

Tongan

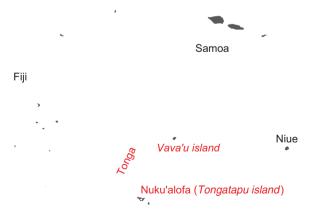
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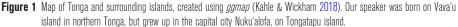
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Tongan (lea fakatonga, ISO 639-3 code ton) is a Polynesian language spoken mainly in Tonga, where it is one of two official languages (with English). There are about 104,000 speakers of the language in Tonga, with nearly 80,000 additional speakers elsewhere (Simons & Fennig 2017). It is most closely related to Niuean, and more distantly related to West Polynesian languages (such as Tokelauan and Samoan) and East Polynesian languages (such as Hawaiian, Māori, and Tahitian). Previous work on the phonetics and phonology of Tongan includes a general grammar (Churchward 1953), a dissertation with a grammatical overview (Taumoefolau 1998), a phonological sketch of the language (Feldman 1978), two dictionaries (Churchward 1959, Tu'inukuafe 1992), journal and working papers on stress (Taumoefolau 2002, Garellek & White 2015), intonation (Kuo & Vicenik 2012), as well as the 'definitive accent' (discussed below) and the phonological status of identical vowel sequences (Poser 1985; Condax 1989; Schütz 2001; Anderson & Otsuka 2003, 2006; Garellek & White 2010; Ahn 2016; Zuraw 2018). This illustration is meant to provide an overview of the phonetic structures of the language, and includes novel acoustic data on its three-way word-initial laryngeal contrasts, which are cross-linguistically rare. The recordings accompanying this illustration come from Veiongo Hehepoto, a native speaker of Tongan currently living in Melbourne, Australia. Ms. Veiongo was born in 1950 on the island of Vava'u (northern Tonga), but grew up and was educated in the capital city Nuku'alofa on Tongatapu (see Figure 1). She moved to Vanuatu when she was 16 years old, and when she was 21 moved to Australia where she trained as a nurse. She continues to speak Tongan every day with family members (including children, who were born in Australia) and friends.





ILLUSTRATIONS OF THE IPA

Consonants

	Bilabial	Labio- dental	Dento- alveolar	Velar	Glottal
Plosive	р		t	k	?
Nasal	m		n	ŋ	
Fricative		f v	S		h
Lateral approximant			1		

Examples of the consonants are shown below in both word-initial and word-medial positions, with both broad phonemic transcriptions and their orthographic representations. Consonants do not appear word-finally. Due to a sound change $*t \rightarrow /s/$ before /i/ (Morton 1962), sequences of /ti/ are rare and are restricted to loanwords.

Consonants in word-initial position

	IPA	Orthography	GLOSS
р	'paa	pā	'explode'
t	'taa	tā	'hit, strike'
k	'kaa	kā	'clear one's throat'
?	'?aa	ʿā	'fence'
f	'faa	fā	'four'
V	'vaa	vā	'space between'
S	'saa	sā	'rafter'
h	'haa	hā	'appear'
m	'maa	mā	'be ashamed'
n	'naa	nā	'be respectful'
ŋ	'ŋaa	ngā	'pant hard'
1	'laa	lā	'sail'

Consonants in word-initial and word-medial positions

	IPA	Orthography	GLOSS
р	'papa	papa	'rough mat, wood'
t	'tata	tata	'scoop out'
k	'kaka	kaka	'climb up'
?	,?aa'?aa	ʻā ʻā	'vigilant'
f	feelfee	fēfē	'surrender, defeated'
v	iveve	veve	'waste, rubbish'
S	si'sii	sisī	'silent'
h	'haha	haha	'lash, beat, thrash'
m	'mama	тата	'link, ring, slug'
n	'nunu	пипи	'flock to in large numbers'
ŋ	, <mark>դսս'</mark> դսս	ngūngū	'crunch, tumour'
ĺ	lulu	lulu	'shake, play dice'

Feldman (1978) describes /t n/ as apico-dental, /l/ as an apico-alveolar lateral (flap), and /s/ as lamino-alveolar. In intervocalic position, /k/ sometimes spirantizes to [x] or [y]; compare [k] vs. [y] in two tokens of /fakaaoao?i/ *fakaaoao*'i 'act like a despot'. This process

appears to be optional, and is also attested in neighbouring Niuean (Brown & Tukuitonga 2018).

