



# **Indonesian Stress, What We Know and What We Don't: A Systematic Review**

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*Abstract*

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The present study reviews the current body of research on Indonesian stress assignment, as current findings on Indonesian are not in agreement on where stress might land, or whether it is at all present. Through systematically analysing and synthesising the current body of research, this review aims to provide a state-of-the-art account on what is known of Indonesian stress, what gaps can be identified in the field and what causes the many confounds found in the mixed reports on Indonesian. The findings of this review indicate that Indonesian participants' substrate language modulates their usage of stress when speaking Indonesian. Further research should investigate what specific mechanisms underlie this process and more importantly, map the behaviour of Indonesia's many substrates. Moreover, the influence of substrates on Indonesian stress, indicates that generalising Indonesian stress patterns as one may not be relevant for discussion, as Indonesian stress is determined by a speakers' substrate language.

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## 1. Introduction

Phonology is a subfield of linguistics that is concerned with the systematic study of sounds that bear meaning in languages around the world, one of the fundamental concepts in phonology is the study of stress assignment. Stress refers to the degree of relative emphasis or prominence given to a syllable in a word or phrase (Hayes, 1995), and stress assignment is the study of which constituents carry this relative emphasis or prominence. The topic of prominence can be split into two types of prominence, phrase/sentence level prominence otherwise known as accent and word-level prominence otherwise known as stress. The present study is primarily concerned with the latter, however, accent does play a role in experiments on stress assignment and therefore will be briefly discussed in the present review as well.

Stress assignment is a frequently investigated topic and for most well-researched languages, evidence has been found for a pattern of stress assignment. One such language is Indonesian, however, despite being well-investigated, the current-body of research does not seem to agree on a consensus on how stress In Indonesian works exactly.

The form of stress that is of particular interest to the present study is word stress, or lexical stress, which is used to differentiate between the meaning of words that would otherwise sound identical i.e. minimal pairs (e.g. Figure 1). However, the patterns by which languages choose a stress-carrying syllable are often language-specific in the way that they are determined. For instance, Spanish has what is known as a fixed-stress pattern, where stress typically falls on the same syllable in roughly 80% of Spanish vocabulary, namely the penult e.g. *nosótro*s (Hualde, 2007). However, even in Spanish the fixed/free-stress dichotomy is a blurred line as Spanish has phonemic stress (e.g. Figure 1). However, Spanish stress is still seen as fixed as 80% of words have penultimate-stress and all other stresses fall on the last three syllables (Hayes, 1995).

(1) A stress minimal pair in Spanish (Adapted from Kim, 2015)

- |          |          |
|----------|----------|
| (a) pápa | ‘Potato’ |
| (b) papá | ‘Father’ |

Contrastively, Russian has been described as having a free-stress system as stress may fall on any syllable. However, the distinction of fixed/free-stress systems is again not so simple, as Mačutek & Kelih (2022) show that there is a statistical correlation between word-length and stress position, as the distribution of stress systematically moves from the left to the right-edge depending on the amount of syllables a word has (Mačutek & Kelih, 2022, p.92).

As previously mentioned, a language where no standardised observations have been posited is Indonesian. The most commonly observed pattern is that Indonesian has penultimate stress (Cohn & McCarthy, 1998; Dardjowidjojo, 1978; Teeuw, 1971), although some claim that Indonesian word stress does not exist (Halim, 1981; Van Zanten & Goedemans, 2009). whereas Cohn (1989) claims that stress is fixed on the penultimate syllable (regardless of changes in the internal structure of the word), and Samsuri (1971) claims it is word final. Another account of Indonesian stress by Laksman (1994) presents evidence of schwa being stressed, as such being treated as any other vowel in the inventory, a phenomenon which is typologically unexpected of stress languages.

Due to the discrepancies found in investigations on Indonesian, the current review aims to provide a state-of-the-art account of what is known of Indonesian stress. The significance of this question lies in the fact that no consistent account of Indonesian word stress has been established, which has proven to be a challenge for researchers. By synthesising the current literature on this topic, gaps in the current knowledge may be identified and provide a sufficient foundation for further research. A systematic literature review may be especially relevant in this case, as showing reported inconsistencies for Indonesian stress may elucidate on points where more data is required. In the following sections the properties of stress will be discussed (Section 2.1), as well as the Indonesian language and its background (Section 2.2). Furthermore, how Indonesian grammar is organised from a morpho-phonological perspective (Section 2.3), what substrates mean in the context of Indonesian (Section 2.4), and how stress is typically investigated in terms of experiments (Section 2.5). Moreover, Section 3 contains the methodology utilised for this systematic literature review, Section 4.1 contains a summary of the relevant findings and Section 4.2 will discuss the importance of substrates in investigating Indonesian stress. Lastly, Section 5. will conclude the present review by summarising the findings and providing suggestions for further research.

