taqu* 'to know, to be knowledgeable'. Some related languages retain this use, such as Malay *tahu* 'to know' and Madurese *tao* 'to know' (Greenhill et al. 2008).

¹¹Atayal *-in-* is reconstructed as **-in-* for Proto-Austronesian, and its reflexes are widespread in other Austronesian languages (Ross 1995, 2009; Blust 2013). In Squiliq Atayal, the morpheme is sometimes realized as *-n-* or *n-* (which replaces the initial consonant of the stem). The realization of *-in-* also interacts with voice affixes: while *-in-* co-occurs with the actor voice or locative voice marker, it doesn't co-occur with the patient voice marker, and rarely with the circumstantial voice marker.

the matrix clause. While *tau* and *-in-* do differ in some ways, our paper analyzes their shared semantics; it is striking that both these morphemes have the same basic semantics given that they are not cognates, and that the two languages are only distantly related within Austronesian.¹² The limited ways in which *tau* and *-in-* differ from each other are brought up throughout the paper, and briefly discussed in our concluding remarks in Sect. 9.

3.1 Javanese *tau* and Atayal *-in-* in matrix clauses

First and foremost, these markers both have salient experiential readings, as shown in (2)–(3), where the emphasis is on the fact that the event or state occurred at some past time. Further examples are given in (9) and (10); what is relevant in these contexts is that at least one event of meeting with the interlocutor's brother or hunting goats took place in the past—not the specific time at which this happened.

- (9) Translation from English to Javanese (Dahl 1985:#37)¹³

Q: Opo awakmu weroh dulur-ku?

Q 2SG know sibling-my
'Do you know my brother?'

A: Yo, aku **tau** ketemu dulur-mu, dadi aku weroh dulur-mu.
yes, 1SG E.PST meet sibling-your become 1SG know sibling-your
'Yes, I have met him so I know him.' (Javanese)

- (10) Context: 'Has he ever hunted?' 'Yes, ...'

q<m><n>alup mit sraral hiya'.

hunt<AV><E.PST> goat before 3SG.N

'He has hunted goats before.' (Atayal)

A second shared property of Javanese *tau* and Atayal *-in-* is that they can be used with change-of-state verbs without any implication that the result state still holds. The lack of a resultative reading contrasts sharply with English (present) perfect change-of-state verbs, which do carry such an implication, as shown in (11) (Mittwoch 2008; among others).

- (11) I have lost my watch (#but I found it again).

In fact, as illustrated in (12), in such cases *tau* and *-in-* imply that the result state no longer holds, as observed by Gorbunova (2015) for *-in-*. Note that this property by itself does not tell us whether a tense or aspectual analysis is appropriate. We will discuss these 'cessation' effects in Sect. 6.3 for change-of-state and stative verbs, arguing that they result from pragmatic interaction with a pronominal null tense.

¹²There is a question whether the cognates of *-in-* in other Formosan languages can be analyzed as a past tense (cf. Jeng 1999) in the same way as Atayal *-in-*. Based on prior descriptions, we suspect that many of the cognates convey existential quantification, but whether they can equally receive an existential tense analysis requires future investigation; see Chen and Jiang (2020) for such an attempt for Isbukun Bunun *-in-*.

¹³This translation exercise was done as suggested in Dahl (1985): the English sentences were presented with bare predicates (e.g., 'Yes, I MEET him so I KNOW him.'). [Q = Question; A = Answer]

- (12) Context: *Describe to your friend how you lost your watch and found it.*
- a. Jam tangan-ku **tau** ke-lang-an.
hour hand-my E.PST PASS-lose-VBLZ
'My watch got lost.' (Javanese)
- b. m-<**in**>gzyuwaw tuki=maku'.
AV-<E.PST>get.lost watch=1SG.GEN
'My watch got lost.' (Atayal)

A third property *tau* and *-in-* share is that they express anteriority: they indicate that the event occurred in the past. As such, they are infelicitous with temporal adverbs that express present or future reference times, as shown in (13).

- (13) a. Aku **tau** mangan rajungan { wingi / # **saiki** / # **sesok** }.
1SG E.PST AV.eat crab yesterday / # now / # tomorrow
'I ate crab yesterday.' / ≠ 'I have eaten crab now.' / ≠ 'I will have eaten crab tomorrow.' (Javanese)
- b. m-<**in**>qwalax { ssawni' / # **misu qani** / # **kira** }.
AV-<E.PST>rain earlier.today / # now this / # later.today
'It rained earlier.' / ≠ 'It has rained now.' / ≠ 'It will have rained later.' (Atayal)

It is important to note that a mere restriction to anteriority does not make it an automatic conclusion that *tau*/*-in-* are tenses. See, for example, the lively debate on the status of 'tenseless' languages, and whether 'optional' tenses can even exist (Bohnenmeyer 2002, 2009; Ritter and Wiltchko 2009, 2014; Tonhauser 2011, 2015; Bochnak 2016; Cable 2017; and references cited therein). The anteriority restriction also does not reveal whether an aspectual analysis is correct; additional tests must be applied. In Sect. 7, we show that, except for having experiential readings, *tau* and *-in-* do not behave in accordance with the predictions of current theories of perfect aspect, in that they do not allow past perfect or future perfect readings. This supports our conclusion that an aspectual analysis is not applicable.

A fourth property *tau* and *-in-* have in common is that they are not obligatory when reporting on events that took place in the past; again, by itself this is not enough to decide between an aspectual and a tense analysis. In Javanese, bare predicates are compatible with past time readings (Robson 2002), as shown in (14). To locate the reference time in the past, temporal adverbials can also be used, such as in (15) from Dahl's (1985) questionnaire.¹⁴

- (14) Context: *A woman describing her previous job where she taught in Jember, East Java.*
- Aku ketemu bocah-bocah sing boso-ne seje-seje.
1SG meet RED-children REL language-DEF RED-different
'I met children whose languages were different (from each other).' (Javanese)

¹⁴See also Vander Klok and Matthewson (2015:192) for additional examples.

- (15) Translation from English to Javanese (cf. Dahl 1985:#39)

Q: *Do you know my brother?* (Same as in (9))

A: Yo, aku ketemu dulur-mu se-pisan **pirang-pirang taun**
yes 1SG meet sibling-your one-time RED-how.many year
keprungkor.

ago

‘Yes, I met him once several years ago.’

(Javanese)

Similarly in Atayal, bare predicates allow for past interpretation with or without past-time adverbials, as shown in (16)–(17).¹⁵

- (16) Context: *Telling your friend what happened yesterday at your house*:

m-bka’ qu tubung **shira’** ru’ maymaw=sami m-nkux
AV-break ABS window yesterday CONJ so.that=1PL.EXCL.ABS AV-scared
kwara’=myan.

all=1PL.EXCL.GEN

‘The window got broken yesterday and so we all got scared.’

(Atayal)

- (17) Context: *A conversation about why someone was absent from the meeting yesterday. A asks, “Why didn’t you come yesterday?” and B answers*:

nway ki! yaqih hi’=maku’ gaw!

alright PRT bad.AV body=1SG.GEN PRT

‘Sorry! I was sick!’ (lit. My body was bad)

(Atayal)

We propose in Sect. 6 that sentences with bare predicates are only superficially tenseless: Javanese and Atayal both possess a phonologically null pronominal tense morpheme, and the apparent optionality of the existential past tenses *tau* and *-in-* is conditioned by competition with the null pronominal tense morpheme.

3.2 Javanese *tau* and Atayal *-in-* in embedded clauses: Obligatory backward shifting

A further property of Javanese *tau* and Atayal *-in-* is revealed when we look at their behaviour in embedded clauses: they obligatorily back-shift the interpretation of the embedded predicate relative to the matrix event time. This fact is similar to some of the uses of the simple past tense or the past perfect in English. We will argue in Sect. 8 that as *tau* and *-in-* are not analyzable as perfect aspects, these data support an analysis of *tau*/*-in-* as relative past tenses which are distinct from perfect aspects (cf. Bohnemeyer 2014).

In languages like English, past-tense statives that are embedded under a past-tense attitude or report verb can receive either a simultaneous or a back-shifted reading, as shown in (18). In the simultaneous reading, the event time of the matrix predicate is located at or within the event time of the embedded predicate, as in the direct-speech paraphrase in (18)a; this is known as a ‘Sequence of Tense’ (SOT) effect (e.g., Eng

¹⁵ Sentences with bare stative predicates (e.g., *yaqih* ‘bad’ in (17)) can also be interpreted as present when situated in an appropriate context.

1987; Abusch 1988, 1997; Ogihara 1996). In the back-shifted reading, the event time of the embedded predicate is located prior to the matrix event time, as in (18)b.

- (18) Sue **believed** that Mary **was** sick...
- a. Sue believed: "Mary is sick." (simultaneous reading)
 - b. Sue believed: "Mary was sick." (back-shifted reading)

In contrast, predicates modified by *tau* or *-in-* that are embedded under attitudes or reports can only have a back-shifted interpretation, as shown in (19) and (20). For these examples, the same sentence was tested separately in a context in which only a simultaneous reading is felicitous and in one in which only a back-shifted reading is.

- (19) a. ✓Back-shifted context: *Agus was angry last week but now he is not anymore. Agus called me yesterday afternoon to tell me that he had been angry.*
 b. #Simultaneous context: *Agus was scheduled to meet with Eko at 10 am yesterday. But at 1 pm, Eko was still not there. Agus called me because he was angry. Then, I told my neighbour:*
 Pak Agus ngomong deke **tau** nesu.
 Mr. Agus AV.say 3SG E.PST angry
 'Mr. Agus said that he had been angry.' (Javanese)
- (20) a. ✓Back-shifted context: *My dad had been in a bad mood the past few days and he called me to chat yesterday when he felt better.*
 b. #Simultaneous context: *Yesterday my dad was in a bad mood and he called me to chat.*
 k<m><n>ayal shira' yaba' maha m-<in>yaqih
 say<AV><E.PST> yesterday father COMP AV-<E.PST>bad
 inlungan=nya' sa wayal qani.
 heart=3SG.GEN LOC past this
 'Dad said yesterday that his mood had been bad these past few days.' (Atayal)

Javanese *tau* and Atayal *-in-* hence do not pattern with SOT languages like English, but rather with non-SOT languages where only back-shifted readings of an embedded past tense are possible, such as Hebrew (Sharvit 2003), Japanese (Ogihara 1996; Kusumoto 1999; Kubota et al. 2009), Russian (von Stechow and Grønn 2013) or Medumba (Mucha 2017). The data suggest that *tau/-in-* in embedded clauses mark pastness relative to some evaluation time, which is supplied by the time of the matrix event, rather than to the utterance time.

These data also point to our claim that each language has both a pronominal tense and a quantificational past tense. In the Javanese example in (19), we assume the matrix past is supplied by a null pronominal past tense, while in the Atayal example in (20), it is overtly provided by *-in-* (but for both languages, either the overt quantificational past tense *tau/-in-* or a null pronominal past tense is possible in the matrix clause and gives the same results). We discuss this point in more detail in Sect. 6.

Our proposal that *taul-in-* mark past relative to some evaluation time is supported by their interpretation when they are embedded under a matrix future as in (21) and (22): the reference time of the embedded clause is not located prior to the sentence's utterance time, but prior to the future event time of the matrix clause (the time of knowing). In both cases of *taul-in-* embedded under a matrix past or future, we have $RT < EvalT$, and *not* $RT < UT$.

- (21) Context: *You encourage Siti to work on her thesis this afternoon, even though it is implausible that she can write the whole thesis. "After all, Mother will know you have worked," you say.*

Ibuk-mu **ape** ngerti awakmu **tau** nggarap skripsi-mu.
 mother-your FUT know 2SG E.PST AV.make thesis-your
 'Your mother will know you worked on your thesis.' (Javanese)

- (22) Context: *You encourage Tali' to take this afternoon to weed the farm, even though it is implausible that he can weed the entire farm. "After all, Grandpa will know you have worked," you say.*

musa'=nya' baq-un maha l<m><n>ahing=su'.
 FUT=3SG.ERG know-PV COMP weed<AV><E.PST>=2SG.ABS
 'He will know that you weeded (some).' (Atayal)

It is noteworthy that the future auxiliary *musa'* and other future markers in Atayal form a mirror image with *-in-* with respect to the readings in embedded clauses. As illustrated in (23), when *musa'* is embedded under a past attitude/report verb (either marked by *-in-* or a null pronominal tense interpreted with a past reference time), it receives a forward-shifted reading relative to the event time of the matrix verb, rather than relative to the utterance time (i.e., it receives a 'future in the past' reading).¹⁶

- (23) Context: *Maya's kid is a chief now. Maya' already predicted this when she was pregnant.* (adapted from Matthewson 2006:689)

squ kki'an na' qu Maya' hga, si=nya'
 LOC pregnancy still ABS Maya' first.TOP PRT=3SG.ERG
 bq~baq-i maha **musa'** m-g-mrhuw na' 'tayal qu
 EMPH~know-PV.DEP COMP FUT AV-become-sage GEN Atayal ABS
 'laqi' cyux ktu'=nya' qasa.
 child exist.DIST belly=3SG.GEN that
 'During Maya's pregnancy, she knew that that kid in her belly would become a chief of the Atayal people.' (Atayal)

To sum up their shared empirical properties, Javanese *tau* and Atayal *-in-* both express anteriority, have prominent experiential readings but lack resultative readings, and have cessation effects. In embedded contexts, they obligatorily back-shift the interpretation of the embedded predicate relative to the time of the matrix event. None of these properties immediately suggest either an aspectual or a tense analysis.

¹⁶The parallel between *musa'* and *-in-* suggests that they compete for a single slot in the clause; this may provide an explanation for the fact that they do not co-occur in monoclausal sentences (see e.g., (84) below).

4 Javanese *tau* and Atayal *-in-* are existential past tenses

Two of our main claims are that both pronominal and existential past tenses are attested in natural language, and that a single language can have both types. In this section, we provide empirical diagnostics to show how an existentially quantified past tense differs from a pronominal one, and demonstrate that Javanese *tau* and Atayal *-in-* behave like existential past tenses. In Sect. 6, we show how these tenses are empirically distinct from pronominal past tenses in terms of their pragmatic interactions.

4.1 Pronominal vs. existential past tense

We propose that Javanese *tau* and Atayal *-in-* are domain-restricted existential past tenses, a type of past tense that has been proposed for other languages (Musan 1997; von Stechow 2009; Roberts 2012; Mucha 2017; among others). Our analysis predicts that *tau* and *-in-* contrast empirically with non-quantificational past tenses—specifically, tenses analyzed as pronouns with presuppositional features (Partee 1973, 1984; Heim 1994; Abusch 1997; Kratzer 1998; among others).

Starting with pronominal past tenses, Partee's (1973, 1984) insight is that just like pronouns, pronominal tenses have anaphoric, deictic, and bound interpretations, as illustrated in (24). In the anaphoric interpretation, the RT of the second clause in (24)a refers back to the RT of the first clause: Peter's leaving occurred at (or immediately after) the time at which Susan walked in. For the deictic interpretation, the context provides the RT; the sentence in (24)b is true if and only if the speaker failed to turn off the stove at the time that is most salient in the context (for instance, the time just before the speaker left the house). A bound reading is exemplified in (24)c, where the RT is bound by *always*; this reading can be paraphrased as *For all times t at which you eat Chinese food, you are hungry at $t+1$ hour*.