Tongan has a three-way laryngeal contrast in initial position; words may begin with /2/, /h/, or a vowel. This is a rare contrast across languages; it is attested in other Malayo-Polynesian languages, and is also said to be marginal in some Mayan languages (see discussion in Garellek 2013: 9–10). At the beginning of utterances, Tongan vowel-initial words may begin with weak voicing and slight breathiness.

Three-way laryngeal contrasts utterance-initially

	IPA	Orthography	GLOSS
?	'?aa	ʿā	'fence'
h	'haa	hā	'appear'
ø	'aa	ā	'heat sticks over fire'
?	'?ia	ʻia	'with'
h	'hia	hia	'crime, sin'
ø	'ia	ia	'she, he, it'
?	'?ena	'ena	'their'
h	'hena	hena	'over there'
ø	'ena	ena	'withdraw oneself'
?	'?ono	'ono	'barracuda'
h	'hono	hono	'her, his, its'
ø	ono	ono	'six'
?	'?ulu	ʻulu	'ruling body, headquarters'
h	'hulu	hulu	'vast'
Ø	'ulu	ulu	'shine, glow of sun or moon'

Three-way laryngeal contrasts word-medially

	IPA	Orthography	GLOSS
?	'ma?a	maʻa	'be clean'
h	'maha	maha	'be empty'
ø	'maa	mā	'be ashamed'
?	pi'i?i	pii'i	'slosh'
h	^ī pihi	pihi	'splash, squirt, spurt'
ø	'pii	$\overline{p}\overline{l}$	'wasp, hornet'
?	'he?e	he'e	'grasshopper, locust, cicada'
h	pe'he?i	pehe'i	'like this'
ø	hee	hē	'stray'
?	'to?o	toʻo	'remove, take, carry'
h	'toho	toho	'drag, draw, pull'
ø	'too	tō	'sugarcane, plant'
?	'hu?u	hu'u	'head somewhere'
h	'huhu	huhu	'suck, sting'
Ø	'huu	$har{u}$	'enter, penetrate'

We analysed the voice quality of vowels adjacent to the three-way laryngeal contrast in both utterance-initial and word-medial positions. For utterance-initial tokens, we segmented the initial vowel, ignoring the preceding consonant if present. For word-medial tokens, we segmented the entire V(C)V sequence. We then used VoiceSauce (Shue et al. 2011) to measure H1*–H2*, Cepstral Peak Prominence (CPP), and f0 over the segmented intervals. H1*–H2* is the difference in amplitude between the first and second harmonics, corrected for the effects of formants. Higher values index a voice quality with greater vocal fold spreading,

i.e. a breathier or less creaky voice quality. CPP is a harmonics-to-noise ratio measure; lower values index a noisier voice quality, i.e. a breathy quality with more aspiration noise, or a creaky quality with less periodic voicing. Therefore, breathier vowels should have a higher H1*–H2* and lower CPP (relative to a more modal vowel), whereas creakier vowels should have both a lower H1*–H2* and CPP relative to a more modal vowel (Gordon & Ladefoged 2001, Garellek & White 2015).

The time courses of f0, H1*–H2*, and CPP for utterance-initial vowels are plotted in the top panels of Figure 2. As expected, vowels following initial /?/ have lower H1*–H2* (but comparable CPP) compared with vowels following initial /h/. The H1*–H2* difference remains for most of the vowel's duration. CPP rises towards the middle of the vowel (regardless of initial stop), because this portion of the vowel is most periodic (see also Garellek 2012). CPP remains lower for vowels after /?/ than those following /h/, suggesting that the effect of /?/ on adjacent vowels is longer lasting than the effect of /h/. Vowels following /?/ also begin with a lower f0 than vowels following /h/, likely due to the presence of creaky voice for the former. Creaky voice tends to trigger a lower and less regular f0 on adjacent vowels (Gordon & Ladefoged 2001, Keating, Garellek & Kreiman 2015). The f0 difference between vowels following /?/ vs. /h/ disappears about one-third of the way through the vowel.