## 2. Background

### 2.1 Properties of stress

To understand how stress affects the production and perception of speech in different languages, it is crucial that instances of stress are analysed by their physical properties. Typically, this is done by examining the three acoustic correlates of stress, namely, fundamental frequency (F0), duration and intensity (Gussenhoven & Jacobs, 2017). Fundamental frequency, usually denoted as F0, refers to the rate at which the vocal folds vibrate and is typically measured in hertz (Hz). Stressed syllables, often exhibit a higher F0 i.e. a higher pitch compared to surrounding syllables. Another predominant acoustic correlate of stress is duration. Typically, stressed syllables are pronounced longer than unstressed syllables, however, the difference between unstressed and stressed syllable duration varies cross-linguistically. Moreover, a further common acoustic correlate of stress is intensity, which refers to the measure of energy or loudness a syllable carries and is typically measured in decibels (dB). In terms of stress assignment, stressed syllables will typically have a higher intensity than those that are unstressed, they are produced with more force and muscular effort, which results in a greater amount of air pressure and thus a stronger sound wave (Ladd, 2008). These acoustic correlates increase the prominence of a syllable when they are present and thus make them more distinguishable from other syllables. Moreover, they tend to occur simultaneously as longer duration eases exertion when increasing intensity, and greater intensity eases F0 raising (Ladefoged, 1977, p.250).

From a typological perspective, these acoustic correlates are employed regularly as cues of stress. For example, Ladd (2008) found that F0 raising was used in stress assignment in approximately 60% of the 215 surveyed languages. Moreover, a study by Hayes and White (2013) revealed that 24 out of 32 studied languages employed F0 raising as a stress cue. In contrast, 23 out of 32 showed evidence for intensity as a stress cue and only 14 out of 32 languages used duration as a cue for stress assignment. Conventionally, acoustic correlates are used in research to determine whether a language has stress and to what extent these acoustic correlates play a role in stress assignment.

Apart from acoustic correlates there is also one major phonological correlate of stress, namely, quality. In essence, quality in terms of stress can refer to the quality of the phonemes or sounds of a syllable i.e. the consonants or vowels. Quality as with most phonological patterns is language specific and can determine which vowels may carry stress

under which circumstances (Hayes, 1995), and in acoustically how they change when stressed e.g. F2 raising of /i/ when stressed in Bulgarian (Andreeva, Barry, & Koreman, 2013). There is no report on consonant quality in the body of research on Indonesian stress and will thus not be discussed. However, vowel quality will be briefly discussed in this paper in the context of Laksman (1994), who proposes that schwa can be stressed in Indonesian, which is typologically unexpected.

To summarize, the main acoustic features used to investigate stress systems include F0, intensity and duration, as well as vowel quality of schwa. In the present review, these will be discussed as they are crucial in determining the existence of stress, or lack thereof.

## 2.2 The Indonesian language

While the total sum of languages to exist in the world is still an unknown fact in the field of linguistics, the total sum of languages spoken in Indonesia is believed to estimate to 10% of known languages in the world. Classed as a Malayo-Polynesian (Austronesian) language, Bahasa Indonesia 'language Indonesia' i.e. Indonesian, is the national language of Indonesia, spoken by roughly 199 million people as a first or second language. It is part of the Austronesian language family together with over a thousand other languages, making Austronesian the second largest language family after Indo-European in terms of number of languages. Considering Indonesian, there are a few facts that stand out. Firstly, Indonesian is spoken by roughly 94% of the Indonesian population with only 20% speaking it as their native language, predominantly in the Jakarta metropolitan area. After the second world war and her grasp for Independence, Indonesia adopted a normative version of Malay, named Bahasa Indonesia (synonymous with Indonesian). Since then, it has been used as the official governmental language of the country, the language of instruction in education, the most common language in religious events and national media, as well as being widely used in social environments as a bridge between ethnicities as a lingua franca (Haspelmath & Tadmor, 2009). However, Indonesia is shaped by centuries of trade, migration and colonisation of various other cultures which has left an impact on the current language situation. Approximately 34% of the Indonesian vocabulary is comprised of loanwords, consisting of loans from Javanese (8.9%), Sanskrit (8.4%), Dutch (6.4%) and Arabic (5.7%) as the predominant donor languages (Haspelmath & Tadmor, 2009). The influence of other languages on the Indonesian language further complicates the investigation into Indonesian stress patterns. Tadmor (2009, p.704) highlights this complication, indicating that historically,