(24)	a.	When Susan walked in, Peter left.	ANAPHORIC	(Partee 1973:605)
	b.	I didn't turn off the stove.	DEICTIC	(Partee 1973:602)
	c.	When you eat Chinese food,
you're always hungry an hour later.	BOUND	(Partee 1973:606)

Under a pronominal analysis, the basic idea is that tenses introduce variables over time intervals, which pick out the RT (Partee 1973, 1984; Heim 1994; Abusch 1997; Kratzer 1998). Just like pronouns, tenses carry presuppositions which restrict their interpretation. A past tense, for instance, carries a presupposition which restricts it to only pick out past RTs. Following recent work (Cable 2013; Bochnak 2016), we decompose the tense into an indexed covert temporal variable (T_i), which denotes the contextually provided RT via the assignment function, and a presuppositional feature. This 'pronominal' past feature (which we will refer to as PRON.PAST) contributes a presupposition that the RT precedes the utterance time t_C , and otherwise denotes the identity function:

$$(25) \quad \llbracket \text{PRON.PAST} \rrbracket^{g,C} = \lambda t: t < t_C. t$$

In contrast, the basic idea of the existential analysis is that tenses involve existential quantification over time intervals, with restrictions on their place on the timeline

(Ogihara 1996; Kusumoto 2005; von Stechow 2009). The past tense (which we'll call EXIST.PAST) thus asserts that there is a time t which is restricted to occurring before t_C and P holds at t :

$$(26) \quad \llbracket \text{EXIST.PAST} \rrbracket^{g,C} = \lambda P_{\langle i, st \rangle}. \lambda w. \exists t [t < t_C \ \& \ P(t)(w)]$$

(absolute; to be revised)

The preliminary denotation in (26) puts the RT t before t_C , so it expresses an absolute tense. Since we argue that *taul-in-* are actually relative tenses (see Sect. 8), our existential analysis will look more like (27), in which t is placed before some evaluation time t' . (There will be a further revision of (27) having to do with contextual restriction; see Sect. 5.)¹⁷

$$(27) \quad \llbracket \text{EXIST.PAST} \rrbracket^{g,C} = \lambda P_{\langle i, st \rangle}. \lambda t'. \lambda w. \exists t [t < t' \ \& \ P(t)(w)]$$

(relative; to be revised)

In English, the semantics of past tense has been argued to be quantificational (e.g., Musan 1997), pronominal (e.g., Partee 1973, 1984), or ambiguous between the two types (Grønn and von Stechow 2016). It is hard to provide any knock-down arguments for or against either approach in English (but see Sharvit 2014 for an argument from *before*-clauses). In other languages, empirical arguments have been given that past tenses exhibit properties disfavouring the pronominal analysis and suggesting that they are quantificational in nature (see for instance Mucha 2015, 2017).

Since the facts are subtle at least for English, we make explicit the different predictions of the pronominal and existential analyses. The pronominal analysis of past tenses predicts that they are scopeless, allow deictic, anaphoric, and bound uses, and are infelicitous without a contextual reference time. The existentially quantified analysis predicts the opposite: they have scope interactions, no deictic, anaphoric or bound uses, and are felicitous in out-of-the-blue contexts. Using these diagnostics, we examine the properties of *tau* and *-in-* and argue that they behave like existential tenses.

4.2 Initial diagnostics for existential vs. pronominal tense

In her discussion of the (lack of) interaction of the English past tense with negation, Partee (1973) points out that a quantificational analysis of the past tense makes incorrect predictions: the sentence *I didn't turn off the stove* in the context of (28) is predicted to allow either the interpretation in (29)a or that in (29)b, depending on the scope of tense with respect to negation.

- (28) Context: *Driving on the highway after leaving the house, you realize that you forgot to turn off the stove.*
 I didn't turn off the stove. (Partee 1973:602)

¹⁷The semantic type and the syntactic position of the elements defined in (25), (26) and (27) are different. The presuppositional past in (25) is a feature adjoined to the tense head T_i ; its type is therefore $\langle i, i \rangle$. The existential pasts in (26)–(27) denote operators that apply at the propositional level; (26) is of type $\langle \langle i, st \rangle, st \rangle$ and (27) of type $\langle \langle i, st \rangle, \langle i, st \rangle \rangle$. See Sect. 5 for details of our formal analysis of *taul-in-*.

- (29) a. $\exists t [t < t_C \ \& \ \neg [I \text{ turn off the stove at } t]]$ WIDE-SCOPE EXISTENTIAL
 b. $\neg \exists t [t < t_C \ \& \ I \text{ turn off the stove at } t]$ NARROW-SCOPE EXISTENTIAL
 c. $\neg [I \text{ turn off the stove at } t], \text{ where } t < t_C$ PRONOMINAL

However, the English sentence means neither (29)a nor (29)b. The truth conditions for (29)a are too weak: they are satisfied as long as I failed to turn off the stove at least once in my life, which could be trivially true. The truth conditions for (29)b are too strong: they require that I have never turned off the stove. Partee argues that what the English sentence really conveys is that the speaker failed to turn off the stove at a contextually salient time (such as a time interval before she left her house), namely (29)c.¹⁸

Partee argues that the English past tense refers to a particular time interval “whose identity is generally clear from the extra-linguistic context” (Partee 1973:603). Her analysis leaves open the possibility that languages might differ along this dimension, and that the past tense in some languages other than English might be existential.

4.3 *Tau/-in-* give rise to scope interactions with negation

In stark contrast with the English past tense, Javanese *tau* and Atayal *-in-* do exhibit scopal interactions with negation. In fact, they exhibit exactly the readings predicted by an existential quantifier analysis based on the syntactic scope relations between negation and tense, as shown in (30) and (31). Without any temporal modification, negation overtly scoping over *tau/-in-* gives rise to a reading that the event has not occurred at any point in time before the present (i.e., the ‘never’ reading in (29)b):

- (30) Wong londo **gak tau** mangan sego.
 person western NEG E.PST AV.eat rice
 ‘Foreigners have never eaten rice.’ (Javanese)
- (31) Context: *Friend A is curious to know whether the weight of Friend B has been always above the average: “Have you ever been slim?”*
 ini’ ay! **iyat=saku** m-<**in**>hikang.
 NEG PRT NEG=1SG.ABS AV-<E.PST>slim
 ‘No! I have never been slim.’ (Atayal)

Moreover, Javanese *tau* can overtly scope over negation, as illustrated by (32) (contrasting with (30)). This receives a wide-scope existential interpretation parallel to (29)a.¹⁹

¹⁸A reviewer notes that (29)c might not be a correct analysis of (28), since an event of turning off the stove takes a very short time and the past tense would only pick out a time within the contextually provided interval; to deal with this issue, even a pronominal analysis would also need to encode existential quantification (Ogihara 1996; see also von Stechow 2009:149). It is unclear under this alternative how existential and pronominal pasts can be distinguished. This alternative also makes the wrong prediction when the past tense co-occurs with a temporal adverb and negation (von Stechow 2009:151).

¹⁹While (32) is a wide-scope existential reading, similar to the formula in (29)a, it is not trivially true because it is standard in many parts of Indonesia that one eats rice for each meal throughout one’s entire life except a few times. We assume that (32) involves domain restriction, so that a paraphrase is ‘There is some time *t* within the contextually salient set of eating times, such that Pak Wanan did not eat rice at *t*.’ For further details, see the discussion of domain restriction in Sect. 4.9.

- (32) Context: *As a Paciran villager, Wanan typically eats rice at every meal, three times a day. But maybe once or twice in his life there was a time when he didn't eat rice.*

Pak Wanan **tau** **gak** mangan sego.

Mr. Wanan E.PST NEG AV.eat rice

'Pak Wanan has sometimes not eaten rice.'

(Javanese)

The wide-scope reading of *-in-* is missing in Atayal, possibly for morphosyntactic reasons: since *-in-* is an infix to the predicate of the sentence, and the negation *iyat* as an auxiliary only grammatically occurs above the predicate, *-in-* always follows the negation *iyat*.

Note that in Javanese and Atayal, negative scope with *tau/-in-* is determined by surface structure. For instance, the order *gak tau* 'NEG E.PST' is judged as infelicitous in (32), showing that inverse scope is not available. In (33)b, the wide-scope interpretation of negation is not available when negation occurs below *tau*; instead only surface scope is possible.^{20,21} (33)b only has the reading that there is a past time when Mrs. Deli did not move. Because this reading is trivially true, the consultant's comment that she was continuously moving reveals a pragmatic reinterpretation of the sentence, changing the context to one in which it is worth mentioning the existence of a time when Mrs. Deli did not change her residence location.²²

- (33) Context: *Mrs. Deli has lived in the same house all her life.*

a. Bu Deli **ora tau** pindah.

Mrs. Deli NEG E.PST move

'Mrs. Deli never moved.'

b. #Bu Deli **tau ora** pindah.

Mrs. Deli E.PST NEG move

'Mrs. Deli once did not move.'

(Javanese)

Consultant's comment (translated): '*... Deli was continuously moving.*'

Overall, the (negative) existential readings in (30)–(33) present compelling evidence that *tau* and *-in-* involve existential quantification. To derive these readings, a pronominal analysis would either require an ad hoc application of existential closure or would need to attribute the existential quantification to some other element in the sentence.²³

²⁰The different negation forms are due to dialect differences: *ora* is used in Semarang (Central Javanese), while *gak* is primarily used in Paciran (East Javanese).

²¹Double negation is also possible in Javanese, with readings which are compatible with our analysis:

- (i) Context: *Mr. Agus smokes every day.*

Mas Agus **ora tau ora** nge-rokok.

Mr. Agus NEG E.PST NEG AV-smoke

'Mr. Agus did not ever not smoke.'

(Javanese)

²²We thank a reviewer and the editor for discussion of the pragmatic reinterpretation of (33)b.

²³See Ogihara (2006:233) and von Stechow (2009:149, 151) for discussion of the second alternative.

4.4 *Tau/-in-* do not have anaphoric uses

We demonstrate that *tau* and *-in-* do not have an anaphoric reading, based on data from narrative progression contexts; these are cases of temporal anaphora. In simple linear narratives, a past tense (eventive) sentence typically 'updates' the reference time to a time just after the reference time provided by the preceding discourse (Partee 1984; Hinrichs 1986; Kamp and Reyle 1993; among others). Importantly, the RT of a past eventive sentence is obtained from the immediately preceding sentence; this anaphoric relation requires a pronominal tense rather than a (contextually constrained) existential tense.

We can draw a parallel with the nominal domain: although the second sentence in both (34)a and (34)b is true if Sam has three children, (34)a, which has a pronominal subject, is a possible case of discourse anaphora, but (34)b, where the subject is an existential quantifier (with or without restriction on its quantificational domain), is not:

- (34) a. My friend Sam is married. *He* has three children.
(adapted from Partee 1984:245)
b. My friend Sam is married. #*A friend (of mine)* has three children.

Our claim that *tau* and *-in-* are existential past tenses predicts that *tau/-in-* will be rejected in the subsequent clauses of a narrative discourse that follow the first clause.²⁴ The prediction is borne out, as demonstrated in the mini-narratives in (35) and (36). Crucially, in the second or subsequent clauses, predicates with *tau/-in-* are rejected by the consultants as instances of regular narrative progression, while bare predicates are accepted. This point is reinforced by the consultant's comments, which indicate that to the extent that *tau/-in-* are acceptable here they do not represent narrative progression. Refraining from using *tau* and *-in-* in anaphoric contexts is similar to the avoidance of indefinites in anaphoric contexts in the nominal domain (cf. Mittwoch 2008).

- (35) Context: *You are describing what you did on a past trip:*
 Aku **tau** numpak pesawat neng Jakarta, (**#tau**) mudun pesawat
 1SG E.PST AV.ride airplane to Jakarta E.PST AV.descend airplane
 terus (**#tau**) nggowo koper-ku. Mari ngono aku (**#tau**)
 continue E.PST AV.bring suitcase-my finish like.that 1SG E.PST
 numpak taksi reng hotel.
 AV.ride taxi to hotel
 'I once took a plane to Jakarta, got off the plane, and then got my suitcase.
 After that, I took a taxi to the hotel.'
 Consultant's comment (translated): "If *tau* is added, then it becomes
 a different story."
 (Javanese)

²⁴An anonymous reviewer points out that there are various analyses of narrative progression, and the correlation with tense semantics might not be as simple as we make out; see for example Kehler (2002); Asher and Lascarides (2003); Altshuler (2016).

- (36) Context: *You are describing how Tali' acted when he came home.*
- a. m-zyup blihun qu Tali' ru' m-tama' ru' h<m>zi' qutux
 AV-enter door ABS Tali' CONJ AV-sit CONJ pour<AV> one
 kupu' qwaw.
 cup wine
 'Tali' came in, he sat down, and poured a glass of wine.'
- b. #m-zyup blihun qu Tali' ru' m-<in>tama'.
 AV-enter door ABS Tali' CONJ AV-<E.PST>sit
 'Tali' came in, and he sat down.
 Consultant's comment (translated): "*mzyup blihun qu Tali'* means that
 Tali' just got in, so it should be followed by *mtama'* ('he sat down').
 How come you said he once sat down?" (Atayal)

Note that whether *taul-in-* can appear in the *first* clause of a narrative is a separate issue, which does not bear directly on narrative progression. This may depend on a variety of factors such as the context and the presence of any temporal adverbials. *Taul-in-* are able to appear at the start of a story as in (35) (and in (37) below), but we expect that bare sentences (with the null tense) are preferred if there is a clearly established reference time as is the case in (36). Investigating these factors in detail is beyond the scope of this paper.

The use of *taul-in-* for subsequent events in narratives is either incongruous with the previous event (hence totally rejected, as in (35) and (36)), or interrupts the narrative progression. The latter case is illustrated by the following Atayal data. (37) is the beginning of a story about an old man going to the mountain and returning home. Replacing the bare verb in the second clause with the *-in-* form, as in (38), only makes sense to our consultant if the returning event takes place at some point during the old man's journey to the mountain (i.e., if he fails to reach the mountain). In other words, using *-in-* interrupts the normal sequence of events by jumping to some previous time. This is comparable to the pragmatic effect of interpreting an indefinite noun in discourse, as seen in (34)b, where *a friend (of mine)* cannot refer to the man who was introduced in the first sentence.

- (37) m-<n>wah rgyax qu bnkis qasa ru' m-sbzih m-usa' ngasal...
 AV-<E.PST>go mountain ABS elder that CONJ AV-return AV-go house
 'The old man went to the mountain, he returned home...' (Atayal)
- (38) m-<n>wah rgyax qu bnkis qasa ru' m-<in>sbzih ska'
 AV-<E.PST>go mountain ABS elder that CONJ AV-<E.PST>return middle
 tuqi.
 road
 'The old man went to the mountain, but he returned halfway.' (Atayal)

We conclude from these data that *taul-in-* do not have an anaphoric reading.

4.5 *Taul-in-* do not have deictic uses

We now turn to the question of whether *taul-in-* can deictically refer to a salient past time the way the English past tense can (e.g., in the stove case in (29)c). As acknowledged by Partee (1984:276), and later argued by Ogihara (1996, 2006) and von

Stechow (2009), a reading virtually indistinguishable from the deictic one provided by the pronominal analysis may be derived by treating past tenses as contextually restricted existentially bound variables. The idea is that a quantificational past tense where the existentially bound variable is restricted to a short interval (or even an instant) is (nearly) equivalent to a pronominal (deictic) one. For instance, suppose that the time you were supposed to turn off the stove is between 11 am and 11:15 am. The narrow-scope existential in (29)b can be modified as (39), whose meaning is very similar to the pronominal analysis in (29)c (repeated here as (40)), where the time variable t directly refers to that salient time interval in the context.