As mentioned above, utterance-initial vowels not preceded by a consonant are generally breathy. This is shown for H1*–H2* and CPP in the top panels of Figure 2: vowels not preceded by a consonant have comparably high values of H1*–H2* and low values of CPP as vowels following /h/. In fact the low CPP remains for the first half of the vowel, indicating that the breathiness for vowels not preceded by a consonant have a much lower f0 (by about 30–40 Hz) than vowels following both /h/ and /?/; whereas the lower f0 of vowels following /?/ lasts for about a third of the vowel's duration, the lower f0 of vowels not preceded by a

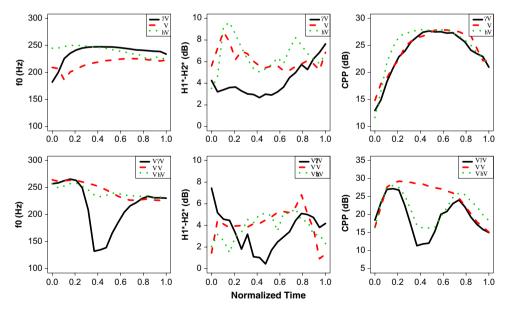
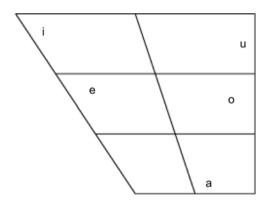


Figure 2 Time courses of f0, H1*-H2*, and CPP for the three-way laryngeal contrast in utterance-initial (top) and word-medial (bottom) positions. The x-axis represents mean normalized time. For utterance-initial tokens (top), the time course represents the duration of the initial vowel only for word-medial tokens (bottom), the time course represents the duration of the V(C)V sequence.

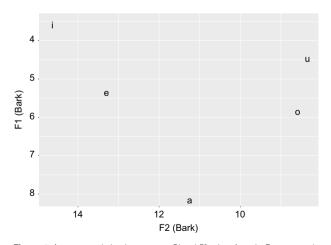
consonant lasts for most of the vowel's duration. Because breathy voice often co-occurs with lower or falling pitch in languages of the world (Gordon & Ladefoged 2001), we believe that this f0 lowering is due to the breathy implementation of onsetless vowels.

The time courses of f0, H1*–H2*, and CPP for word-medial V(C)V sequences are plotted in the bottom panels of Figure 2. As expected, /V?V/ sequences show a dip in H1*–H2*, CPP, and f0 centred around halfway through the sequence, where creaky voice is strongest. /VhV/ sequences also show a dip in CPP (due to aspiration noise) but only a small rise in H1*–H2* (perhaps because the strong voiced frication of intervocalic /h/ interacts acoustically with the voice source). In contrast, /VV/ sequences with no intervening laryngeal consonant show high and more stable H1*–H2* and CPP values, indicating that these sequences are more modal in their production than either /V?V/ or /VhV/ sequences.

Vowels



Tongan contrasts five vowels, /i e a o u/. Figure 3 shows the mean F1 and F2 values for vowels produced by our speaker (see also data for four female speakers in Garellek & White 2015).





	IPA	Orthography	GLOSS
i	'ifi	ifi	'blow'
e	'efi	efi	'crowded'
а	'afi	afi	'fire'
0	'ofi	ofi	'be near'
u	'ufi	ufi	'be modest'

Vowels in word-initial position

Vowels in word-final position

	IPA	Orthography	GLOSS
i	'afi	afi	'fire'
e	'afe	afe	'burn'
a	'afa	afa	'resemble'
0	'afo	afo	'cord'
u	'afu	afu	'fine mist, spray'

Word-final unstressed vowels, especially the high vowels /i u/, can undergo devoicing, especially when they occur phrase-finally (Morton 1962, Feldman 1978). Final unstressed /i/ can also be elided completely; in the story, there are tokens of /mataŋi toŋaa/ *matangi Tongá* 'the South Wind' that are realized as [ma'taŋ] (see phonetic transcription below). Long homorganic vowel sequences are usually analysed as being sequences of identical vowels (Taumoefolau 1998, 2002; Anderson & Otsuka 2006; Garellek & White 2015; see also discussion in Zuraw 2018). Sequences of non-identical vowels are likewise considered not to be diphthongs (Taumoefolau 1998, 2002; Anderson & Otsuka 2006) though it has been observed that some sequences – especially those ending in a higher vowel – may sometimes be realized as diphthongs (Churchward 1953, Feldman 1978, Poser 1985, Schütz 2001); Garellek & White (2010) find some acoustic evidence for this claim. We discuss this in more detail in the 'Stress' section below.