proto-malayan maximally allowed (C)V(C) syllables but the influence of donor languages has expanded this to maximally (C)(C)(C)V(C)(C)(C). The high percentage of loanwords in Indonesian adds another layer to the investigation as to how the stress system might work. The myriad loanwords complicate methodologies concerning stress as researchers must find a compromise between including colloquial lexemes i.e. loans and excluding them as they may behave differently. Ideally, the effect of loans on stress should be adequately described when investigating stress in Indonesian, however this has not been the case with studies to date.

### 2.3 Features of Indonesian

Considering grammar, Indonesian exhibits prototypical patterns of an Austronesian language. Like most other Austronesian languages it has rich morphology, characterised by prefixation, suffixation, circumfixation, affix substitution, compounding and cliticisation (Denistia & Baayen, 2022). In terms of prominence, reduplication can be of interest in investigations on prominence, as the reduplicated constituent usually carries accent (e.g. 2). Reduplication in Indonesian is used to signal plural forms of nouns and habitual repetition of verbs or utilised as adverbialisation from adjectives. Although there have been no investigations into the interface between morphology and stress in Indonesian, it should still be noted that accent and stress are comparable phenomena when it comes to prominence. An example of morphologically conditioned stress can be seen in the Choguita Rarámuri language (Caballero, 2011), a phenomenon too broad to tackle in the present review but important to mention, as it may also play a role in Indonesian. In terms of general phonological features, Indonesian features predominantly (C)V(C) syllables and a tendency to avoid consonant clusters. Furthermore, the Indonesian vowel inventory contains /a, e, i, o, u, ə/. Schwa in particular is a crucial vowel as it occurs in many prefixes and thus initial syllables<sup>1</sup> in many morphologically complex words (e.g. 3).

(2) Reduplication and accent in Indonesian

(Adapted from Rafferty, 2002)

(a) Dia lari cepat-cepát

‘he runs fast.’

‘he runs quickly.’

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<sup>1</sup> The frequency of schwa initial syllables has not yet been discussed in terms of stress.

(3) Schwa in Indonesian prefixes	(Adapted from Ruijgrok, 2008).
(a) pər-aŋkat	‘to run along’
(b) tər-batas	‘limited’
(c) bə-rasa	‘to have a feeling’
(d) mə-ŋatu	‘to unify’

To summarise, the Indonesian languages is a morphologically complex language with a straightforward syllable structure and avid use of schwa, predominantly in initial syllables in morphologically complex words.

## 2.4 Substrates

Besides the existence of numerous loans, the distribution of Indonesian speakers is striking. Estimates posit approximately 43 million speakers speak it as their first language, whereas Javanese has 85 million native-speakers. Indonesia itself has one of the highest language counts per country, with a recent count of 724 of which 710 are still spoken (Eberhard, Simons & Fennig, 2023). Furthermore, the language diversity index of Indonesia indicates that when two Indonesian individuals are picked at random, the odds that they will speak a different native language to one another is 84% (Eberhard et al., 2023). This falls in line with Indonesian being spoken as a lingua franca along the archipelago of Indonesia (e.g. Figure 6). A more apt description, however, is that Indonesian is spoken as a prestigious language on a number of ‘substrate’ languages (Steinhauer, 1981). Van Heuven & Van Zanten (1997) describe substrates as less prestigious languages compared to the centralised or nationalised language of a country. Typically, substrates are spoken as an L1 whereas the national language is spoken as an L2 and taught primarily in educational environments and not so much at home. In the case of Indonesian there are many substrates which follow their own prosodic patterns (Van Heuven & Van Zanten, 1997). Examples include the Toba-Batak language and Javanese, the prior which follows a pattern of penultimate-stress, disregarding affixation (Nababan, 1981).

