

Processing past time reference is harder than future time reference: Evidence from Paiwan, a mood-prominent language

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The temporal reference of a sentence (i.e., whether the situation described in the sentence is understood as holding in the past, present or future time) can be grammatically expressed with tense (grammatical localization of time; *past*, *present*, *future*), aspect (viewpoint of a temporal structure of a situation; *(im)perfective*, *perfect*), or mood marking (reality status of the event; *realis*, *irrealis*). This marking also exhibits crosslinguistic differences: tense, aspect and mood are not grammaticalized to the same degree in all the languages [1]. Additionally, deictic time adverbs (e.g., *yesterday*, *tomorrow*) can also be used to specify the temporal reference of the sentence.

The processing of temporal reference has been the topic of numerous studies in the past years, focusing on tense-prominent languages (Dutch [2], Italian [3]) or aspect-prominent languages (Mandarin Chinese [4]). The results have been generalized under the Past Discourse Linking Hypothesis (PADILIH [5]), stating that processing the temporal violation of a past-time related morpheme (e.g., a past tense or morpheme after a future time adverb, as in **Tomorrow, John painted a house.*) is harder than processing the temporal violation of a non-past time related morpheme (e.g., a present tense morpheme after a past time adverb, as in **Yesterday, John paints a house.*). However, the PADILIH has only been tested with tense-prominent and aspect-prominent languages so far, and despite the claim that it is crosslinguistically valid, it has not been tested with mood-prominent languages. Different hypotheses can be stated regarding the processing of the temporal reference involving *realis* and *irrealis* morphemes:

- (i) In line with the PADILIH, it can be hypothesized that a *realis* morpheme placed after a future time adverb is harder to process than an *irrealis* morpheme after a past time adverb;
- (ii) In contrast, the temporal violation of a *realis* or *irrealis* morpheme can be seen as the same type of violation, i.e., the integration of contradictory information from the possible world perspective. Therefore, processing the temporal violation of *realis* and *irrealis* marking would be equally hard.

The present study aims to test these hypotheses with Paiwan, a mood-prominent Formosan language. *Realis* mood is expressed with the preverbal clitic *na=* (which is marked for perfective aspect), and *irrealis* mood with *uri=* [6]. Crucially, *na=* is grammatical after a past time adverb, but ungrammatical after a future time adverb. The opposite holds for *uri=* (see Table 1). Hence, Paiwan is suitable to test the PADILIH with a mood-prominent language.

Eighteen native speakers of Paiwan (9 female, age = 60 ± 12 y.o.) took part in the experiment and were asked to judge the acceptability of the sentences in Table 1 (binary response). The acceptability results confirmed that *na=* is grammatical after a past time adverb but not after a future time adverb, and vice-versa for *uri=* (Figure 1, Panel A). However, the accuracy results showed a discrepancy between *na=* and *uri=*: *na=* in an ungrammatical context was less accurately judged when compared with its grammatical counterpart; no such difference was found for *uri=* (Figure 1, Panel B). The reaction time results also exhibit a similar pattern: judging the ungrammatical *na=* required more time (Figure 1, Panel C; results statistically verified with generalized and linear mixed-effect models (following [7]'s advices)).

Overall, the results support the claim made by the PADILIH that processing past time reference is harder than non-past time reference, even with *realis/irrealis* distinctions in mood-prominent languages. Furthermore, the fact that *na=* also encodes a perfective meaning may have required additional processing efforts, e.g., it may have induced a 'sequencing' processing. This interplay with verbal forms/morphemes encoding perfective aspect may have been involved in previous studies too (e.g., in Dutch [2] and Mandarin [4]), suggesting that processing past time reference is harder than non-past time reference when perfective aspect comes into play.