Vowel sequences

As with other Polynesian languages, words in Tongan may have sequences of many vowels. Sequences of all vowels are permitted, and sequences of up to seven vowels are attested (Morton 1962: 21). Examples of up to six vowel sequences are shown below.

	IPA	ORTHOGRAPHY	GLOSS
aa	'faa	fā	'four'
ee	'fee	fē	'which?'
ii	'fii	fī	ʻplait, braid'
00	foo	fō	'wash'
uu	'fuu	fū	'clap hands'
ae	'kae	kae	'but'
ai	'kai	kai	'eat'
ao	'kao	Kao	'name of volcano'
au	'kau	kau	'belong, pertain'
ea	'lea	lea	'speak'
ei	'mei	mei	'from'
eo	'feo	feo	'coral'
eu	'keu	keu	'that I may'

ia	'ia	ia	'him, her, it'
ie	'fie	fie	'want'
io	'?io	'io	'yes'
ou	'mou	тои	'you (plural)'
ua	'ua	иа	'two'
ue	u'e?i	ue'i	'move, cause to move'
ui	'ui	ui	'call'
uo	'luo	luo	'pit, trench'
			-

aoao	ao'ao	aoao	'build round and round'
ouau	ou'au	ouau	'rite, ordinance'
auau	aua'uni	auauni	'consist of several folds'
aaue	naau'e?i	ngāueʻi	'utilise'
ooua	loo'ua	lōua	'double, two-fold'
iauee	iau'ee	iauē	'(expression of surprise)'
aaoao	fakaao'ao	fakaaoao	'act like a despot'
uoouoo	u _l oou'oo	นอินอิ	'be crowded, happy'
eoooa	fe ₁ 0000'aki	feōōaki	'go back and forth'
oiauee	?oiau'ee	<i>'oiauē</i>	ʻalas'

Stress

Garellek & White (2015) found that phrase-medial vowels with primary stress have higher f0, higher F1, longer duration, higher energy, and more periodic voice quality relative to unstressed vowels. (However, final stressed vowels at the end of an intonational phrase often have a low pitch accent, as discussed below.) All stressed vowels (even high ones) show a higher F1 than unstressed vowels, suggesting that stressed vowels are lowered in the vowel space due to sonority expansion. But as the authors mention (Garellek & White 2015: 29–30), some of these correlates may belong to POST-LEXICAL (accentual) prominence, rather than to primary LEXICAL stress. Vowels with secondary stress (and no pitch accent) are marked by higher f0 and energy, but shorter duration than unstressed vowels.

Primary stress in Tongan almost always falls on the penultimate mora of a phonological word (or 'stress group', see Taumoefolau 1998), which may include a content word plus clitics, and affixes. For instance, the present tense marker '*oku* may have stress on either syllable, depending on the number of syllables in the following verb (plus enclitics): compare from the story [(,?oku)('?alu)] '*oku 'alu* 'goes' vs. [?o(,kune)('tui)] '*oku ne tui* 'wearing-3SG'. Secondary stress placement depends on morphology (Feldman 1978) and can be variable for loanwords (Zuraw, O'Flynn & Ward 2010).

One common process that interacts with stress in the language is the 'definitive accent', which marks definiteness, specificity, or uniqueness (Churchward 1953; Clark 1974; Feldman 1978; Condax 1989; Schütz 2001; Anderson & Otsuka 2003, 2006; Ahn 2016). The definitive accent involves the addition of a mora (whose quality is a copy of the phrase's final vowel) to the end of the relevant phrase, which induces a leftward stress shift; compare two tokens of *tangata* 'man', *kote* 'coat', and *puhi* 'blow' from the story: [ha ta'ŋata] *ha tangata* 'a man' vs. [he taŋa'taa] *he tangatá* 'the man-DEF.ACC'; [ha 'kote] *ha kote* 'a coat' vs. [hono ko'tee] *hono koté* 'his coat-DEF.ACC'; [ne 'puhi] *ne puhi* '(he) blew' vs. [,'Pe ne pu'hii] '*e ne puhi* '(the more strongly) he blew-DEF.ACC'. (Orthographically, the definitive accent can be marked unambiguously by an acute accent, but may also be marked with a macron, just like unaccented sequences of identical vowels where the first vowel is stressed. Sometimes the definitive accent is orthographically unmarked.)