(4) Penultimate-stress through affixation in Toba-Batak

(Adapted from Nababan, 1981)

['da.lan]	'road'
[mar.'da.lan]	'walk'
[par.da.la.'ni.on]	'journey'

Furthermore, speakers of Toba-Batak utilise a shift in stress to signal a contrast in grammatical function:

(5) Phonemic stress in Toba-Batak

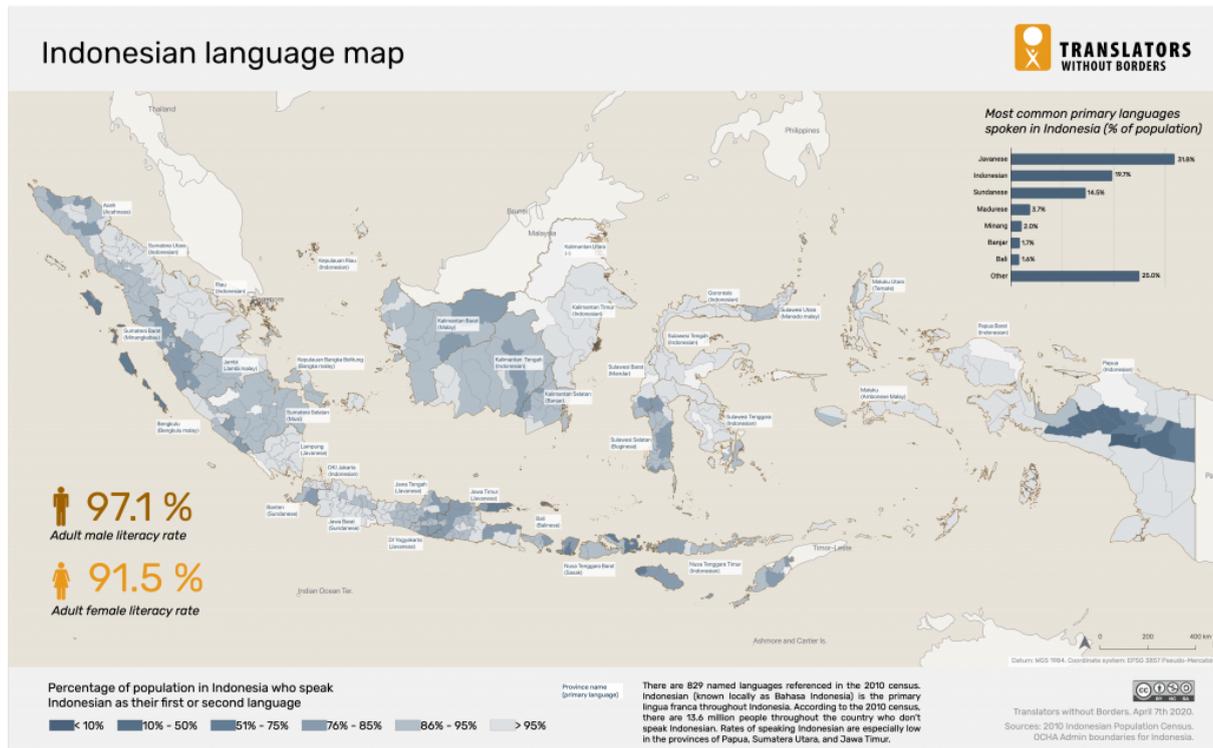
(Adapted from Nababan, 1981)

['ma.ɔl]	'difficulty'	- Noun
[ma.'ɔl]	'difficult'	- Adjective
['la.pu]	'length'	- Noun
[la.'pu]	'long'	- Adjective

Contrastively, investigations of Javanese seem to follow the same patterns found for Indonesian in that it is unclear what exactly Javanese. Poedjosoedarmo (1982) claims that Javanese has final stress, whereas Ras (1983) claims that it has penultimate-stress with the exception of nuclei containing a schwa, in which case stress is final. Others claim Javanese follows no fixed pattern of stress assignment (Horne, 1961) or any proof of acoustic correlates of stress at all (Goedemans & Van Zanten, 2007). Another example of substrates possessing different prosodic features is the Betawi Malay substrate of Jakarta, for which Van Heuven, Roosman & Van Zanten (2008) found, has only phrasal accent and no word-level prosody.

The existence of substrates poses a challenge for linguists' attempts at ascertaining the status of stress for Indonesian. The factors of language diversity and number of native speakers makes generalising patterns on the population of a sample very complicated. To effectively conduct research on linguistic behaviour in a language such as Indonesian, methodologies and samples must be controlled for by carefully dissecting which native languages and/or substrates are spoken and what sort of effects the L1 might have on the L2.

Figure (6) The Indonesian language map according to the 2010 Indonesian Population-Census (Translators without borders, n.d.)



The primary issue is that many studies conducted on Indonesian stress have methodological issues. Firstly, a large body of research conducted on Indonesian is based on corpora consisting of a limited number of speakers with a large number of targets. The limited target stimuli produced in corpora adds to the challenge of dividing stress and focus in carrier sentences (Samsuri, 1971). Furthermore, very few reports include participants' substrate language and/or the substrates of their parents, as well as linguistic environment, all of which could potentially influence the way in which they utilise prosody.