- (39) *Narrow scope existential tense restricted to a short temporal interval*
 $\neg \exists t [t < t_C \ \& \ \underline{t \subseteq [11 \text{ am}, 11:15 \text{ am}]} \ \& \ \text{I turn off the stove at } t]$
 (adapted from von Stechow 2009:150)

- (40) *Pronominal tense analysis*
 $\neg [\text{I turn off the stove at } t], \text{ where } t < t_C$

Consequently, the two analyses are very difficult to distinguish truth-conditionally. However, Javanese and Atayal provide evidence that they are actually distinct.

As will be shown in Sect. 4.9, *tau* and *-in-* are existential past tenses that allow for domain restriction; they hence present a testing ground for teasing apart the two analyses. Interestingly, we find an empirical difference between sentences with *tau/-in-* and sentences with bare predicates when replicating Partee's stove example in Javanese or Atayal. Sentences containing *tau/-in-* are clearly judged as infelicitous by consultants, as shown in (41)a,b, and instead sentences with bare predicates are offered, as in (41)a,c.²⁵

- (41) Context (adapted from Partee 1973:602): *Driving on the highway after leaving the house, you realize that you didn't turn off the stove.*
- a. aku kok rung (# **tau**) mate-ni kompor yo!
 1SG PRT not.yet E.PST AV.die-APPL stove yes
 'I didn't turn off the stove!' (Javanese)
- b. #iyat=maku' in-uyut qu gasu'.
 NEG=1SG.ERG E.PST.PV-put.off ABS gas
 Intended for 'I didn't turn off the gas.' (Atayal)
- c. ini'=maku' yuc-i qu gasu'.
 NEG=1SG.ERG put.off-PV.DEP ABS gas
 'I didn't turn off the gas.' (Atayal)

These data show that *tau/-in-* resist directly referring to a particular salient time in the context, while a bare predicate can easily do so. We take the fact that bare predicates allow deictic uses (as in (41)a,c) and anaphoric uses (as in (35), (36)a and (37)) as evidence that bare predicates have a null pronominal tense which presupposes a con-

²⁵The use of the two Atayal negations *iyat* and *ini'* in (41)b and c is conditioned by the type of predicate: *iyat* is used with sentences containing *-in-* or future markers, and in equational sentences, and *ini'* is used elsewhere.

textually salient time.²⁶ We provide further evidence for this null pronominal tense in Sect. 6.

4.6 *Tau/-in-* do not have bound uses

Besides anaphoric or deictic uses, a third use which we would expect with *tau/-in-* if they were pronominal tenses is the bound reading, as in (24)c above ('When you eat Chinese food, you are always hungry one hour later'). In this case, the RT of the main clause is bound by *always*. In contrast, a quantificational tense analysis predicts (at least without making additional assumptions) that such uses are infelicitous since the RT is existentially quantified.

Testing this type of sentence in Javanese and Atayal, we find that the predictions of a pronominal tense analysis are not borne out. There is no bound reading for *tau* or *-in-* in the main clause, as demonstrated in (42)–(45).²⁷ As we would expect, the presence of *tau* or *-in-* in the 'whenever/every time' subordinate clause is also infelicitous, as shown in (43)–(45).^{28,29}

- (42) Context: *Bu Dur used to go for a walk in the mornings, but now she is too old.*

Sa'ben Bu Dur mlaku-mlaku, dheke (#**tau**) ketemu Dhifa.
every Mrs. Dur RED-walk 3SG E.PST meet Dhifa
'Every time Mrs. Dur went for a walk, she met Dhifa.' (Javanese)

- (43) Context: *When I was young, I could not eat spicy food.*

Sa'ben aku (#**tau**) mangan pedhes, weteng-ku (#**tau**) loro.
every 1SG E.PST AV.eat spicy stomach-my E.PST pain
'Every time I ate spicy food, my stomach hurt.' (Javanese)

²⁶(i) might be considered a potential counterexample, where *-in-* is felicitous in a context which appears to have a contextually salient reference time; however, it is also possible that the reference to the contextually salient interval is effected by the domain restriction variable of *-in-* (Sect. 5.1). A further examination of this data point is required.

- (i) Context: *A and B meet up.*

A: m-<n>luw=su' nanu' m-wah?
AV-<E.PST>accompany=2S.ABS what AV-come
'How did you get here? (lit. What did you accompany to come?)'
B: m-<n>luw=saku' basu'.
AV-<E.PST>accompany=1S.ABS bus
'I took the bus.' (Atayal)

²⁷For the intended universal readings in Atayal, the consultant prefers the presence of the invariant modal *mutu*, glossed as generic for now, and crucially, *-in-* cannot co-occur with *mutu*; this fact is indicated by the ungrammaticality marker on the first *-in-* in (44).

²⁸Repairs that Javanese speakers offered to avoid a bound reading were to replace *sa'ben* 'every' with *kaplan-an-e* 'when-NMLZ-DEF' or *kadang-kadang nek* 'RED-sometime COMP', as in (i):

- (i) **Kapan-an-e** aku mangan pedhes, weteng-ku **tau** loro.
when-NMLZ-DEF 1SG AV.eat spicy stomach-my E.PST pain
'Some time when I ate spicy food, my stomach hurt.' (Javanese)

²⁹Atayal *-in-* in 'when(ever)' subordinate clauses is often interpreted as situating the event in the subordinate clause prior to the event of the main clause (see also fn. 33).

- (44) Context: *When I was young, my body was weak and I easily got cold symptoms.*

mutu=saku' m-(*<in>)sngihi' krryax i
 GEN=1SG.ABS AV-<E.PST>have.a.runny.nose every.day COND

m-(<in>)nbu'=saku'.

AV-<E.PST>get.sick=1SG.ABS

'I would have a runny nose every time I got sick.' (Atayal)

- (45) Context (offered, translated): *I didn't like taking an Atayal class before.*

krryax i m(<n>)ung=saku' k<m>ayal kay' Tayal
 every.time COND listen.AV<E.PST>=1SG.ABS speak<AV> word Atayal

lga, t<m>(<n>)ubun=saku' la.

PRT.TOP doze<AV><E.PST>=1SG.ABS PRT

'Every time I heard people speak Atayal, I dozed off.' (Atayal)

Unmarked predicates are felicitous in these cases; as we argue in Sect. 6, the bound reading is expected under a null pronominal tense analysis for Javanese and Atayal.

In sum, the lack of bound readings for *tau/-in-* leads to the same conclusion as the lack of anaphoric and deictic uses. That all three canonical uses for a pronominal tense analysis are unavailable for Javanese *tau* and Atayal *-in-* strongly suggests such an analysis is untenable. Furthermore, combined with the evidence from negation, our results demonstrate that Javanese and Atayal exhibit a clear empirical distinction between the two analyses.

4.7 *Tau/-in-* are felicitous in contexts without a specific reference time

Given the evidence from negation that *tau* and *-in-* are quantificational, we expect that the two tenses are felicitous in contexts without a salient reference time. This prediction is borne out:

- (46) Context: [No previous discourse.] *Imagine that you are telling a story to your friend.* (inspired by Mittwoch 2008:325)

Paspor-ku **tau** ilang.

passport-my E.PST lose

'My passport was lost once.'

(Javanese)

- (47) Context: [The beginning of a story.]
 (extracted from the elicited storyboard 'On the lam,' TFS Working Group 2011)

maki' qutux ryax, m-<n>wah t-qulih syaw na bsilung.

live.AV one day AV-<E.PST>go VBZR-fish.AV side GEN deep.pool

'One day, they went fishing by the lake.' (Atayal)

The Javanese and Atayal facts are as expected under our existential analysis of *tau* and *-in-*. Interestingly, their translation into English with a simple past tense seems to be problematic for a pronominal tense analysis of the English past: the English past tense can be uttered out of the blue, as shown in (48), or in contexts where the reference interval is vague or irrelevant, as in (49).

- (48) Context: *Imagine you are looking at churches in Italy. There is no previous discourse when the following question comes up:*
 Who built this church? Borromini built this church. (Kratzer 1998:16)
- (49) Who killed Julius Caesar?³⁰ (Partee 1984:276)

Indeed, data like these have been used to argue that the English past involves existential quantification (e.g., Ogiwara 1996, 2006, 2011). An alternative approach is that of Kratzer (1998), who argues that the English simple past is ambiguous: it can convey a pronominal past, or—as in out-of-the-blue cases like (48)—the combination of present tense plus perfect aspect. We do not comment further on the analysis of the English past tense as it is beyond the scope of this paper.³¹ Our main conclusion is that a quantificational analysis for *tau* and *-in-* straightforwardly captures their existential interpretation, including the fact that they are felicitous in contexts without a salient reference time.

4.8 Summary: Javanese *tau* and Atayal *-in-* are existential past tenses

We have shown that the following predictions of an existential past analysis are upheld for *tau* and *-in-*: they exhibit scopal interactions with negation, are infelicitous in anaphoric or deictic contexts, cannot be bound by other quantifiers, and are felicitous in contexts without a salient reference time. The first three properties are in direct opposition to those of pronominal tenses, and the last two can only be accounted for by a pronominal analysis by making additional assumptions. Together, these diagnostics constitute evidence that *tau*/*-in-* are unambiguously quantificational.^{32,33}

4.9 Domain restriction with *tau* and *-in-*

Before turning to our formal analysis, we highlight the fact that *tau* and *-in-* do not simply have an unrestricted domain of quantification. For example, in negative sentences, the domain of the existential quantification that *tau* and *-in-* introduce can be subject to restriction via a salient time interval in context, as in (50)–(52), or a temporal adverb, as in (53). For instance, (50) asserts that there was no event of practicing

³⁰Partee (1984) doesn't provide a context for the sentence in (49); presumably the sentence is uttered out of the blue. According to Partee, the speaker "[doesn't] have to know when it happened to know who did it, given that it could only have happened once if it happened at all" (p. 276), in which case the reference time can be the whole of the past.

³¹See Matthewson et al. (2019) for some discussion of the problem posed by examples like (48).

³²A reviewer refers us to Stojnić (2016), who (following Stone 1997) argues that modals, although quantificational, display anaphoric and deictic effects. This deserves further research, but importantly, *tau*/*-in-* do not show anaphoric- or deictic-like properties like modals do. A Stojnić-style account applied to tense would need to explain why some quantificational tenses can, and others cannot, participate in anaphora and deixis.

³³Sharvit (2014) argues that quantificational tenses cannot be used in *before*-clauses because the quantificational tense would not meet the presupposition of *before*. Our preliminary data confirm this prediction for *tau*/*-in-*: *tau* is not felicitous in *before*-clauses, and the presence of *-in-* in temporal clauses yields 'after' readings (see also L. Huang and Wu 2016:213). Further research is necessary to better understand *before*-clauses in Javanese, since *sa'durunge* 'before' is polymorphemic, composed of *sa'* 'as', *durung* 'not.yet', and *-e* 'DEF'.

English in the contextually salient time interval starting when the speaker became a business owner. And (51) asserts that there was no event of Dewi's eating rice during the contextually salient time interval—not that she has never eaten rice in her life. The examples in (50)–(52) also show that the restriction on the quantificational domain can be made covertly.

- (50) **Context:** [conversation] *Mr. Jun is talking about his English capabilities since he became an embroidery business owner. He used to be an elementary school English teacher (so, practicing his English regularly). He says:*
 Aku gak **tau** praktek boso inggris.
 1SG NEG E.PST practice language English
 'I haven't practiced English.' (Javanese)
- (51) **Context:** *Dewi lives in Semarang. She went to Canada for 4 months from September to December 2015. Now it's October 2016.*
 Dewi ora **tau** mangan sego neng Kanada.
 Dewi NEG E.PST AV.eat rice in Canada
 'Dewi never ate rice in Canada.' (Javanese)
- (52) **Context:** *Describe how your friend walked in the mountains without any food. He suffered from starvation but survived.*
 iyat m-<n>aniq ana cikay mami'.
 NEG AV-<E.PST>eat even some rice
 'He didn't eat even some rice.' (Atayal)
- (53) **Context:** *Seeing a student dozing off in class, the teacher asks:*
 iyat=su' m-<n>'abi' **shira'**?
 NEG=2SG.ABS AV-<E.PST>sleep yesterday
 'Didn't you sleep yesterday?' (Atayal)

These facts are paralleled in positive sentences in which the domain of existential quantification can be restricted by temporal adverbials or context, as shown in (54)–(55):

- (54) Adik-ku **tau** lungu neng Indonesia **September 2015**.
 younger.sibling-my E.PST go to Indonesia September 2015
 'My younger sibling went to Indonesia in September 2015.' (Javanese)
- (55) **Context:** *A reply to the question in (53); a teacher asks if a student who dozed off in class didn't sleep yesterday. The student answers:*
 m-<n>wah=saku' mluw yaba'=mu m-usa'
 AV-<E.PST>go=1SG.ABS accompany.AV father=1SG.GEN AV-go
 psabu' qulih **sgbyan**.
 net.fish.AV fish night
 'I went with my father to fish (with a net) last night.' (Atayal)

We thus conclude that *tau/-in-* are not limited to readings where the domain of quantification could encompass any time in an individual's lifespan, but can be subject to domain restriction to a shorter interval by an overt temporal adverbial or by the context. To capture this, we follow von Stechow (2009) in including a free predicate

variable R of type $\langle i, st \rangle$ in the semantic representation which picks out a contextually restricted set of times (spelled out in Sect. 5.1). In other words, all these examples have existential quantification over a salient interval (e.g., he never ate during that time-span of walking in the mountains in (52)).

Despite the fact that *tau* and *-in-* are subject to domain restriction, the infelicity of these markers in anaphoric and deictic contexts (shown in Sects. 4.4–4.5) clearly shows that they do not involve temporal deixis or anaphora. This contrast is parallel to the one in the nominal domain between existentially quantified noun phrases and pronouns (see (34)). The contrast between *tau*/*-in-* sentences and bare predicates supports our proposal that *tau*/*-in-* are unambiguously quantificational tenses, and that there are empirical differences between domain-restricted quantifiers over times and temporal deixis or anaphora.

5 Formal analysis

5.1 The analysis of the existential past tenses

We have argued that *tau* and *-in-* are existential past tenses, following similar analyses for other languages by Ogiwara (1996), von Stechow (2009), and Mucha (2017), among others. For our formal semantic analysis we adopt the framework of Kratzer (1998) and much subsequent work, in which VPs denote properties of events (of type $\langle l, st \rangle$), which are mapped by aspectual operators (of type $\langle \langle l, st \rangle, \langle i, st \rangle \rangle$) onto properties of times (type $\langle i, st \rangle$). Tenses map properties of times onto properties of times.

Tau/*-in-* denotes a function that takes a property P of times, denoted by an AspP, and an evaluation time t , and asserts that there is a time t' preceding t at which P holds. The times over which *tau*/*-in-* quantify are additionally contextually restricted via a variable R of type $\langle i, st \rangle$, following von Stechow (2009). Thus, the previous formula for an existential past tense in (27) is now revised to (56).

$$(56) \quad \llbracket \textit{tau/-in-} \rrbracket^{g,C} = \lambda R_{\langle i, st \rangle}. \lambda P_{\langle i, st \rangle}. \lambda t. \lambda w. \exists t' [t' < t \ \& \ R(t')(w) \ \& \ P(t')(w)]$$

(adapted from von Stechow 2009:150)

The syntactic structure we assume is presented in (57), where *tau*/*-in-* are in the head T of TP. The contextual restriction R is represented in the syntax as a free object-language variable that is the first argument of *tau*/*-in-*.

Our analysis assigns relative tense denotations to *taul-in-*: they do not simply place the reference time before the utterance time as absolute tenses do. In matrix clauses, predicates modified by *taul-in-* are necessarily located prior to the utterance time (t_C). However, as shown in Sect. 3.2, when the complement clause of a propositional attitude/report predicate is marked with *taul-in-*, the event time is necessarily located prior to the evaluation time of the complement clause, which coincides with the matrix event time (the time of the attitude/report). In Sect. 8, we will show that *taul-in-* as relative tenses are distinct from a perfect aspect and give an example derivation.