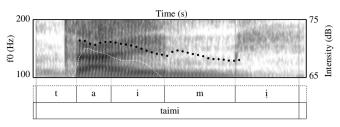


Figure 4 Spectrogram of *taimi* 'time' from the passage. The black speckled line is the f0 track, and the white dashed line is the intensity track. Note that the f0 and intensity peaks occur on the antepenultimate vowel.

As mentioned earlier, adjacent vowels are typically treated as sequences rather than long vowels (if homorganic) or diphthongs (if heterorganic). However, in cases of falling diphthongs like /ai au ao/, there is some evidence that stress can shift leftward to the highersonority vowel, even if antepenultimate. One example of this in the story is for the word ['taimi] *taimi* 'time', which is an English loanword. That word has a higher f0 and intensity on the [a], even though stress should ordinarily be expected to fall on the penult [i] (Figure 4). In fact, Feldman (1978: 136) assumes that the word *taimi* 'time' always has antepenultimate stress, presumably because of the word's stress pattern in English. We note that this example is problematic, given its status as a loanword. However, Garellek & White (2010) show that native Tongan words with falling vowel sequences also exhibit acoustic correlates of diphthongization and stress shift. Unfortunately, no such native Tongan words were elicited explicitly or were present in the passage.

Intonation

The intonation of Tongan has recently been analysed (Kuo & Vicenik 2012) within the autosegmental-metrical framework (Ladd 2008). The authors find evidence for two tonally marked levels of phrasing in Tongan: the intonational phrase (IP) and the accentual phrase (AP). The IP corresponds roughly to a full utterance or major phrase, and is marked at its right edge by a boundary tone (a high tone, an upstepped high tone, a low tone, or a rising tone). The AP usually contains one lexical word plus preceding function words, and ends with an AP edge tone (a high tone or a low tone). The head of the AP is the vowel bearing primary stress, which is marked by a pitch accent, usually a rise or (in the case of the final pitch accent in a declarative sentence) a low/falling target (see Figure 5). According to Kuo & Vicenik (2012), focus is realized intonationally via increased pitch range on the focused constituent.

As in other Polynesian languages, Tongan allows for very long lexical items with over 10 vowels, such as /fefakavaha?apule?aŋa?aki/ *fefakavaha'apule'anga'aki* 'to vie with each other as nations' and /ŋaauetootooivimaalohi?aki/ *ngāuetōtōivimālohi 'aki* 'to use zealously and industriously'. In such cases, a word may or may not be broken up into multiple APs,

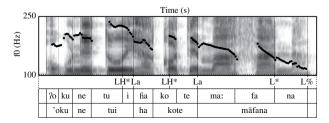


Figure 5 An f0 track of the phrase 'oku ne tui ha kote māfana 'wearing a warm coat' from the story, with intonational annotations based on the model proposed by Kuo & Vicenik (2012).

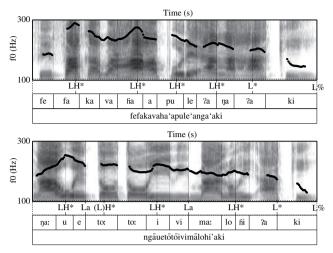


Figure 6 An f0 track of the *fefakavaha' apule' anga' aki* 'to vie with each other as nations' with only one AP (shown in the top panel), and a token of *ngāuetōtōivimālohi aki* 'to use zealously and industriously', with three APs posited, based on the model proposed by Kuo & Vicenik (2012). The presence of an AP is determined primarily by the percept of lengthening, as well as an AP-final phrase accent.

which are cued by final phrase accents and AP-final lengthening. Compare one token of *fefakavaha'apule'anga'aki* 'to vie with each other as nations', with only one AP (shown in the top panel of Figure 6), and a token of *ngāuetōtōivimālohi 'aki* 'to use zealously and industriously' with three APs (bottom panel of Figure 6). The first word is marked as having one AP because no word-medial lengthening is perceived, and because there is no evidence of pitch targets other than the pitch accents associated with stressed syllables and the IP-final boundary tone. The second word has clear AP-final lengthening associated with the right edge of both word-medial APs. Vowels with secondary stress may also receive pitch accents; for example, all syllables with secondary stress in the word [fe₁fakava₁faa₁pule₁?aŋa^l?aki] *fefakavaha'apule'anga'aki* 'to vie with each other as nations' bear a pitch accent.