## 2.5 Commonly used methods in determining stress

In investigating stress patterns, there are two main ways to test whether a language has stress. Namely, perception and production experiments, both of which will be discussed in the current section, starting with perception.

### 2.5.1 Perception experiments

In perception experiments, participants are tasked with perceiving stress, which can be done in a number of different ways. Some common methods include testing whether participants can perceive stress in their L2 language, to investigate whether their L1 impacts the

acceptability of stress in their L2. Behavioural experiments which have previously employed to investigate stress perception in Indonesian are predominantly Judgement tasks (Van Zanten et al., 2003; Van Zanten & Goedemans, 2009). In the experiment by Van Zanten et al. (2003), the claim that Indonesian has penultimate-stress was investigated by ways of a pairwise-comparison experiment. In this experiment, the participants listened to two versions of the same word consisting of four syllables, one with penultimate stress and one with stress on a different syllable. This study included three different groups of Indonesian speakers, namely, L1 Javanese, L1 Betawi-malay and L1 Toba-Batak speakers. The results indicate that Javanese and Betawi-Malay speakers have deem final-stressed words more acceptable than penultimate-stressed words, whereas the Toba-batak speakers expectedly preferred penultimate-stress. Furthermore, in the experiment by Van Zanten & Goedemans (2009), a comparable pairwise-comparison experiment was conducted with Javanese and Toba-Batak speakers. However, in this experiment the stimuli were implemented in a declarative carrier-sentence to control for possible interference of accent placement. The results of this experiment contrast the findings of Van Zanten et al. (2003), as Javanese speakers deemed penultimate-stress just as acceptable as final-stress. As for the Toba-Batak speakers, the results corroborate the earlier finding, as they seem to prefer penultimate-stress over any other stress placement.

Furthermore, established research has tasked participants with stress perception experiments in languages which they do not speak (Van Heuven & Faust, 2009). This particular may be employed to investigate whether participants can perceive stress in general. The study by Van Heuven & Faust (2009) investigated L2 Indonesian speakers of Dutch, in a perception experiment of Dutch stress. Much like Van Zanten et al. (2003) and Van Zanten & Goedemans (2009), this study conducted a judgement task, testing Indonesians on the Dutch stress system with Dutch participants as a control. The findings of Van Heuven & Faust (2009) indicate that Indonesian L2 speakers of Dutch are insensitive to the Dutch stress system.

Another possible method is tasking participants with perceiving stress in non-words. This method is useful as it can investigate whether Indonesian speakers utilise can perceive stress in phonologically similar non-words (Rahmani, Rietveld & Gussenhoven, 2015). Lastly, participants can be tasked with perceiving stress in synthesised speech, where acoustic and phonological correlates can be transposed individually. This method is particularly useful in situations where it is unclear which correlate underlies stress, and which does not. This method has, however, not yet been used in the current body of research on Indonesian.

Generally, perception studies investigate exactly what one might expect, a listener's perception of any given phenomenon. In terms of stress, some investigations have proven inadequate when it comes to using perception to prove the existence of stress, or the lack of stress, especially when production data is not simultaneously incorporated. A notable example of such an occurrence is Mandarin speakers showing the ability to perceive stress in their own language, one could assume from such findings that Mandarin is a stress language. However, alleged perception of stress for Mandarin speakers has been shown to be attributable to related acoustic measures, in this case tone (Altmann, 2006). False positives such as these indicate that both perception and production experiments should be employed simultaneously, as production experiments allow acoustic measures of consistent stress patterns to be compared with speakers' perception of that same stress, should these not match it would be a clear indication that further investigations are necessary to delineate the underlying issues concerning stress patterns.

### 2.5.2 Production experiments

Besides perception experiments, stress is also commonly investigated by tasking participants with producing stressed syllables. Typically, production experiments involve participants producing a target stimulus in a given carrier phrase, resulting in a natural pronunciation of the target, as well as providing insight into how, for example, prosodic features are used in a given language by native speakers. When it comes to Indonesian, a number of different production methods have been used in the past, each method controlling for different confounds commonly observed in investigations of stress. An example of how stress in Indonesian has been explored via a production task can be seen in the carrier sentence and target stimuli in Figure (7).