5.2 *Taul-in-* combine with a null aspect

A few notes are needed on the AspP that *taul-in-* combines with. First, neither *tau* nor *-in-* is compatible with any overt aspectual marking. Second, they allow for slightly different aspectual readings including perfective and habitual readings for Javanese *tau* (Vander Klok 2012), and perfective, progressive, and habitual readings for Atayal *-in-* (Chen 2018); in both languages, the perfective reading allows for non-culminating accomplishments in the sense of Bar-el (2005) (see the references therein). An important observation is that the same aspectual readings allowed with *taul-in-* are also found in bare sentences. The aspectual similarity with bare sentences suggests that *tau* and *-in-* are not portmanteau morphemes combining tense and aspect; we hypothesize that *taul-in-* obligatorily select a phonologically null aspect.³⁴

Chen (2018) gives a detailed analysis of the aspectual system of Atayal, proposing that the non-culminating perfective reading of bare sentences in Atayal is best analyzed as encoding a null neutral aspect in the sense of Smith (1997)—a unique viewpoint aspect that allows reference to the beginning stage of an event but not to the final point. Whether Chen's neutral-aspect proposal can be extended to Javanese bare sentences is an open question, but analyzing the aspectual system of the two languages goes beyond the scope of this paper. For purposes of illustration, in the next section and in Sect. 8.2 we will use a simple perfective semantics for the Aspect Phrase in the derivations of *tau* and *-in-* sentences; the reader is referred to Chen (2016, 2018) for the semantics of the null neutral aspect.

5.3 Illustrating our analysis

We now illustrate how our analysis can account for different uses of *taul-in-*, which are similar to experiential perfect sentences in English in some cases, and to simple

³⁴ A reviewer asks if *taul-in-* behave similarly to the Russian imperfective or the French *imparfait*. The Russian imperfective, for example, has been noted to be associated with past tense, and to yield experiential perfect readings and the so-called annulled result state (Grønn 2003; Altshuler 2012). While these appear to overlap with the uses of *taul-in-*, most literature analyzes the Russian imperfective as an aspectual marker without arguing that it encodes a tense. Even if *taul-in-* did additionally fold in the semantics of the French *imparfait* or the Russian imperfective, this would not invalidate any of our arguments about their status as tenses.

past sentences in others. A case parallel to an English experiential perfect is (58) (repeated from (10)), whose semantics is as in (59). The resulting truth conditions are that the sentence is true at a world w and a time t iff there is a time t' preceding the evaluation time t which temporally includes the run time of the event of the speaker's hunting goats. Note that the evaluation time t is bound by a lambda-operator, but in a root clause like (59) it will end up being identified with the utterance time t_C ; see Sect. 8.2 for details. In principle, t' can be any time preceding t , but pragmatically t' is restricted to the interval of the speaker's life span (via the contextual variable R). This is the experiential interpretation.

- (58) $q\langle m \rangle \langle n \rangle$ alup mit sraral hiya'.
 hunt<AV><E.PST> goat before 3SG.N
 'He has hunted goats before.' (Atayal)
- (59) $[(58)]^{g,C} = [-in-]^{g,C}([AspP]^{g,C}) = [-in-]^{g,C}([Asp]^{g,C}([VP]^{g,C}))$
 $= \lambda t. \lambda w. \exists t' [t' < t \ \& \ t' \subseteq \text{his life span in } w \ \& \ \exists e[\text{he.hunt.goats}(e)(w) \ \& \ \tau(e) \subseteq t']]$

On the other hand, the reading of *tau* in (60) (repeated from (54)) is better rendered in English using the simple past, because R is restricted to the interval of September 2015, which includes the run time of the event of the speaker's younger sibling going to Indonesia, as shown by the representation in (61).

- (60) Adik-ku **tau** lungo neng Indonesia **September 2015**.
 younger.sibling-my E.PST go to Indonesia September 2015
 'My younger sibling went to Indonesia in September 2015.' (Javanese)
- (61) $[(60)]^{g,C} = [\text{tau}]^{g,C}([AspP]^{g,C}) = [\text{tau}]^{g,C}([Asp]^{g,C}([VP]^{g,C}))$
 $= \lambda t. \lambda w. \exists t' [t' < t \ \& \ t' \subseteq \text{September 2015 in } w \ \& \ \exists e[\text{the.speaker's.younger.sibling.go.to.Indonesia}(e)(w) \ \& \ \tau(e) \subseteq t']]$

(62) (repeated from (32)) illustrates the same point for a case where *tau* scopes over negation; again the existentially quantified tense is pragmatically restricted to a contextually salient set of times (for instance, the normal meal times during Wanan's lifetime):

- (62) Pak Wanan **tau** **gak** mangan sego.
 Mr. Wanan E.PST NEG AV.eat rice
 'Pak Wanan has sometimes not eaten rice.' (Javanese)
- (63) $[(62)]^{g,C} = [\text{tau}]^{g,C}([NEG]^{g,C}([Asp]^{g,C}([VP]^{g,C})))$
 $= \lambda t. \lambda w. \exists t' [t' < t \ \& \ t' \subseteq \text{the set of normal meal times during Wanan's life span in } w \ \& \ \neg \exists e[\text{Wanan.eat.rice}(e)(w) \ \& \ \tau(e) \subseteq t']]$

In sum, the apparent ambiguity—suggested by the English translations—between a perfect aspect and a past tense with *tau/-in-* in fact only represents pragmatic variants of a single existential past tense reading in Javanese and Atayal, conditioned by the domain restriction on the existential quantification.

6 Javanese and Atayal have both an existential and a null pronominal past tense

One of our main claims is that a single language can have *both* an existential tense and a pronominal tense. This finding runs counter to the assumption that some economy principle might rule out this type of language, and expands the space of permissible cross-linguistic variation.³⁵ We have argued that *tau* and *-in-* are existential past tenses based on their scopal interactions with negation, their infelicity in deictic, anaphoric, and bound contexts, and their felicity without a salient contextual reference time. In contrast, we showed in Sect. 4 that sentences without any temporal marking in Javanese and Atayal are felicitous in deictic, anaphoric, and bound contexts. We argue that sentences which superficially lack tense marking are not semantically tenseless, but contain a phonologically null pronominal tense morpheme. We show that the contrast between bare predicates with a null pronominal tense and those with *tau/-in-* is correctly predicted by the Maximize Presupposition principle proposed by Heim (1991). We show furthermore that these contrasts would not be captured if *tau/-in-* were pronominal, or if temporally unmarked sentences had no tense at all.

6.1 The semantics of the null pronominal tense

As discussed in Sect. 4.1, we assume that pronominal tenses are decomposed into a covert temporal variable (T_i) and a presuppositional feature, following, for example, Cable (2013) and Bochnak (2016). The null tenses differ in their presuppositional features: the Javanese pronominal null tense has the presuppositional feature in (64), which places no restrictions on the reference time, but merely presupposes that t is a contextually salient time. This captures the fact that bare predicates in Javanese are compatible with past, present, and future reference times (Vander Klok and Matthewson 2015:174–175).³⁶ In contrast, the Atayal pronominal null tense carries a tense feature that is restricted to a non-future interval, yielding past or present but not future interpretations, as expressed in (65).³⁷

(64) $\llbracket \text{PRON.TENSE} \rrbracket^{g,C} = \lambda t: t \text{ is salient in } C. t$ (Javanese)

(65) $\llbracket \text{PRON.NON-FUT} \rrbracket^{g,C} = \lambda t: t \text{ is salient in } C \ \& \ t \leq t_C. t$ (Atayal)³⁸

³⁵Cf. Sharvit (2014:300), who considers a typology based on the dimensions of having (i) a quantificational tense, (ii) a pronominal tense, (iii) an SOT rule, and (iv) a “shiftable” present tense.

³⁶Vander Klok and Matthewson (2015:174) assumed that Javanese was tenseless, having neither covert nor overt tense. Based on the evidence given in this paper, we reject that assumption.

³⁷A complication is that non-actor voice sentences in Atayal allow for future interpretations (see (85)a below), but this does not concern us here (see Chen 2018 for discussion and analysis).

³⁸(65) assigns an absolute, rather than relative, semantics to the Atayal non-future tense. This makes an interesting prediction which should be tested in future research: that in examples like (22) above (‘He will know that you weeded’), *-in-* is obligatory. The reason is that an absolute non-future tense in this sentence would wrongly force the weeding event to precede the utterance time. If it turns out that a null tense is possible in sentences like (22), then (65) should be amended to make the null non-future tense relative rather than absolute. Thanks to Yurika Aonuki (p.c.) for pointing this prediction out to us.

The fact that bare (i.e., superficially tenseless) sentences in Javanese can have a future interpretation whereas those in Atayal cannot is thus captured in our analysis by the different semantics of the null tense morphemes of the two languages; note that an analysis that does not posit a null tense morpheme would have difficulty accounting for this difference because it would have to resort to a sentence-level, perhaps pragmatic, difference in temporal interpretation, which seems unmotivated (see Matthewson 2006 for a similar argument applied to St'át'imcets (Lillooet Salish)). The difference in the presuppositional features of the null pronominal tenses in the two languages does not affect their interaction with *taul-in-*, which is discussed in the rest of this section.

6.2 A pronominal tense analysis of *taul-in-* would predict incorrect Maximize Presupposition effects

A prediction of a pronominal analysis of tenses is that such tenses are obligatory as soon as their presuppositions are met in the context (unless there is an alternative tense morpheme in the language which carries stronger presuppositions that are also met in that same context). This prediction is a consequence of the Maximize Presupposition principle (MP) (Heim 1991; see also Percus 2006; Sauerland 2008; Singh 2011; Schlenker 2012). MP was initially proposed to explain constraints on the use of (non-)presuppositional determiners and quantifiers; for example, given that there is exactly one sun, not using the definite determiner in (66) results in infelicity, and similarly in (67), *both* is chosen over *all* because it carries the additional presupposition that John has exactly two eyes.

- (66) a. #A sun is shining.
- b. The sun is shining.
- (67) a. #All of John's eyes are open.
- b. Both of John's eyes are open. (Singh 2011:150)

The application of MP has been extended to the temporal domain (Sauerland 2002; Ippolito 2003; Cable 2013; Mucha 2015; Bochnak 2016), and can provide indirect evidence for the semantics of temporal markers across languages. Cable (2013) shows that the past remoteness markers in Gĩkũyũ (Bantu) denote temporal domains that are ordered in terms of specificity (e.g., 'immediate past' denotes a strict subset of 'current past'). Speakers must choose the most specific past marker that is consistent with their knowledge; that is, the availability of a more specific marker blocks the use of a less specific one. This blocking effect parallels that of the determiners in (66)–(67). On the basis of this, Cable argues that the Gĩkũyũ past markers carry presuppositional features, and the restrictions on their distribution follow from MP.³⁹ A contrasting scenario is provided by Mucha (2015, 2017), who argues that the past remoteness markers in Medumba (Bantu) denote distinct past time intervals, and are optional: in contexts where a specific past marker is motivated, a temporally unmarked sentence is also acceptable. Mucha suggests that this presents an argument

³⁹Unlike tenses, the Gĩkũyũ past remoteness morphemes are analyzed as event modifiers, serving to restrict the event time; see Cable (2013) for details.

against a presuppositional analysis of the Medumba past markers because if the past markers were presuppositional, MP should make their presence obligatory.⁴⁰

Suppose that Javanese *tau* and Atayal *-in-* were pronominal past tenses carrying a presupposition of pastness. In past contexts *tau/-in-* would be more specific than the null unrestricted/non-future tense in superficially tenseless sentences, and MP would predict *tau/-in-* to be obligatory. However, *tau* and *-in-* resemble the Medumba past remoteness markers in *not* being obligatory in past contexts; in an appropriate context, the null tense in both languages can refer to past times (see (14)–(17) above).

A related fact is that we also do not observe 'implicated presupposition' effects for temporally unmarked sentences in Javanese and Atayal. Implicated presuppositions arise when a non-presuppositional utterance triggers the inference that its presuppositional alternative is not felicitous (see Sauerland 2002, 2008; Chemla 2008; among others). For example, using the indefinite determiner in (66)a leads to an implicated presupposition that there is no unique sun. Concerning tenses, Sauerland (2002) argues that the English present tense displays implicated presupposition effects: the present tense is semantically vacuous, but is used for non-past time reference, due to the avoidance of the presuppositional past. Along these lines, if *tau* and *-in-* were pronominal pasts with presuppositional features, then temporally unmarked sentences in both languages should have the implicated presupposition that they do not refer to the past.⁴¹ This is however not the case: as mentioned above, temporally unmarked sentences in both Javanese and Atayal can have a past interpretation.

6.3 The existential tense analysis predicts correct Maximize Presupposition effects

Now suppose that *tau/-in-* are existential, as we have argued, and that both languages have a presuppositional covert tense as in (64)–(65). We predict that if a contextually salient past time is referred to, MP will force the speaker to choose the null pronominal tense over non-presuppositional *tau/-in-*. This prediction is borne out: as illustrated in Sects. 4.4–4.5, in deictic and anaphoric contexts, the null tense is felicitous whereas *tau/-in-* are ruled out. This is the case even though *tau/-in-* possess a contextual variable for their domain restriction. Parallel to the application of MP with determiners and quantifiers as in (66) and (67), MP forces the speaker to choose bare predicates over sentences with *tau/-in-* because the null pronominal tense presupposes that there is direct reference to a salient time (e.g., the time when the speaker was supposed to turn off the stove; cf. (41)a,c vs. (41)a,b).

We also predict that *tau/-in-* give rise to an implicated presupposition that there is no direct reference to a salient past time at which the proposition is true. This prediction is also borne out: for instance, as shown in (35)–(38) above, using *tau/-in-*

⁴⁰ An exception to this line of reasoning is past tense in Washo (Hokan/isolate), which is analyzed as pronominal but is not obligatory (Bochnak 2016). Bochnak argues that superficially tenseless sentences in Washo possess a null pronominal tense without presuppositional features, and due to the absence of a tense feature, the tenseless sentences do not form syntactic alternatives to be compared with past sentences by MP.

⁴¹ This would follow if temporally unmarked sentences were tenseless, had a null quantificational tense, or had a null pronominal tense with less specific temporal reference.

in narratives interrupts the normal narrative progression, which results in incongruity or infelicity. Whenever *taul-in-* are used, the reading is existential.

Crucially, neither of these predictions would fall out if there were no null pronominal tense in Javanese and Atayal bare sentences. If these superficially tenseless sentences were instead analyzed as truly tenseless or as having a null existential tense marker, we would neither predict their felicity, nor the infelicity of *taul-in-*, in deictic, anaphoric, and bound contexts.

6.4 The tense system of Javanese and Atayal predicts cessation implicatures

We consider here ‘cessation inferences’: the strong inference with stative predicates marked with *taul-in-* that the described state does not continue to the utterance time. We argue that this is best accounted for as another pragmatically conditioned effect of having both a null pronominal tense and an existential past tense in the tense systems of Javanese and Atayal.

Consider first that stative predicates with *taul-in-* are accepted in the context of (68) and (69), where the subject is no longer fat/slim; in fact, such sentences are not only compatible with the cessation of the state, they imply it even when this is not favoured by the context.