Transcription of recorded passage

Broad phonemic transcription

matani tonaa mo e la?aa

ne alea ?a e mataŋi toŋaa pea mo e la?aa pe ko hai ?oku maalohi tahaa, lolotoŋa ena aleaa ?oku ?alu hake ha taŋata ?oku ne tui ha kote maafana. na?a na felotoi ko ia ko ee te ne fai ha me?a ke vete ai ?e he taŋataa hono kotee ko e maalohi tahaa ia. ne puhi ?e he mataŋi toŋaa ?aki hono maalohi tahaa, ko e maalohi aŋe ?e ne puhii, ko e to e maalohi aŋe ia hono takatakai ?e he taŋataa ?a hono kotee, faifai pea fakafisi ?a e mataŋi toŋaa. pea ulo maafana ?a e la?aa, ?ikai hano taimi, kuo vete ?e he taŋataa hono kotee. ne tukulolo leva ?a e mataŋi toŋaa ?o ne tala ko e la?aa ?a e maalohi tahaa ia na uaa

Phonetic transcription

ma'taŋ to'ŋa: mo ĕ la'a:

,ne a'lea ,a ma'taŋ to'ŋa: | pea ,mo e la'a: || pe ko 'hai ,og ,ma:'loi ta'ha: || ,lolo'toŋa ĕ,na ale'a: || ,okŭ 'alu 'hakĕ a ta'ŋata || ?o,ku ne 'tui ha 'kote ,ma:'fana || na'a na ,felo'toi || ko 'ia ko 'e: | te ne 'fai fia 'mea || ke 'vete 'ai \notin e 'taŋa'ta: | 'fiono ko'te: || ko ĕ 'ma:'loi tă'fia: ia || ne 'pufii e e ma'taŋi to'ŋa: || '?aki 'hono 'ma:'loi ta'fia: || ko ĕ 'ma:'lofii 'aŋe | \notin ne pu'fii: || kŏ e to e 'ma:'loi 'aŋe 'ia | 'hono 'taɣata'kai e: 'taŋa'ta: || # 'fiono ko'te: || 'fai'fai 'peă 'faɣa'fisĭ a ĕ ma'taŋ to'ŋa: || 'p#a 'ulo 'ma:'fana 'a ĕ la'#: || ?i'kai 'ano 'taimi || 'kuŏ 'vete fie 'taŋa'ta: 'fiono ko'te: || ne 'tuɣu'lolo 'leva | # ma'taŋ to'ŋa: || '?o ne 'tala || ko ĕ la'?a: | '?a ĕ 'ma:'loi 'tafia: '#a na u'a: ||

Orthographic version

Matangi Tongá mo e La'á

Ne alea 'a e Matangi Tongá pea mo e La'á pe ko hai 'oku mālohi tahá, lolotonga ena aleá 'oku 'alu hake ha tangata 'oku ne tui ha kote māfana. Na'a na felotoi ko ia ko ē te ne fai ha me'a ke vete ai 'e he tangatá hono koté ko e mālohi tahá ia. Ne puhi 'e he Matangi Tongá 'aki hono mālohi tahá, ko e mālohi ange 'e ne puhí, ko e to e mālohi ange ia hono takatakai 'e he tangatá 'a hono koté, faifai pea fakafisi 'a e Matangi Tongá. Pea ulo māfana 'a e La'á, 'ikai hano taimi, kuo vete 'e he tangatá hono koté. Ne tukulolo leva 'a e Matangi Tongá 'o ne tala ko e La'á 'a e mālohi tahá ia na uá.

English translation

The South Wind and the Sun

The South Wind and the Sun were discussing who was strongest, when a man walked past wearing a warm coat. They agreed that whoever would get the man to take off his coat would be considered the strongest. The South Wind blew with all his strength, but the stronger he blew, the more tightly the man wrapped his coat around himself. Eventually the South Wind gave up. Then the Sun shone strongly on the man, and this time the man took off his coat. The South Wind immediately was forced to admit that the Sun was the stronger of the two.

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Supplementary material

To view supplementary material for this article, please visit https://doi.org/10.1017/S0025100 318000397.

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