(7) Carriers including [+focus] and [-focus] (Adapted from Goedemans & Van Zanten, 2007, p.41)

- |               |  |
|---------------|--|
| (a) Focus:    | Dia mengucapkan kata <b>X</b> .<br>'he pronounces the word <b>X</b> .' |
| (b) Non-focus | Kata X itu <b>tepat</b> .<br>'The word X is <b>correct</b> .'          |

Observing participants who produce the utterances in Figure (7) allows the researcher to measure which acoustic correlates respond to either the focus condition or the non-focus condition<sup>2</sup>. The inclusion of carrier-sentences is particularly useful, as the information structure, specifically phrase-level prosody can indicate which syllable can be accented or not. Moreover, measuring the acoustic correlates for accent and comparing them to word-level prominence such as stress can allow us to measure whether prominent syllables in production, are accented or stressed. In contrast, the stimuli shown in Figure (8) do not control for prosodic boundary effects (e.g. declarative sentence pitch contour). Figure (8) displays a comparable experiment by Roosman (2007) where the design is altered to control for both the focus condition as well as any prosodic boundary effects, as the target stimulus **X** is placed in medial, and final position. Including a medial and final position is relevant, as phrasal pitch contours typically feature in the last constituent of a phrase e.g. ‘tadi’ in Figure (8d).

(8) Carriers including four conditions (Roosman, 2007, p.94)

(c) Focus + final	Die bilang <b>X</b> . ‘He said <b>X</b> .’
(d) Focus + medial	Die bilang <b>X</b> tadi ‘He said <b>X</b> just now.’
(e) Non-focus + final	<b>Tadi pagi</b> die bilang X. ‘ <b>This morning</b> he said X.’
(f) Non-focus + medial	Die bilang X <b>buku</b> ‘He said X <b>of books</b> .’

The phrases in Figure (8) will thus not incur any phrasal accent prominence, be it caused by focus or prosodic boundary effects. Roosman (2007) included Betawi-Malay substrate speakers and Toba-Batak speakers, investigating their productions of carrier-phrases comparable to Figure (8). The findings by Roosman indicate that Toba-Batak speakers consistently stress penultimate-syllables, and the pitch raising is stacked when the stressed syllable is also accented, this happens regardless of vowel quality i.e. they also stress and accent penultimate schwa. The Betawi-Malay speakers however, show more variable

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<sup>2</sup> Focus can be explained as phrase-level prominence, in contrast with stress as word-level prominence. Focus is utilised primarily as a way of putting emphasis on a specific constituent as a focal point in the phrase, separating it from the other constituents which are seen as given (Wagner, 2019, p.97)

behaviour as they consistently stress and accent penultimate-syllables but may shift prominence to the final-syllable if the penult is a schwa, however, it should be noted that the accent shift to the final syllable seems to be optional (Roosman, 2007).

Compiling the results of both perception and production experiments, it seems that substrate speakers of Indonesian show great variance when it comes to Indonesian stress, be it from a perception or a production point of view. Therefore, any state of the art-account investigating stress, should employ a methodology incorporating both a production and perception experiment, investigating both within and between participant correlations, controlling for focus conditions and prosodic boundary effects, as well as providing an acoustic analysis of the production data.

### **3. Method**

The methods of the present review consist of five steps. Firstly, inclusion and exclusion criteria were devised to obtain a general idea of what sort of reports should be included or excluded. Secondly, a search strategy was employed containing key terms, relevant for the investigation of Indonesian stress. Thirdly, following the searches strategy, search terms were implemented in the available databases resulting in an initial trawl of reports. Moreover, the initial trawl was screened for inclusion and exclusion criteria. Lastly, the final trawl of reports was mapped out on a number of (see Section 3.4).

#### **3.1 Inclusion and Exclusion Criteria**

In devising the methods for the present review, inclusion and exclusion criteria were necessary to adequately delineate the current body of research on Indonesian stress. Therefore, reports to firstly had to report primarily on Indonesian stress assignment, or behaviour of Indonesian speakers regarding stress. Secondly, reports had to be primary behavioural (e.g. perception/production) or introspective (e.g. theoretical accounts). Lastly, reports preceding 1960 are excluded to ensure that more recent and attested linguistic methods are accounted for when describing stress in Indonesian. Furthermore, in typical linguistics-systematic reviews a last criterion would ensure no reports are included involving bilinguals/multilinguals when investigating language specific phenomena such as stress. However, in the case of Indonesian it is relevant to include these studies as most of the Indonesian speaking population speaks more than one native-language (Steinhauer, 1981).