- (68) Context: *Mrs. Siti is now slim.*
 Bu Siti **tau** lemu.
 Mrs. Siti E.PST fat
 ‘Mrs. Siti was fat.’ (Javanese)
- (69) Context: *Tali’ is now fat.*
 m-<**in**>hikang qu Tali’.
 AV-<E.PST>slim ABS Tali’
 ‘Tali’ was slim.’ (Atayal)

This cessation inference, using the terminology of Altshuler and Schwarzschild (2013), has been observed for the English past tense (Musan 1997; Iatridou 2000:248; Magri 2011; Thomas 2012; Altshuler and Schwarzschild 2013). It is illustrated by (70), in which B’s reply implies that Scotty is no longer anxious.

- (70) A: How is Scotty doing?
 B: Scotty **was** anxious. (Altshuler and Schwarzschild 2013:47)

We suggest that an account of cessation inferences based on tense choice, along the lines of Altshuler and Schwarzschild (2013), can be extended to Javanese and Atayal, under our analysis whereby *taul-in-* are existential past tenses and the languages also possess a pronominal null free/non-future tense. According to Altshuler and Schwarzschild, if a stative clause is true at a moment *m*, it is also true at some moment *m'* preceding *m*, assuming time is dense. Given this property of statives, a null pronominal-tense stative sentence in Javanese and Atayal, uttered in a context where the present time is salient, is true when the state holds at the present *and* past, and this asymmetrically entails the truth of a counterpart with *taul-in-*, in which the state only holds at a past time. Choosing the *taul-in-* stative sentence over the more

informative pronominal one implicates that the pronominal stative sentence is false (by the standard Gricean Maxim of Quantity); therefore, the described state is understood not to hold at the utterance time.⁴² This analysis also goes through with *taul-in-* sentences uttered out-of-the-blue, since the default time picked out by the null pronominal tense is an interval that includes the utterance time.

There is evidence in support of our claim that the cessation inference of *taul-in-* is an implicature. (71) and (72) show that the inference of Miss Lulu's being no longer fat, or of the speaker's not liking "that guy," can be cancelled by directly asserting the continuation of the state (also noted in Gorbunova 2015 for Atayal):

- (71) Mbak Lulu **tau** lemu. Sampek sa'iki mbak Lulu isek tetep lemu.
Miss Lulu E.PST fat until now Miss Lulu still remain fat
'Miss Lulu was once fat. Until now, Miss Lulu still remains fat.' (Javanese)
- (72) s<n>awy-an=maku' sraral squliq qasa ru' misu qani ga
like<E.PST>-LV=1SG.ERG before people that CONJ now this TOP
sawy-an=maku' na'.
like-LV=1SG.ERG still
'I liked that guy before and now, I still like him.' (Atayal)

We note that direct cancellation is not always accepted by speakers, and is more felicitous in certain environments, unlike the cancellation of cessation implicatures in English,⁴³ but integrating this point formally is beyond the scope of this paper.

Returning to the lack of resultative readings found with *tau* and *-in-* with change-of-state predicates (see (12) in Sect. 3.1), we tentatively suggest that the fact that *taul-in-* are compatible with the result state having ceased to hold may receive a unified explanation with the facts presented here for stative predicates. Examples showing that the cessation of a result state is also cancellable are given in (73) and (74). Working out this extension in more detail, however, is something that we will leave for future work.⁴⁴

- (73) Bapak-e **tau** melbu nok WBL terus deke isek nok kono.
father-DEF E.PST AV.enter at WBL then 3 still at there
'Father entered WBL (*Wisata Bahari Lamongan*, Marine Tourism Lamon-
gan) and he is still there.' (Javanese)

⁴²An anonymous reviewer points out one outstanding issue, namely that a free variable and its existentially bound counterpart might not count as scalar alternatives on a classic conception of Horn scales. We observe that there is an asymmetric entailment relationship when the variable for the evaluation time has its value filled in (by the assignment function) as the utterance time, for the same reason that *She left* (where *she* refers to a contextually salient person) asymmetrically entails *Someone left*. Formal details of the MP account will have to be worked out, but go beyond the bounds of the current paper. See Thomas (2012) and Sharvit (2017) for related discussion.

⁴³In both Atayal and Javanese, cancellation of the cessation implicature is more prevalent in cases where either the context or the sentence entails that the state ceased at some past time, but has resumed again by the utterance time. In Atayal, cessation is also readily cancellable when the speaker explicitly asserts ignorance concerning the present (also noted in Cable 2017), as well as when a present time adverbial is topicalized, as in (74).

⁴⁴See Cable (2017) for possible unification of cessation inferences of the two types of predicates in Tlingit.

- (74) m-<in>shriq hiya' qu knayril=nya' ru' ana misu qani
 AV-<E.PST>separate 3SG.N ABS woman=3SG.GEN CONJ even now this
 ga ini' uwah na'.
 TOP NEG come.AV.DEP still
 'His wife separated from him, and even now she hasn't come back yet.'
 (Atayal)

7 Javanese *tau* and Atayal *-in-* are not perfect aspects

We have presented evidence that Javanese *tau* and Atayal *-in-* are both existential past tenses. However, the salient empirical properties that *tau* and *-in-* share, as shown in Sect. 3, could suggest that an aspectual analysis is also conceivable. This section therefore explores the alternative hypothesis that *tau/-in-* involve the semantics of perfect aspect. We test *tau/-in-* against the predictions of two theories of the perfect—the Extended Now (XN)/Perfect Time Span (PTS) theory and the anteriority theory—and conclude that a perfect analysis along either of these two lines cannot capture the properties of *tau/-in-*.⁴⁵ First, *tau/-in-* do not exhibit the aspectual and/or pragmatic properties commonly associated with an XN/PTS theory of present perfects, and second, the anteriority of *tau/-in-* is different from what we would expect with an anteriority analysis of a perfect.

Our aim in this section is to show that *tau/-in-* do not behave like perfects according to two of the most prominent formal theories of the perfect. We note here that, although in the following discussion (especially in Sect. 7.1) we make comparisons between *tau/-in-* and the English perfect, we do not assume that the properties of the perfect in English are valid for all tense/aspect categories in other languages that have been called 'perfect', let alone that there exists such a thing as a universal crosslinguistic semantic category of "the" perfect.⁴⁶ For better or worse, the properties of the English perfect have been the starting point for most formal theorizing about the semantics of perfect aspect. Whether so-called perfects in other languages might receive a unified analysis with the English perfect, or behave in ways more similar to *tau/-in-* and might therefore be amenable to an analysis as existential tenses along the lines proposed here, or require yet another analysis (for instance, as past perfectives) is an open question that we do not aim to answer here.

7.1 Lack of properties that motivate an Extended Now/Perfect Time Span analysis

The first alternative analysis for *tau/-in-* that we discuss—and reject—is the Extended Now (XN) or Perfect Time Span (PTS) theory (McCoard 1978; Dowty 1979; Iatridou et al. 2001; Pancheva 2003; Portner 2003; among others), according to which the

⁴⁵We do not consider the Result State theory of the perfect (e.g., Moens and Steedman 1988; Parsons 1990; Kamp and Reyle 1993; Giorgi and Pianesi 1997; a.o.) since *tau/-in-* lack resultative readings.

⁴⁶It is well known that even in closely related languages like German, the tense/aspect that is traditionally known as the 'perfect' behaves differently in important respects from the English perfect (see e.g., Musan 2002).

perfect introduces a time interval that extends backwards from the utterance time, and asserts that the proposition is true within that interval. PTS is a generalized version of this approach, according to which the interval extends backwards from any reference time and not just from the utterance time as in the XN theory. We illustrate the PTS theory in (75), where the time argument t determines the right boundary of the PTS and will be saturated by the reference time.

- (75) $\llbracket \text{PERFECT} \rrbracket^{\text{g.C}} = \lambda P. \lambda t. \lambda w. \exists t' [\text{PTS}(t', t) \ \& \ P(t')(w)]$
 where $\text{PTS}(t', t) = 1$ iff t is a final subinterval of t'
 (adapted from Pancheva 2003:284)

The XN/PTS theory was specifically designed to account for the properties of the perfect in English (and related languages). However, *taul-in-* do not exhibit the crucial properties that motivate this analysis: they lack universal perfect and result state readings, current relevance, and 'lifetime effects'.⁴⁷

First, *taul-in-* cannot convey a universal perfect reading, in which the eventuality denoted by the predicate holds throughout an interval starting at some point in the past and extending to the present.⁴⁸ This reading is predicted by the XN/PTS theory, all else being equal (e.g., Iatridou et al. 2001; Pancheva 2003; Portner 2003).⁴⁹

- (76) a. Context: *You moved to Jember from Paciran in 2014 and you still live there now.*
 # Aku **tau** manggon nek Jember sampai 2014.
 1SG E.PST AV.live in Jember since 2014
 Intended for 'I have lived in Jember since 2014.' (Javanese)
 b. Context: *Tali' is a lazy person. I have known him from childhood and he hasn't changed.*
 # m-<in>qilang krayryax qu Tali'.
 AV-<E.PST>lazy every.day ABS Tali'
 Intended for 'Tali' has always been lazy.'
 Consultant's comment (translated): "*minqilang* means he has changed now; not lazy anymore." (Atayal)

⁴⁷ According to the semantics in (75), the perfect encodes a relation between two time intervals—the reference time and the PTS—without involving the time of an event and for this reason, it could be considered a relative tense. However, the fact that *taul-in-* do not have any properties of the PTS suggests that they do not involve this possible sense of relative tense. Crucially, this paper argues that a relative tense is not equivalent to a perfect aspect which has a reference time variable to be saturated in the same clause; see Sect. 8 for details.

⁴⁸ Gorbunova (2015) claims that universal perfect readings are possible for Atayal *-in-*, but her examples involve durative time phrases in the canonical predicate position (i.e., sentence-initial position), with *-in-* appearing only inside the argument.

⁴⁹ It has been argued that the availability of a universal perfect reading depends on the aspectual component in the scope of the perfect (Iatridou et al. 2001; Pancheva 2003). The question therefore arises whether the lack of a universal perfect reading with *taul-in-* can be attributed to the aspectual contribution of *taul-in-* or the viewpoint aspect that they combine with. However, *taul-in-* do not co-occur with any aspectual marker and they allow habitual and/or progressive readings (see Sect. 5.2). The fact that *taul-in-* do allow certain imperfective readings but still lack a universal perfect reading suggest that they are not perfects restricted to a perfective form, as in, for example, Greek (see Iatridou et al. 2001:207–208).

Second, an XN/PTS theory would also predict that *tau/-in-* have resultative readings where the state resulting from the event still holds at the utterance time (e.g., McCawley 1971; Comrie 1976; Iatridou et al. 2001; Katz 2003; Portner 2003; Mittwoch 2008). However, instead of expressing resultative readings, *tau* and *-in-* strongly imply that the result state *ceases* to hold; this was shown in (12). The examples in (77) demonstrate that *tau/-in-* do not entail a result state.

- (77) a. Context (offered, translated): *You are dating again; before that, you broke up.*
 Awakmu mbek aku **tau** putus.
 2SG with 1SG E.PST break.off
 'You and I (once) broke up.' (Javanese)
- b. Kunci-ku **tau** tak {cicir-no/ilang-no}, tapi wes ketemu
 key-my E.PST 1SG.CL fall-APPL/lose-APPL but already meet
 maneh.
 again
 'I dropped/lost my key, but I already found it again.' (Javanese)
- c. h<n>utaw=maku' g-gyah sawsu'=maku' ga,
 drop<E.PST.PV>=1SG.ERG CV-open lock=1SG.GEN TOP
 nyux=maku' 'lwan la.
 PROG.PROX=1SG.ERG find.LV PRT
 'I dropped my key, but I've found it.' (Atayal)

Third, whereas the XN/PTS theory also accounts for current relevance readings, *tau* and *-in-* are infelicitous in such contexts, as shown in (78) and (79). Instead, other markers are used for current relevance, such as *wis/wes* 'already' in Javanese (Vander Klok and Matthewson 2015) and the perfect marker *wal* 'PRF' in Atayal (Gorbunova 2015; Chen 2017).

- (78) Context: *Your friend asks if you want to eat at Mrs. Maula's. You finished eating 10 minutes ago. You say:*
 Sepura-ne, aku { # **tau** / ✓ **wes** } mangan.
 sorry-DEF 1SG E.PST already AV.eat
 'Sorry, I've (already) eaten.' (Javanese)
- (79) Context: *You go to your bamboo farm and see your bamboo is gone.*
 a. # s<n>'ung=naha' qu ruma'=maku'.
 chop<E.PST.PV>=3PL.ERG ABS bamboo=1SG.GEN
 'My bamboo was chopped (by them/others).'
- b. ✓ **wal**=naha' s'ng-un ruma'=mu la.
 PRF=3PL.ERG chop-PV bamboo=1SG.GEN PRT
 'My bamboo has been chopped (by them/others).' (Atayal)

Additionally, we find no 'lifetime' effects with *tau* or *-in-*, as shown in (80). This is in contrast to data which would be accounted for under the XN/PTS theory, as in (81), where the present perfect is infelicitous with subjects referring to people who are no longer alive.

- (80) a. Columbus **tau** nemok-no Amerika.
Columbus E.PST AV.find-APPL America
'Columbus found America.' (Javanese)
- b. **in**-lwan ni Krumpu' qu giqas na rhzyal krahu'.
E.PST-find.LV ERG Columbus ABS new GEN land big
'Columbus found America (lit. the new big land).' (Atayal)
- (81) a. # Gutenberg has discovered the printing press. (McCoard 1978)
b. # Columbus has found America.

Thus, almost all of the readings predicted by or associated with the XN/PTS analysis are not found with *taul-in-*; we therefore reject this as an analysis for *taul-in-*. The only reading which is similar to perfect aspect is the experiential as illustrated in (2)–(3) and (9)–(10). Yet even in this case, we have shown that *tau* and *-in-* do not always yield experiential readings over the subject's lifespan; there are also domain-restricted readings similar to past-tense readings, as in (50)–(55).⁵⁰

The evidence so far does not rule out the possibility that *taul-in-* are perfect aspects that simply temporally locate an event as anterior relative to some reference time, an idea which goes back to Reichenbach (1947). In the next subsection, we show that the anteriority that *taul-in-* encodes is more like that of a past tense than of a perfect, leading us to reject an anteriority-based analysis.

7.2 Evidence against an anteriority-based analysis

In the (neo-)Reichenbachian system (Reichenbach 1947; Klein 1994), aspects do not restrict the location of reference times, and are able to co-occur with different tenses, allowing for different reference times. Along these lines, the perfect can be analyzed as denoting only a precedence relation between the event time and reference time (ET < RT). An illustration of this idea is shown for English in (82). In (82)c, for instance, the event of eating crab is expected to occur after the utterance time but before a future reference time (UT < ET < RT).

- (82) a. I had eaten crab. PAST PERFECT
b. I have eaten crab. PRESENT PERFECT
c. I will have eaten crab. FUTURE PERFECT

A formal representation of this analysis is given in (83).

⁵⁰Perhaps also relevant is that 'repeatability' of the predicate is not required for *taul-in-*, in contrast to the English present perfect under an experiential interpretation (e.g., McCawley 1971; Inoue 1978; Dahl 1985; Michaelis 1994; but see Smith 1997 and Mittwoch 2008); this is shown in (i–ii). Thus even the 'experiential' is different with *taul-in-*. Vander Klok (2012:32) shows that some Paciran Javanese speakers judge examples like (iia) as unacceptable; this variation is likely due to whether or not speakers can cancel the cessation implicature, as discussed in Sect. 6.3.