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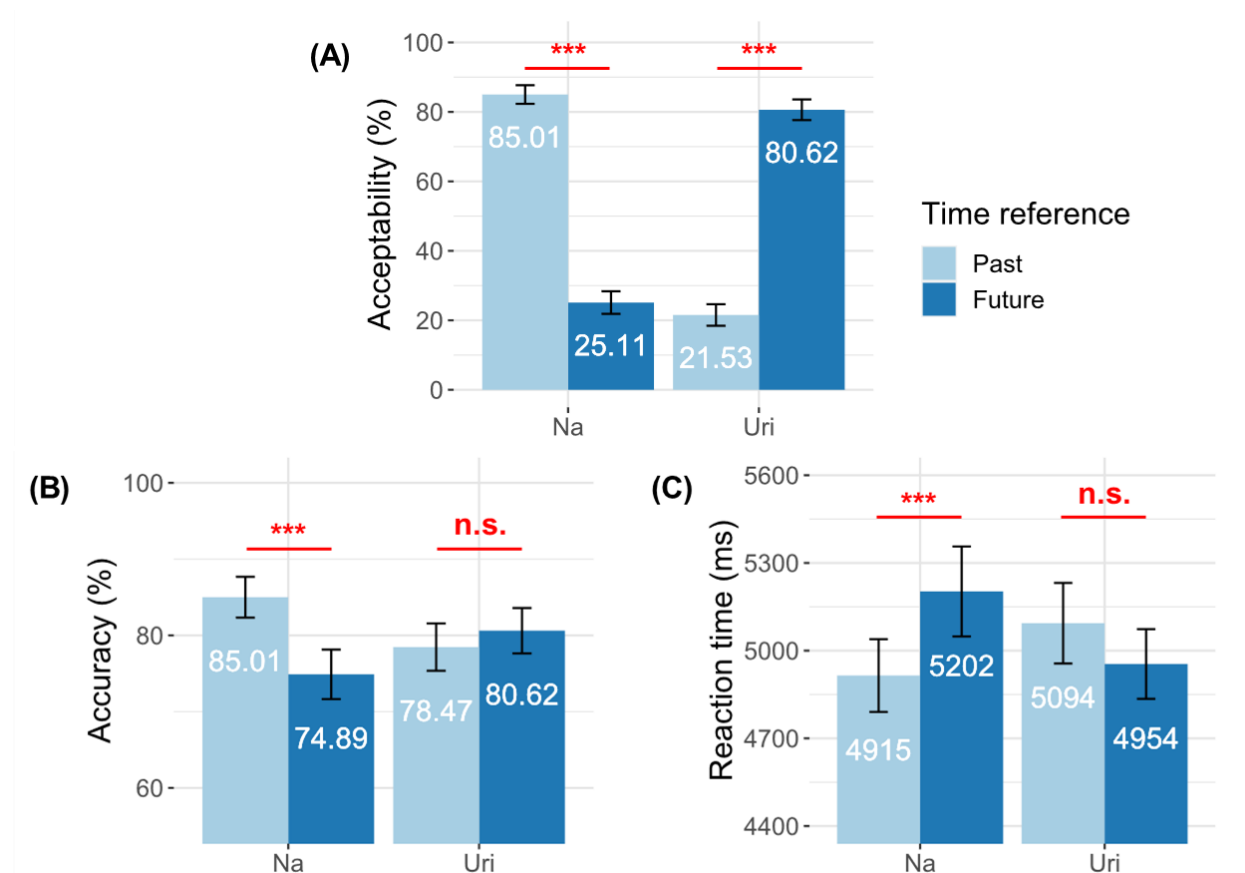


Figure 1. Panel A: Mean acceptability rate (in %); Panel B: mean accuracy rate (in %); Panel C: mean reaction time (in ms). The 95% confidence interval is represented with the error bars. (‘***’ = $p < .0001$; ‘n.s.’ = ‘not significant’)

Table 1. Sample items from the experiment (total number of 152 items; 38 items per condition dispatched in four lists). The experimental materials have been controlled for their naturalness, the aspectual category of the verb (non-stative verbs), and the agency of the subject

Conditions	Sentence examples					
(1) <i>na</i> -conditions	katiaw	<i>na=kan</i>	a	kakedrian	tua	vurasi.
	yesterday	NA=<AV>eat	NOM	child	OBL	sweet.potato
	'Yesterday, the child ate sweet potatoes.'					
	*nutiaw	<i>na=kan</i>	a	kakedrian	tua	vurasi.
	tomorrow	NA=<AV>eat	NOM	child	OBL	sweet.potato
	**'Tomorrow, the child ate sweet potatoes.'					
(2) <i>uri</i> -conditions	*katiaw	<i>uri=kan</i>	a	kakedrian	tua	vurasi.
	yesterday	URI=<AV>eat	NOM	child	OBL	sweet.potato
	**'Yesterday, the child will eat sweet potatoes.'					
	nutiaw	<i>uri=kan</i>	a	kakedrian	tua	vurasi.
	tomorrow	URI=<AV>eat	NOM	child	OBL	sweet.potato
	'Tomorrow, the child will eat sweet potatoes.'					

** = 'ungrammatical sentence'; 'AV' = 'actor voice'; 'NOM' = 'nominative case'; 'OBL' = 'oblique case'

Table 2. Paiwan verbal morphology (based on Huang (2012) and Huang (to appear))

			AV	UV		
				UVP	UVL	UVC
Indicative	Realis	Neutral		-en	-an	si-
		Imperfective	 + RED	-en + RED	-an + RED	si- + RED
		Perfective	na=	<in>	<in>-an	s<in>i-
	Irrealis		uri=	ki + -en	ki + -an	ki + si-
Non-indicative		Imperative	-u	-u	-i	-an
		Hortative	-i	—	—	—
		Optative	—	-aw	-ay	si-...-an
		Dependent	Ø	-i	-i	-an

'UV' = 'undergoer voice'; 'UVP' = 'undergoer voice – patient'; 'UVL' = 'undergoer voice – locative'; 'UVC' = 'undergoer voice – circumstantial'; 'RED' = 'reduplication'; '<>' indicates infixation; '-' indicates affixation (prefix or suffix); '=' indicates