In sum, the inclusion and exclusion criteria for the current systematic literature review on Indonesian stress include:

(9) Inclusion and exclusion criteria of the present review, reports needed to be:

1. A report on Indonesian stress assignment.
2. Primary, behavioural or introspective research.
3. Research carried out since 1960.

### 3.2 Search strategy

In acknowledging the multiple ways that stress has been characterised in linguistic work over the years, e.g. word accent, lexical stress, stress, accent atc, the search strategy for the current paper aims to incorporate all possible terminology concerning stress. The list of terms consisted of seven individual searches per database and bibliography scours, including the combinations presented in the figure below.

(10) Summary of employed search terms<sup>3</sup>

- (a) Indonesian + stress
- (b) Indonesian + intonation
- (c) Indonesian + accent\*
- (d) Indonesian + prominen\*
- (e) Indonesian + prosod\*
- (f) Indonesian + acoust\*
- (g) Indonesian + phon\*

### 3.3 Databases searched

Given the time and funding limitations of the current paper, the following list is composed of databases which are open source or accessible via The University of Amsterdam. Ideally, more databases would be utilised in a systematic review but for the purposes of this review, the current list is sufficient, as, in the screening (Section 3.4), all the resulting papers were

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<sup>3</sup> In these search terms, the usage of “+” equals an AND operation, whereas the usage of “\*” ensures that all possible following constituents are included in the search e.g. phon\* would include all possible endings such as phon-ology, phon-ological, phon-etic/s, phon-eme, phon-emic etc.

cross-referenced with their bibliographies to verify whether no relevant papers were excluded.

(11) List of employed databases

- (a) EBSCO host database
- (b) Google Scholar
- (c) JSTOR
- (d) Linguistic and Language Behaviour abstracts
- (e) Linguistics bibliography
- (f) ProQuest
- (g) MLA international bibliography
- (h) PsycINFO

3.4 Initial screening N = 22

The initial trawl following the search strategy yielded a total sample of 33. This included many papers which reported on varieties of Malay conventionally not seen as close relatives to standard Indonesian (Jakartan) e.g. varieties of Malay such as Ambonese and Papuan. These are excluded as they do not fall within the scope of this paper. After excluding these reports the total sample consisted of 22 reports, which can be seen in Table (1). Henceforth, in discussing reports from the mapping activity they will be referred to by their corresponding number in Table (1).

Table1: Mapping activity by number

Number	Author/s	Date
1	Adisasmito-Smith, N., & Cohn, A. C.	1996
2	Athanasopoulou, A., Vogel, I., & Pincus, N.	2021
3	Cohn, A. C.	1989
4	Cohn, A. C.	1993
5	Cohn, A. C., & McCarthy, J. J.	1998
6	Goedemans, R. W. & van Zanten, E.	2014
7	Goedemans, R., W. & Van Zanten, E.	2007
8	Halim, A. A.	1981
9	Halle, M., & Idsardi, W. J.	1994

10	Heuven, V. J., & Faust, J.	2009
11	Laksman. M.	1994
12	Odé, C., Van Heuven, V. J., & Van Zanten, E.	1994
13	Poedjasoedarmo, S.	1982
14	Rahmani, H., Rietveld, T., & Gussenhoven, C.	2015
15	Roosman L. M.	2006
16	Roosman L. M.	2007
17	Roosman L. M.	2009
18	Van Heuven, V. J., & Van Zanten, E.	1997
19	Van Zanten, E., & Goedemans, R.	2009
20	Van Zanten, E., & Heuven, V. J.	1998
21	Van Zanten, E., & Van Heuven, V. J.	2004
22	Van Zanten, E., Goedemans, R., & Pacilly, J. J. A	2003

### 3.4 Mapping activity

Following the Initials screening, conditions were devised to systematically categorise the sample. These conditions were assigned to an excel column with individual reports as rows. Per column each condition was phrased as a yes and no question, such that the sheet could be conditionally formatted and analysed based on descriptive statistics of the sample. Furthermore, basic open questions were inserted on the left hand side of the conditional columns, these open-ended columns provided standard protocol information on the reports such as: author, date, what sort of methods, what sort of experiment, the sample, which substrates were included, if at all. The most relevant conditional questions incorporated in the mapping activity can be seen in Table 2, and the full table in Appendix A.

Table2: Conditional mapping of primary variables of interest.