- (i) # Fred has been born in Paris. (Kiparsky 2002:117)
- (ii) a. Ibu-ku **tau** lair neng Semarang.
mother-my E.PST born in Semarang
'My mother was born in Semarang.' (Javanese)
- b. m-<**in**>kahul sa Nahuy.
AV-<E.PST>come.out LOC Nahuy
'He was born in Nahuy.' (Atayal)

- (83) $\llbracket \text{PERFECT} \rrbracket^{\text{g,C}} = \lambda P. \lambda t. \lambda w. \exists e [\tau(e) < t \ \& \ P(e)(w)]$
 (adapted from Kratzer 1998)

Extending this semantics to *tau* and *-in-* would predict that they are ‘pure’ (i.e., tenseless) perfects that are compatible with past or future reference times. However, we showed in Sect. 3.1 that *tau* and *-in-* are restricted to the past in main clauses (see e.g., (13)). In this section we provide further evidence against an anteriority-based analysis for *tau* and *-in-*.

7.2.1 Lack of future perfect readings

In combination with future marking, *tau* and *-in-* do not behave like perfect aspects. In Atayal, reference to the future is obligatorily marked—either by the prefix *p-* or the auxiliary *musa*—in aspectually-unmarked actor-voice sentences and in sentences with an overt aspect (Chen 2018). In such future-marked sentences, *-in-* is disallowed; we illustrate this here with an actor-voice sentence without an overt aspect:

- (84) { *p*-(**in*)qwalax / *musa*’ m-(**in*)qwalax } kayal=nya’.
 FUT.AV-<E.PST>rain / FUT AV-<E.PST>rain sky=3SG.GEN
 ‘It will rain.’ (Atayal)

Non-actor-voice sentences without an overt aspect can have a future interpretation, but with *-in-* they can only be interpreted in the past, as shown by the contrast in (85) (with a locative-voice verb). In short, the co-occurrence of the future marking and *-in-* in monoclausal sentences is ungrammatical, and thus cannot yield a future perfect reading.

- (85) a. thaygal-an ni Tali’ { *shira*’ / *babaw=nya*’ } laqi’ qasa.
 bully-LV ERG Tali’ yesterday / above=3SG.GEN child that
 ‘Tali’ bullied that kid yesterday.’ / ‘Tali’ will bully that kid in the future.’
 b. c<*inshira*’ / # *babaw=nya*’ } laqi’
 bully<E.PST>-LV ERG Tali’ yesterday / above=3SG.GEN child
 qasa.
 that
 ‘Tali’ bullied that kid yesterday.’ / # ‘Tali’ will bully that kid in the future.’
 (Atayal)

In Javanese, we also do not find future perfect readings with *tau*. The combination of *tau* with the Paciran Javanese future marker *ape* yields a counterfactual reading, as is found with past tense plus future marking in many languages (cf. von Stechow and Iatridou 2008).⁵¹ The sentence in (86) does not allow the interpretation ‘Putri will have met Justin Bieber.’⁵²

⁵¹*Ape* is a non-volitional future marker, found primarily in East Javanese dialects. In Semarang (Central Javanese), *tau* plus the volitional future marker *arep* (Robson and Wibisono 2002) or non-volitional future marker *meh* also only has a counterfactual reading.

⁵²These observations are in line with the theory of temporal-modal interaction proposed by Rullmann and Matthewson (2018), in which cross-linguistically, tenses scope over modals while aspects scope under

- (86) Putri **tau** **ape** ketemu Justin Bieber.
 Putri E.PST FUT meet Justin Bieber
 'Putri would have met Justin Bieber.'
 Consultant's comment (translated): "*It didn't happen—the tickets were sold out.*" (Javanese)

7.2.2 Lack of past perfect ('perfect-in-the-past') readings

The use of *tau* and *-in-* is also infelicitous for so-called 'perfect-in-the-past' readings in main clauses involving the configuration ET < RT < UT, for which English uses *had V-ed* (see Sect. 8.1 for the other reading of this form). For instance, in (87)a, the ET of *metu* 'go out' is intended to be located prior to the RT specified by the *pas* 'when'-clause, which is located prior to the UT. This intended interpretation is impossible with *tau*. A parallel example is given in (87)b with Atayal *-in-*.

- (87) a. # Pas adik-ku m-uleh wingi, aku **tau** metu.
 when younger.sibling-my AV-return yesterday 1SG E.PST AV.go.out
 Intended for 'When my younger sibling got home yesterday, I had already gone out.'
 (Javanese)
- b. # m-wah=saku' shira' lga, m-<**in**>busuk
 AV-come=1SG.ABS yesterday PRT.TOP AV-<E.PST>drunk
 kwara'=naha' la.
 all=3PL.GEN PRT
 Intended for 'When I came yesterday, they had already got drunk.'
 (Atayal)

Instead, to express this meaning in Javanese it is most appropriate to use *wis/wes* 'already' in the second clause (but a bare predicate is also accepted); Atayal uses the perfect marker *wal* or *rima* 'already'. (These forms are also used for the intended future perfect readings in Sect. 7.2.1.) These data suggest that *tau* and *-in-* are not perfect aspects that can be combined with a past tense.

The lack of past perfect readings for *tau*/*-in-* also shows conclusively that they cannot co-occur (within the same clause) with the null pronominal tense that we argued for in Sect. 6. The null pronominal tense can freely refer to a past time (provided this is salient in the context), so combining it with *tau*/*-in-*, which would existentially quantify over a time preceding the time picked out by the null pronominal tense, would result in a back-shifted reading analogous to that of the past perfect in English and many other languages. Our hypothesis that *tau*/*-in-* is a tense and not an aspect straightforwardly accounts for this non-co-occurrence of *tau*/*-in-* with the null pronominal tense, as long as we make the common (and default) assumption that there can be only one tense per clause. Since tense and aspect can and do co-occur in

modals. Assuming that *ape* (like the abstract morpheme 'WOLL' posited for English by Abusch 1985) is a future modal, and that counterfactual readings involve future modals scoping under past tense (*would* in English) whereas perfect aspect scoping under a future modal (*will have*) is interpreted as future perfect, we expect (86) to behave as it does if *tau* is a tense and not an aspect. A counterfactual reading is also found with the alternative order *ape* > *tau* (Vander Klok 2012). However, the syntactic structure of the alternate order *ape* > *tau* is not yet understood (e.g., whether it has head-modification or is a biclausal structure).

one clause, the alternative hypothesis that *taul-in-* is an aspect could not explain the absence of past perfect readings.

We have shown that *taul-in-* are empirically not able to be captured by two of the main theoretical contenders for a perfect analysis. In contrast to what the XN/PTS theory would predict, *taul-in-* lack any of the aspectual and pragmatic properties that have been argued to motivate a time interval that extends backwards from the reference time. And *taul-in-* do not allow the readings predicted for a perfect that shifts an event time prior to a future or past reference time. We conclude that the anteriority of *taul-in-*, revealed in both main and embedded clauses, is that of a past tense.⁵³

8 Javanese *tau* and Atayal *-in-* are relative tenses

8.1 Relative tense as a distinct phenomenon from perfect aspect

Based on the finding that *taul-in-* behave like relative tenses in that they lead to obligatory back-shifting in embedded clauses (Sect. 3), but do not have the properties expected of a perfect (Sect. 7), our analysis supports the view that relative tense is not equivalent to perfect aspect, a point that was already argued for by Bohnemeyer (2014).

To briefly explain the debate about whether relative tense is an independent category, the opposite view—that relative tense and perfect aspect are one and the same thing—is based primarily on the fact that the English pluperfect (*had V-ed*) can have both a ‘past-in-the-past’ and a ‘perfect-in-the-past’ reading (Comrie 1985:66):

- (88) John had already left at ten o’clock.
- a. *The clock struck 12; John had already departed at ten o’clock.*
PAST-IN-THE-PAST
 - b. *Mary came to visit John at ten o’clock, but John had already left.*
PERFECT-IN-THE-PAST

Klein (1992, 1994) assigns the same perfect semantics to both readings, where ET is prior to RT, with the different interpretations depending on whether the temporal adverbial modifies ET or RT. Bringing data from several other languages into the discussion, Bohnemeyer (2014) argues that the two readings cannot both be analyzed as perfect aspect, by showing that some languages have morphemes that only express one of the two interpretations. According to Bohnemeyer, Japanese and Kituba (Bantu) have a marker that excludes the ‘perfect-in-the-past’ reading but can be used for the ‘past-in-the-past’ reading, as well as a past tense reading. He proposes that the relevant marker in these languages is a relative tense, which relates a reference

⁵³The fact that *taul-in-* are restricted to the past suggests that *taul-in-* also are not like event modifiers in that they do not relate ET to RT (Altshuler 2016; cf. Bach 1986; Krifka 1992), as was suggested to us by a reviewer, since event modifiers are expected to be compatible with any reference time. Moreover, a possible analysis for perfect aspect under this theory is that “perfect denotes a function from a set of events to a set of final states of those events” (Altshuler 2016:156), but *taul-in-* lack such resultative readings.

time to a 'perspective time' different from the utterance time. Thomas' (2014) work on the Mbyá (Guaraní) verbal marker *kue* supports the existence of a true relative tense.⁵⁴

Our data on *tau* and *-in-* provide new and conclusive evidence for this debate, further sharpening the theoretical distinction between relative past tense and perfect aspect. We have shown that *tau/-in-* are relative tenses (Sect. 3.2) and not perfect aspects (Sect. 7). A crucial part of our argumentation involves the difference between matrix and embedded clauses. As shown in (84)–(86), *tau/-in-* cannot be combined with a future marker *in the same clause* to derive a 'future perfect' reading of the kind we get in sentences like *It will have rained* in English. This shows that, unlike the English perfect, *tau* and *-in-* are not aspectual markers that can back-shift the event time relative to a clause-mate future operator. This contrasts with *tau* and *-in-* in embedded clauses, which can (and must!) back-shift the embedded event time relative to the event time of a future-marked matrix clause, as illustrated in (21) and (22) in Sect. 3.2.

Similarly, if *tau/-in-* were perfect aspects, we would expect it to be possible to combine them with a clause-mate null pronominal tense referring to a salient past time (in a suitable context) to derive a past perfect interpretation, but as (87) shows, that is not possible. Again, this contrasts with the (obligatory) back-shifting relative to a *matrix* past tense that we saw in (19) and (20). The crucial difference between relative past tense and perfect aspect, then, is that the perfect can combine with a clause-mate tense and derive future perfect (*will have V-ed*) and past perfect (*had V-ed*) interpretations, whereas relative tense can only back-shift an embedded clause relative to a matrix clause.⁵⁵

With the exception of Bohnemeyer (2014) and Thomas (2014), the predominant focus of previous literature concerning the debate on perfect aspect vs. relative past tense has been on English *have*. Our data thus add to the cross-linguistic picture in support of the existence of relative past tense distinct from perfect aspect.

8.2 Deriving the relativity of *tau/-in-*

Our formal analysis is applied to cases with embedded clauses as follows. Recall that the existentially quantified time variable t' is located prior to another variable t representing the evaluation time; see (89), repeated from (56). The variable t is bound by a lambda-operator and gets "passed up" the tree in the course of the derivation.

$$(89) \quad \llbracket \textit{tau/-in-} \rrbracket^{g,C} = \lambda R_{<i, st>}. \lambda P_{<i, st>}. \lambda t. \lambda w. \exists t' [t' < t \ \& \ R(t')(w) \ \& \ P(t')(w)]$$

When *tau/-in-* appears in the complement clause of an attitude/report predicate, the evaluation-time variable will be identified with the matrix event time (the time of the

⁵⁴See Tonhauser (2007, 2011) for an alternative view of tense and *kue* in closely related Paraguayan Guaraní.

⁵⁵Bohnemeyer seems to suggest that true relative tenses, such as the Japanese past tense *-ta*, while lacking a 'perfect' interpretation, can have a back-shifted (past in the past) reading even in a monoclausal sentence. If correct, this would cast doubt on (or require cross-linguistic parameterization of) our claim that relative tense cannot co-occur with a clausemate tense to give back-shifting. However, our own fieldwork with a Japanese speaker found that *-ta* itself does not lead to such back-shifting in monoclausal environments.

attitude/report); this accounts for the obligatory back-shifting in embedded clauses. A rule for the combination of an attitude/report verb with its complement that ensures this is given in (90); it first applies the CP denotation (of type $\langle i, st \rangle$) to the time of the matrix event (e), before feeding the resulting proposition as an argument to the verb (type $\langle st, \langle e, \langle l, st \rangle \rangle \rangle$).

$$(90) \quad \llbracket [\text{VP } V \text{ CP}] \rrbracket^{g,C} = \lambda x. \lambda e. \lambda w. \llbracket V \rrbracket^{g,C}(\llbracket \text{CP} \rrbracket^{g,C}(\tau(e)))(x)(e)(w)$$

When *taul-in-* are in matrix clauses, the evaluation-time variable t is identified with the utterance time t_C . We assume that this is ensured by a default rule which fills in any remaining time and world variables at the root level with the time and world of the utterance context C (i.e., the utterance time and the actual world). Thus, TPs that are of type $\langle i, st \rangle$ (or $\langle s, t \rangle$) will be eventually reduced to type t .

For purposes of illustration, we repeat from (20) the back-shifted example in (91), where the matrix and embedded clause both contain the existential relative past tense *-in-* and a null aspect. (92) provides a simplified representation of the semantics of (91), in which the first *-in-* ensures that a saying event occurred within yesterday, and the second *-in-* ensures that the state of Dad's bad mood holds at a time which precedes the time of the saying event and which is within some time before yesterday. The evaluation time of the first *-in-* is saturated by the utterance time in the last step of the derivation, while that of the second *-in-* coincides with the time of the calling event (via (90)). The back-shifted reading of (91) is correctly derived with two existential quantifiers over times; a similar derivation applies to examples that have a pronominal tense instead of *taul-in-* in the matrix clause (as in (19)).

- (91) Context: *My dad had been in a bad mood the past few days and he called me to chat yesterday when he felt better.*

k<m><n>ayal shira' yaba' maha m-<in>yaqih inlungan=nya'
say<AV><E.PST> yesterday father COMP AV-<E.PST>bad heart=3SG.GEN
sa wayal qani.
LOC past this

'Dad said yesterday that his mood had been bad the past few days.' (Atayal)

- (92) $\llbracket (91) \rrbracket^{g,C} = \llbracket -in-(R)(\text{Asp}(\text{say}[-in-(R)(\text{Asp}(\text{his.mood.be.bad}))(Dad)))] \rrbracket^{g,C}$
 $= \exists t'[t' < t_C \ \& \ \text{yesterday}(t')(w_C) \ \& \ \exists e[\tau(e) \subseteq t' \ \& \ \text{say}(e)(w_C)(Dad,$
 $\lambda w \ \exists t''[t'' < \tau(e) \ \& \ \text{few.days.before.yesterday}(t'')(w) \ \& \ \exists e'[\tau(e') \subseteq t'' \ \& \ \text{bad}(e')(w)(\text{his.mood})]]]]]$

9 Conclusions

We have argued that Javanese *tau* and Atayal *-in-* are existential relative past tenses. In navigating which is the correct analysis for these morphemes, we have made headway towards empirically and analytically distinguishing different types of markers of temporal anteriority, as well as investigating possible inventories of such markers in natural language. We now return to the questions about temporal anteriority markers laid out in (1), repeated here, and summarize our answers.

- (93)
- a. Do both pronominal and existential past tenses exist?
 - b. If yes, how does one empirically distinguish them?
 - c. Can one language possess *both* a pronominal *and* an existential past tense?
 - d. What is the difference between an existential past tense and a present perfect?
 - e. What is the difference between relative tenses and perfect aspects?
 - f. Are 'experiential' readings always contributed by perfect aspects, or can they be contributed by past tenses?

We claim that (a) both pronominal and quantificational past tenses exist in natural language, and (b) they can be empirically distinguished by looking at their scopal interactions and their behaviour with anaphoric, deictic, bound, and out-of-the-blue readings. Specifically, we proposed that an existential past tense will have scopal interactions (with negation and other operators), but will lack anaphoric, deictic, and bound interpretations and will be felicitous without a salient contextual reference time. On the other hand, a pronominal past tense will not exhibit scopal interactions, but will have anaphoric, deictic, and bound readings, and will be infelicitous without a salient contextual reference time. On these diagnostics, Javanese *tau* and Atayal *-in-* unambiguously pattern as quantificational past tenses. We have also argued that *taul/-in-* provide empirical support for the distinction between a pronominal past tense and an existential past tense whose quantification can be restricted to a short time interval, which are otherwise (nearly) truth-conditionally equivalent.

Further, we claim that (c) one language can possess both types of tenses. We showed that our analysis of Javanese *tau* and Atayal *-in-* as existential past tenses correctly predicts the choice between sentences with *taul/-in-* and sentences without any overt temporal markers, provided that both languages additionally have a null pronominal tense (but with a somewhat different presupposition in each case). Evidence for the null pronominal tense focused on pragmatic interactions between these two types of tenses. We concluded that deictic, anaphoric, and bound readings (or the lack thereof) as well as Maximize Presupposition effects and cessation implicatures follow if both Javanese and Atayal also possess a null pronominal tense.

We also investigated (d) the difference between an existential past tense and a perfect, under either an Extended Now/Perfect Time Span or an anteriority-based theory of the perfect. We showed that *taul/-in-* lack resultative readings, universal readings, and current-relevance readings. Thus, an XN/PTS analysis cannot be motivated for *taul/-in-*. Furthermore, the anteriority encoded by *taul/-in-* cannot be captured by locating the event time prior to the reference time as in a neo-Reichenbachian account of the perfect: *taul/-in-* do not allow future perfect readings analogous to English *will have V-ed* nor past perfect ones such as *had V-ed*.

A last hope for an aspectual account might have been to analyze *taul/-in-* as dedicated experiential perfect markers (cf. Dahl 1985 for Javanese *tau*), but this does not explain their behaviour as past tenses or their quantificational effects. We conclude that (f) 'experiential' readings are not always (perfect) aspects, but can be past tenses.

Our analysis also bears on (e) the issue of differentiating between perfect aspects and relative tenses, which on some accounts amount to the same thing analytically. Analyzing *taul/-in-* as tenses, we have argued that their obligatory anteriority is best

defined as involving a *relative* past tense: *taul-in-* place the reference time before the evaluation time, which in main clauses is identified with the utterance time, but in embedded clauses corresponds to the event time of the matrix predicate. The fact that—unlike a perfect aspect—*taul-in-* only have the back-shifted reading in embedded clauses but cannot back-shift the event time relative to a clause-mate past or future operator lends empirical cross-linguistic support to the theoretical distinction between perfect aspect and relative tense (see also Bohnemeyer 2014).

10 Future outlook

In this paper, we have focused on the striking similarities in the semantic contributions of Javanese *tau* and Atayal *-in-* across these two only distantly related Austronesian languages. An avenue for future research is to examine more closely the ways in which they differ from each other. We noted that *taul-in-* diverge in their scope readings with respect to negation because of morphosyntactic differences: negation can syntactically scope above or below the auxiliary *tau*, while the infix *-in-* cannot scope over negation. We also noted that Javanese and Atayal may select for different null aspects, given that in addition to perfective readings, Atayal allows habitual and progressive readings with *-in-*, while Javanese only allows habitual readings. Additional differences that merit future research are domain restriction and cessation implicatures. In matrix clauses in Javanese, the closer the domain restriction is to the utterance time, the less likely it is for speakers to accept sentences with *tau*. In other words, *tau* resists domain restriction by temporal adverbials such as *gek ngi* ‘just yesterday’ or *isuk mou* ‘earlier this morning’, while Atayal speakers do not show this with *-in-*. Concerning cessation implicatures, these seem to be more easily cancelled in Javanese than in Atayal, and the nature of these cancellations needs to be better studied.

Another important direction for future research is to explore micro-variation in existential tenses cross-linguistically, given that such tenses across languages do not behave exactly the same. For example, while *tau* and *-in-* possess salient experiential readings, this feature does not seem to be shared by the existential past markers in Japanese (Ogihara 1996; Sharvit 2014), Mbyá (Guaraní) (Thomas 2014), or Medumba (Mucha 2017). Another interesting contrast is that between the existential past markers in Medumba, whose quantificational domain is lexically restricted (Mucha 2017), and *taul-in-*, whose domain is pragmatically conditioned. We also expect that existential tenses may allow different aspectual readings across languages, as shown by the difference between Javanese and Atayal.

Overall, our analysis of *taul-in-* can be extended to a general hypothesis that an ‘experiential’ reading is always the manifestation of an existential temporal operator, which can be either an aspect (as in English) or a tense (as in Atayal and Javanese). Aspect- vs. tense-based experientials differ in ways that are expected in a broadly neo-Reichenbachian framework. Additional specific properties may then depend on a language’s overall inventory of tense/aspect forms; for example, we have argued that the Maximize Presupposition effects and cessation implicatures derive from the pragmatic competition between *taul-in-* and a phonologically null pronominal tense. Further research is needed to test this hypothesis.

Dahl (1985:139–140) identified seven other languages besides Javanese that have morphemes which purportedly express a dominant experiential reading: Indonesian *pernah*, Sundanese *kantos*, Siamese Thai *kheey*, Japanese *koto ga aru*, Mandarin Chinese *guo*, Sotho *ka*, and Itsekiri *re*. Chung (2005, 2012) also identifies the morpheme *-essess* in Korean, which appears to behave similarly in many respects to *tau* and *-in-*. Comparative, in-depth studies of these and other languages will be a good testing ground for our analysis, and may contribute further evidence for a fine-grained theory of cross-linguistic variation in the basic semantic building blocks of tense and aspect.

Lastly, our proposal that the languages possess both an existential and a pronominal tense not only accounts for the apparent optionality of *tau/-in-* without utilizing additional assumptions, but also has implications for the typology of tense systems across languages. This result is directly comparable to the implications of an optional tense analysis in which which languages may possess two pronominal tenses, one of which is only optionally present (Bochnak 2016; Cable 2017). Further research is required to address the issue of what predictions each type of analysis yields and what the ultimate limitations are on the variation among natural language tense systems.

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References

- Abusch, Dorit. 1985. On verbs and time. PhD diss., University of Massachusetts at Amherst.
- Abusch, Dorit. 1988. Sequence of tense, intensionality, and scope. In *West Coast Conference on Formal Linguistics (WCCFL)* 7, ed. Hagit Borer, 1–14.
- Abusch, Dorit. 1997. Sequence of tense and temporal de re. *Linguistics and Philosophy* 20: 1–50.

- Adelaar, K. Alexander. 2005. Malayo-Sumbawan. *Oceanic Linguistics* 44: 357–388.
- Aldridge, Edith. 2004. Ergativity and word order in Austronesian languages. PhD diss., Cornell University.
- Altshuler, Daniel. 2012. Aspectual meaning meets discourse coherence: A look at the Russian imperfective. *Journal of Semantics* 29: 39–108.
- Altshuler, Daniel. 2016. *Events, states and times: An essay on narrative discourse in English*. Berlin: de Gruyter.
- Altshuler, Daniel, and Roger Schwarzschild. 2013. Moment of change, cessation implicatures, and simultaneous readings. In *Sinn und Bedeutung 17*, eds. Emmanuel Chemla, Vincent Homer, and Grégoire Winterstein, 45–62. Paris: ENS.
- Arps, Bernard, Els Bogaerts, Willem van der Molen, Ignatius Supriyanto, and Jan van den Veerdonk, with Betty Litamahuputty. 2000. *Hedendaags Javaans (Contemporary Javanese)*. Leiden: Opleiding Talen en Culturen van Zuidoost-Azie en Oceanie, Universiteit Leiden.
- Asher, Nicholas, and Alex Lascarides. 2003. *Logic of conversation*. Cambridge: Cambridge University Press.
- Bach, Emmon. 1986. The algebra of events. *Linguistics and Philosophy* 9: 5–16.
- Bar-el Leora Anne. 2005. Aspect in Skwxwú7mesh. PhD diss., University of British Columbia.
- Binnick, Robert I. 1991. *Time and the verb: A guide to tense and aspect*. New York: Oxford University Press.
- Blust, Robert. 1999. Subgrouping, circularity and extinction: Some issues in Austronesian comparative linguistics. In *International Conference on Austronesian Linguistics (ICAL) 8*, eds. Elizabeth Zeitzoun and Paul Jen-kuei Li. Vol. 1 of *Symposium Series of the Institute of Linguistics (Preparatory Office)*, *Academia Sinica*, 31–94. Taipei: Academia Sinica.
- Blust, Robert. 2013. *The Austronesian languages*. Canberra: Australian National University.
- Bochnak M. Ryan. 2016. Past time reference in a language with optional tense. *Linguistics and Philosophy* 39: 247–294.
- Bohnemeyer, Jürgen. 2002. *The grammar of time reference in Yukatek Maya*. Munich: Lincom Europa.
- Bohnemeyer, Jürgen. 2009. Temporal anaphora in a tenseless language. In *The expression of time*, eds. Wolfgang Klein and Ping Li, 83–128. Berlin: de Gruyter.
- Bohnemeyer, Jürgen. 2014. Aspect vs. relative tense: The case reopened. *Natural Language Linguistic Theory* 32: 917–954.
- Bohnemeyer, Jürgen. 2015. A practical epistemology for semantic elicitation in the field and elsewhere. In *Methodologies in semantic fieldwork*, eds. Ryan Bochnak and Lisa Matthewson, 13–46. Oxford: Oxford University Press.
- Burton, Strang, and Lisa Matthewson. 2015. Targeted construction storyboards in semantic fieldwork. In *Methodologies in semantic fieldwork*, eds. Ryan Bochnak and Lisa Matthewson, 135–156. Oxford: Oxford University Press.
- Cable, Seth. 2013. Beyond the past, present and future: Towards the semantics of graded tense in Gikuyu. *Natural Language Semantics* 21: 219–276.
- Cable, Seth. 2017. The implicatures of optional past tense in Tlingit and its implications for ‘Discontinuous Past’. *Natural Language and Linguistic Theory* 35: 635–681.
- Chemla, E. 2008. An epistemic step for anti-presuppositions. *Journal of Semantics* 25: 141–173.
- Chen, Sihwei. 2016. Lexical aspect and aspectually-unmarked predicates in Atayal. In *Austronesian Formal Linguistics Association (AFLA) 23*, eds. Hiroki Nomoto, Takuya Miyauchi, and Asako Shiohara, 65–80. Canberra: Asia-Pacific Linguistics.
- Chen, Sihwei. 2017. Bundling perfective and perfect: The Atayal *wal*. In *GLOW in Asia 11*, ed. Michael Yoshitaka Erlewine. Vol. 1, 65–78. MIT Working Papers in Linguistics #84. Cambridge: MIT Working Papers in Linguistics.
- Chen, Sihwei. 2018. Finding semantic building blocks: Temporal and modal interpretation in Atayal. PhD diss., University of British Columbia.
- Chen, Sihwei, and Haowen Jiang. 2020. Ways of talking about the past: *-in-* and *=in* in Bunun. In *Papers from the Austronesian Formal Linguistics Association 25*, eds. Henry Y. Chang and Hui-chuan J. Huang. Vol. 5 of *Journal of the Southeast Asian Linguistics Society Special Publication*, 1–21. Honolulu: University of Hawaii Press.
- Chung, Kyung-Sook. 2005. Space in tense: The interaction of tense, aspect, evidentiality, and speech act in Korean. PhD diss., Simon Fraser University.
- Chung, Kyung-Sook. 2012. *Space in tense: The interaction of tense, aspect, evidentiality and speech acts in Korean*. Amsterdam: Benjamins.

- Cole, Peter, Yurie Hara, and Ngee Thai Yap. 2008. Auxiliary fronting in Peranakan Javanese. *Journal of Linguistics* 44: 1–43.
- Comrie, Bernard. 1976. *Aspect*. Cambridge: Cambridge University Press.
- Comrie, Bernard. 1985. *Tense*. Cambridge: Cambridge University Press.
- Cover, Rebecca T. 2015. Semantic fieldwork on TAM. In *Methodologies in semantic fieldwork*, eds. Ryan Bochnak and Lisa Matthewson, 233–268. Oxford: Oxford University Press.
- Dahl, Östen. 1985. *Tense and aspect systems*. Oxford: Blackwell.
- Deal, Amy-Rose. 2015. Reasoning about equivalence in semantic fieldwork. In *Methodologies in semantic fieldwork*, eds. Ryan Bochnak and Lisa Matthewson. Oxford: Oxford University Press.
- Demirdache, Hamida, and Myriam Uribe-Etxebarria. 1997. The syntax of temporal relations: A uniform approach to tense and aspect. In *West coast conference on formal linguistics (WCCFL)* 16, 145–159. Stanford: CLSI Publications.
- Demirdache, Hamida, and Myriam Uribe-Etxebarria. 2014. Aspect and temporal anaphora. *Natural Language and Linguistic Theory* 32: 855–895.
- Dowty, D. 1979. *Word meaning and Montague Grammar*. Dordrecht: Reidel.
- Egerod, Søren. 1965. Verb inflexion in Atayal. *Lingua* 15: 251–282.
- Egerod, Søren. 1966. Word order and word classes in Atayal. *Language* 42: 346–369.
- Enç, Murvet. 1987. Anchoring conditions for tense. *Linguistic Inquiry* 18: 633–657.
- Errington, Joseph. 1988. *Structure and style in Javanese: A semiotic view of linguistic etiquette*. Philadelphia: University of Pennsylvania Press.
- von Fintel, Kai, and Sabine Iatridou. 2008. How to say 'ought' in Foreign: The composition of weak necessity modals. In *Time and modality*, eds. Jacqueline Guéron and Jacqueline Lecarme, 115–141. Dordrecht: Springer.
- Giorgi, Alessandra, and Fabio Pianesi. 1997. *Tense and aspect: From semantics to morphosyntax*. Oxford studies in comparative syntax. New York: Oxford University Press.
- Gorbulova, Irene. 2015. Perfect and its relatives in Atayal. Trondheim. Paper presented at The Perfect: Variation workshop, Trondheim.
- Greenhill, Simon J., Robert Blust, and R. D. Gray. 2008. The Austronesian basic vocabulary database: From bioinformatics to lexicomics. *Evolutionary Bioinformatics* 4: 271–283. <https://abvd.shh.mpg.de/austronesian/language.php?id=269>. Accessed Proto-Malayo-Polynesian, August 23, 2017.
- Grønn, Atle. 2003. The semantics and pragmatics of the Russian Factual Imperfective. PhD diss., University of Oslo.
- Grønn, Atle, and Arnim von Stechow. 2016. Tense. In *The Cambridge handbook of formal semantics*, eds. Maria Aloni and Paul Dekker, 313–341. Cambridge: Cambridge University Press.
- Hatley, Ron. 1984. Mapping cultural regions of Java. In *Other Javas: Away from the kraton*, eds. Ron Hatley, Jim Schiller, Anton Lucas, and Barbara Martin-Schiller, 1–32. Clayton: Monash University.
- Heim, Irene. 1991. Artikel und definitheit (Articles and definiteness). In *Semantik: Ein internationales handbuch der zeitgenössischen forschung*, eds. Arnim von Stechow and Dieter Wunderlich, 487–535. Berlin: de Gruyter.
- Heim, Irene. 1994. Comments on Abusch's theory of tense. In *Ellipsis, tense and questions*, ed. Hans Kamp, 143–170. Dyana 2 Deliverable.
- Hinrichs, Erhard. 1986. Temporal anaphora in discourses of English. *Linguistics and Philosophy* 9: 63–82.
- Hoogervorst, Tom Gunnar. 2010. *Describing Surabaya's linguistic ecology*, MA thesis, Leiden University.
- Horne, Elinor C. 1961. *Beginning Javanese*. Vol. 3 of *Yale Linguistic Series*. New Haven: Yale University Press.
- Huang, Lillian M. 1993. *A study of Atayal syntax*. Taipei: Crane.
- Huang, Lillian M. 1994. Ergativity in Atayal. *Oceanic Linguistics* 33: 129–143.
- Huang, Lillian M., and Xincheng Wu. (Tali' Hayung). 2016. *Taiyayu yufa gailun [An introduction to Atayal grammar]*, 1st edn. Taipei: Council of Indigenous People.
- Huang, Shuanfan. 2017. Variability and stability in Squliq Atayal syntax. *Journal of Taiwanese Language and Literature* 12: 1–48.
- Iatridou, Sabine. 2000. The grammatical ingredients of counterfactuality. *Linguistics Inquiry* 31: 231–270.
- Iatridou, Sabine, Elena Anagnostopoulou, and Roumyana Izvorski. 2001. Observations about the form and meaning of the perfect. In *Ken Hale: A life in language*, ed. Michael Kenstowicz, 189–238. Cambridge: MIT Press.

- Inoue, K. 1978. How many senses does the present perfect have? In *Chicago Linguistics Society (CLS) 14*, eds. Donka Farkas, Wesley M. Jacobsen, and Karol W. Todrys, 167–178. Chicago: Chicago Linguistic Society.
- Ippolito, Michela. 2003. Presuppositions and implicatures in counterfactuals. *Natural Language Semantics* 11: 145–186.
- Jeng, Heng-hsiung. 1999. Bunun tense and aspect. In *International Conference on Austronesian Linguistics (ICAL) 8*, eds. Elizabeth Zeitoun and Paul Jen-kuei Li. Vol. 1 of *Symposium Series of the Institute of Linguistics (Preparatory Office)*, 455–487. Taipei: Academia Sinica.
- Kamp, Hans, and Uwe Reyle. 1993. *From discourse to logic*. Dordrecht: Kluwer.
- Katz, Graham. 2003. On the stativity of the English perfect. In *Perfect explorations*, eds. Alexiadou Artemis, Monika Rathert, and Armin von Stechow, 205–233. Hague: de Gruyter.
- Kehler, Andrew. 2002. *Coherence, reference and the theory of grammar*. Stanford: Center for the Study of Language and Information.
- Kiparsky, Paul. 2002. Event structure and the perfect. In *The construction of meaning*, eds. David Beaver, Luis Casillas Martínez, Brady Clark, and Stefan Kaufmann, 113–135. Stanford: CSLI Publications.
- Klein, Wolfgang. 1992. The present perfect puzzle. *Language* 68: 525–552.
- Klein, Wolfgang. 1994. *Time in language*. London: Routledge.
- Kratzer, Angelika. 1998. More structural analogies between pronouns and tenses. In *Semantics and Linguistic Theory (SALT) 8*, 92–110.
- Krause, Daniel. 2017. *A description of Surabayan Javanese with special reference to its linguistic etiquette*. MA thesis, Goethe Universität.
- Krifka, Manfred. 1992. Thematic relations as links between nominal reference and temporal constitution. In *Lexical matters*, eds. Ivan Sag and Anna Szabolcsi, 29–53. Stanford: CSLI Publications.
- Krifka, Manfred. 2011. Varieties of semantic evidence. In *Semantics: An international handbook of natural language meaning*, eds. Claudia Maienborn, Klaus von Heusinger, and Paul Portner, 242–267. Berlin: de Gruyter.
- Kubota, Yusuke, Jungmee Lee, Anastasia Smirnova, and Judith Tonhauser. 2009. The cross-linguistic interpretation of embedded tenses. In *Sinn und Bedeutung 13*, 307–320.
- Kusumoto, Kiyomi. 1999. Tense in embedded contexts. PhD diss., University of Massachusetts at Amherst.
- Kusumoto, Kiyomi. 2005. On the quantification over times in natural language. *Natural Language Semantics* 13: 317–357.
- Leech, G. N. 1971. *Meaning and the English verb*. London: Longman Group Ltd.
- Li Paul Jen-kuei. 1985. Linguistic criteria for classifying the Atayalic dialect groups. *Bulletin of the Institute of History and Philology Academia Sinica* 56: 699–718.
- Magri, Giorgio. 2011. Another argument for embedded scalar implicatures, based on oddness in downward entailing environments. *Semantics and Pragmatics* 4: 1–51.
- Matthewson, Lisa. 2004. On the methodology of semantic fieldwork. *International Journal of American Linguistics* 70: 369–415.
- Matthewson, Lisa. 2006. Temporal semantics in a superficially tenseless language. *Linguistics and Philosophy* 29: 673–713.
- Matthewson, Lisa. 2014. Miss Smith's bad day. Totem Fields Storyboards. Available at <http://www.totemfieldstoryboards.org>.
- Matthewson, Lisa, Sihwei Chen, Marianne Huijsmans, Marcin Morzycki, Daniel Reisinger, and Hotze Rullmann. 2019. Restricting the English past tense. *Snippets* 37: 61–64.
- McCawley, James D. 1971. Tense and time reference in English. In *Studies in linguistic semantics*, eds. D. Terence Langendoen and Charles J. Fillmore, 97–113. New York: Holt, Rinehart and Winston.
- McCoard, R. W. 1978. *The English perfect: Tense choice and pragmatic inferences*. Amsterdam: North-Holland.
- Michaelis, Laura. 1994. The ambiguity of the English present perfect. *Journal of Linguistics* 30: 111–158.
- Mittwoch, Anita. 2008. The English resultative perfect and its relationship to the experiential perfect and the simple past tense. *Linguistics and Philosophy* 31: 323–351.
- Moens, Marc, and Mark Steedman. 1988. Temporal ontology and temporal reference. *Computational Linguistics* 14: 15–28.
- Mucha, Anne. 2015. Temporal interpretation and cross-linguistic variation. PhD diss., University of Potsdam.
- Mucha, Anne. 2017. Past interpretation and graded tense in Medumba. *Natural Language Semantics* 25: 1–52.

- Musan, Renate. 1997. Tense, predicates, and lifetime effects. *Natural Language Semantics* 5: 271–301.
- Musan, Renate. 2002. *The German perfect*. Dordrecht: Kluwer.
- Nothofer, Bernd. 1975. The reconstruction of Proto-Malayo-Javanic. In *Verhandelingen van het Koninklijk Instituut voor Taal-, Land-en Volkenkunde (KITLV)*. Vol. 73 of *Treatises from The Royal Netherlands Institute of Southeast Asian and Caribbean Studies (KITLV)*. The Hague: Nijhoff.
- Ogihara, Toshiyuki. 1996. *Tense, attitudes, and scope*. Dordrecht: Kluwer.
- Ogihara, Toshiyuki. 1999. Tense and aspect. In *The handbook of Japanese linguistics*, ed. Natsuko Tsujimura, 326–348. Oxford: Blackwell.
- Ogihara, Toshiyuki. 2006. Tense, adverbials and quantification. In *Crosslinguistic research in syntax and semantics: Negation, tense, and clausal architecture*, eds. Raffaella Zanuttini, Hector Campos, Elena Herburger, and Paul Portner. Washington DC: Georgetown University Press.
- Ogihara, Toshiyuki. 2011. Tense. In *Semantics: An international handbook of natural language meaning*, eds. Claudia Maienborn, Klaus von Stechow, and Paul Portner 1463–1484. Berlin: de Gruyter.
- Pancheva, Roumyana. 2003. The aspectual makeup of perfect participles and the interpretations of the perfect. In *Perfect explorations*, eds. Alexiadou Artemis, Monica Rathert, and Armin von Stechow, 277–306. Berlin: de Gruyter.
- Parsons, Terence. 1990. *Events in the semantics of English: A study of subatomic semantics*. Cambridge: MIT Press.
- Partee, Barbara H. 1973. Some structural analogies between tenses and pronouns in English. *Journal of Philosophy* 18: 601–609.
- Partee, Barbara H. 1984. Nominal and temporal anaphora. *Linguistics and Philosophy* 7: 243–286.
- Percus, Orin. 2006. Antipresuppositions. In *Theoretical and empirical studies of reference and anaphora: Toward the establishment of generative grammar as an empirical science*, ed. Ayumi Ueyama 52–73. Japan Society for the Promotion of Science.
- Plungian, Vladimir A., and Johan van der Auwera. 2006. Towards a typology of discontinuous past marking. *Sprachtypologie und Universalienforschung (STUF)* 59: 317–349.
- Poedjosoedarmo, Soepomo. 1968. Javanese speech levels. *Indonesia (Ithaca)* 6: 54–87.
- Portner, Paul. 2003. The (temporal) semantics and (modal) pragmatics of the perfect. *Linguistics and Philosophy* 26: 459–510.
- Rau Der-Hwa Victoria. 1992. *A grammar of Atayal*. Taipei: The Crane Publishing Co.
- Reichenbach, Hans. 1947. *Elements of symbolic logic*. Berkeley: UC Press.
- Ritter, Elizabeth, and Martina Wiltschko. 2009. Varieties of INFL: TENSE, LOCATION and PERSON. In *Alternatives to cartography*, ed. Jeroen van Craenenbroeck, 153–201. Berlin: de Gruyter.
- Ritter, Elizabeth, and Martina Wiltschko. 2014. The composition of INFL: An exploration of tense, tenseless languages, and tenseless constructions. *Natural Language and Linguistic Theory* 32: 1331–1386.
- Ritz, Marie-Eve. 2012. Perfect tense and aspect. In *The Oxford handbook of tense and aspect*, ed. Robert I. Binnick, 881–912. Oxford: Oxford University Press.
- Roberts, Craige. 2012. Information structure in discourse: Towards an integrated formal theory of pragmatics. *Semantics and Pragmatics* 5: 1–69.
- Robson, Stuart. 2002. *Javanese grammar for students*, 2nd edition. Glen Waverley: Monash Papers on Southeast Asia.
- Robson, Stuart, and Singgih Wibisono. 2002. *Javanese-English dictionary*. Tuttle Publishing: North Clarendon.
- Ross, Malcolm. 1995. Reconstructing Proto Austronesian verbal morphology: Evidence from Taiwan. In *Austronesian studies relating to Taiwan*, eds. Paul Jen-kuei Li Dah-an Ho, Ying-kuei Huang, Cheng-hwa Tsang, and Chiu-yu Tseng, 727–791. Taipei: Institute of History and Philology, Academia Sinica.
- Ross, Malcolm. 2009. Proto Austronesian verbal morphology: A reappraisal. In *Austronesian historical linguistics and culture history: A festschrift for Robert Blust*, eds. Alexander Adelaar and Andrew Pawley, 295–326. Canberra: Australian National University.
- Ross, Malcolm. 2012. In defense of nuclear Austronesian (and against Tsouic). *Language and Linguistics* 13: 1253–1330.
- Rullmann, Hotze, and Lisa Matthewson. 2018. Towards a theory of modal-temporal interaction. *Language* 94: 281–331.
- Sauerland, Uli. 2002. The present tense is vacuous. *Snippets* 6: 12–13.
- Sauerland, Uli. 2008. On the semantic markedness of Phi-features. In *Phi-Features*, eds. Daniel Harbour, David Adger, and Susanna Bajar, 57–82. Oxford: Oxford University Press.

- Schlenker, Philippe. 2012. Maximize presupposition and Gricean reasoning. *Natural Language Semantics* 20: 391–429.
- Sharvit, Yael. 2003. Embedded tense and universal grammar. *Linguistic Inquiry* 34: 669–681.
- Sharvit, Yael. 2014. On the universal principles of tense embedding: The lesson from before. *Journal of Semantics* 31: 263–313.
- Sharvit, Yael. 2017. Sequence of tense: Syntax, semantics, pragmatics. In *Pronouns in embedded contexts at the syntax-semantics interface*, eds. Prityy Patel-Grosz, Patrick Grosz, and Sarah Zobel. Vol. 99 of *Studies in linguistics and philosophy*, 215–247. Dordrecht: Springer.
- Singh, Raj. 2011. Maximize presupposition! and local contexts. *Natural Language Semantics* 19: 149–168.
- Smith, Carlota. 1997. *The parameter of aspect*, 2nd edn. Dordrecht: Kluwer Academic Press.
- Sneddon, James N. 2003. *The Indonesian language: Its history and role in modern society*. Sydney: UNSW Press.
- Starosta, Stanley, Andrew K. Pawley, and Lawrence A. Reid. 1982. The evolution of focus in Austronesian. In *International Conference on Austronesian Linguistics (ICAL)* 3, eds. Amram Halim, Lois Carrington, and S. A. Wurm, 145–170. Pacific Linguistics, C-75.
- Stojnić, Una. 2016. Context-sensitivity in a coherent discourse. PhD diss., Rutgers University.
- Stone, Matthew. 1997. *The anaphoric parallel between modality and tense*, IRCS Report 97–06, University of Pennsylvania.
- Stowell, Tim. 1995. The phrase structure of tense. In *Phrase structure and the lexicon*, eds. Johan Rooryck and Laurie Zaring, 277–291. Dordrecht: Kluwer.
- TFS Working Group. 2011. On the Lam. Totem Field Storyboards. Retrieved from <http://www.totemfieldstoryboards.org>, June 9, 2018.
- Sudaryanto. 1991. *Tata bahasa baku bahasa jawa [Standard Javanese Grammar]*. Yogyakarta: Duta Wacana University Press.
- Thomas, Guillaume. 2012. Temporal implicatures. PhD diss., MIT.
- Thomas, Guillaume. 2014. Nominal tense and temporal implicatures: Evidence from Mbyá. *Natural Language Semantics* 22: 357–412.
- Tonhauser, Judith. 2007. Nominal tense? The meaning of Guaraní nominal temporal markers. *Language* 83: 831–869.
- Tonhauser, Judith. 2011. Temporal reference in Paraguayan Guaraní, a tenseless language. *Linguistics and Philosophy* 34: 257–303.
- Tonhauser, Judith. 2015. Cross-linguistic temporal reference. *Annual Review of Linguistics* 1: 129–154.
- von Stechow, A. 2009. Tenses in compositional semantics. In *The expression of time*, eds. Wolfgang Klein and Ping Li, 129–166. Berlin: de Gruyter.
- von Stechow, Armin, and Atle Grønn. 2013. Tense in adjuncts part 2: Temporal adverbial clauses. *Language and Linguistics Compass* 7: 311–327.
- Vander Klok, Jozina. 2012. Tense, aspect, and modality in Paciran Javanese. PhD diss., McGill University.
- Vander Klok, Jozina, and Lisa Matthewson. 2015. Distinguishing *already* from perfect aspect: A case study of Javanese *wis*. *Oceanic Linguistics* 54: 172–205.
- Wedhawati, Nurlina, Wiwin Erni Siti Setiyanto, Edi Marsono, Sukesti Restu, and Baryadi I. Praptomo. 2006. *Tata Bahasa Jawa Mutakhir (Current Javanese grammar)*. Yogyakarta: Penerbit Kanisius.
- Yeh Maya Yu-ting. 2013. Event conceptualization and verb classification in Sqliq Atayal. PhD diss., National Taiwan University.
- Zeitoun, Elizabeth, Lillian M. Huang, Marie M. Yeh, Anna H. Chang, and Joy J. Wu. 1996. The temporal, aspectual, and modal systems of some Formosan languages: a typological perspective. *Oceanic Linguistics* 35: 21–56.