Variable	Mapping number according to Table 1.
Reports on: F0	1, 2, 6, 7, 12, 15, 16, 19, 20, 21, 22
Reports on: duration	1, 2, 6, 7, 12, 15, 17, 18, 19, 20, 22
Reports on: intensity	1, 2, 6, 12, 15, 17, 19, 22
Reports on: quality (Schwa)	1, 2, 6, 7, 10, 11, 12, 18, 19, 20, 21, 22
Production experiment	1, 2, 11, 16, 17

Perception experiment	10, 12, 14, 18, 20, 21
Perception and production <sup>4</sup>	7, 15, 19, 22

## 4. Discussion

### 4.1 Summary of relevant findings

In summarising the findings of the mapping activity the following descriptive statistics emerged as being significant for the review questions of the present study. It would seem that perception studies are slightly more common than production experiments tallying at six and four respectively, with four studies incorporating both methods. Interestingly, three out of four mixed-method studies are conducted by one common author: Goedemans & Van Zanten, including: [7, 19, 22].

As alluded to in Section 1, the findings of all 22 reports present varying cases of how the Indonesian stress system works. In sum, eight studies posited penultimate stress in Indonesian, five of these studies represented theoretical papers analysing the commonly observed pattern of penultimate-stress. Secondly, 13 studies posited a main finding of no-stress for Indonesian, predominantly pertaining to behavioural studies such as production, perception or a mix of both with the exception of [6]. Lastly, five studies posited the possibility of final-stress where penultimate-stress was not available due to schwa being present, and only one study presented evidence of schwa being stressable (Laksman, 1994). An overview of these results is given in Table (3).

Table3: Distribution of main findings of N = 22. The in-table total exceeds 22 as 5 reports explicitly posited that Indonesian has final-stress in case of schwa in the penultimate syllable.

Main finding	total sample N = 22
Penultimate-stress	36% (N=8)
Final-stress	22% (N=5)
No-stress	59% (N=13)

<sup>4</sup> Experiments pertaining to this category are only tallied for the mixed methods category and not individually for production and perception.

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 Schwa can be stressed
 

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0.04% (N=1)

Most importantly for the present review, only 45% (N=10) of studies reported which substrate language their participants spoke. The significance of this figure lies in the implication that 54% (N=12) of reports do not include substrate language as an independent variable, more on this in section 5.2.

## 4.2 The importance of substrates

Following the mapping activity as seen in Section 3.4, papers [15, 14, 5, 17, 18, 19, 22] posit that participants' substrate language was the primary predictor for the existence of stress, be it in production or perception. However, what might confound findings on Indonesian is not controlling adequately for which substrate language a given participant speaks. One of the earliest reports interpreting results without regarding the confounds due to substrates is the study by [17], who investigate Indonesian and Dutch speakers in a gating experiment on Indonesian spoken stimuli. The groups used for this study include two Balinese, three Sundanese as well as six Dutch participants in a perception task, the authors also indicate that including substrate backgrounds is important. However, the authors conclude that Indonesian stress is irrelevant and essentially free. Such a statement seems to overgeneralise the sample of the population by firstly having insufficient data (limited participant number) and more importantly, assuming that all speakers of Indonesian possess the same pattern of stress, independent of their first language.

This point presents a specifically critical issue in the current body of research on Indonesian stress. A following study by [19], however, investigated the difference between Toba-Batak substrate speakers of Indonesian and Javanese substrate speakers. Their hypotheses were that Javanese speakers would show weak or no stress, whereas Toba-Batak speakers would show penultimate-stress in both production and perception for either group. These hypotheses were based on the findings of earlier studies, indicating that Javanese has weak stress for penultimate-syllables (Ras, 1982) or final stress if the penult contains schwa [22]. Whereas Toba-Batak speakers show clear stresses for penultimate-syllables [16, 17, 20, 22]. The study conducted by [19] stands out from other studies into the Indonesian stress system as the authors accurately control for focal position in the target stimuli, as well as substrate language experience. Furthermore, in terms of acoustic correlates, Javanese and

Toba-Batak followed split patterns in the production experiment. Namely, Toba-Batak speakers always showed an increase in intensity and duration as well as a slight increase of approximately 2.5 dB in prominent syllables. Javanese speakers, on the other hand, did not produce syllables with greater intensity or duration except for the second syllable in the [+focus] condition (see Section 2.5 for more information on focus conditions). Moreover, [19] conducted a 2x2 perception experimental design (Table 2) to control for individual bias of the researcher, as speakers of a stressed language. In this experiment, the expected outcome was borne-out for Toba-Batak speakers when they listened to another Toba-Batak speaker producing Indonesian stimuli, in that they strictly accepted only penultimate-stressed syllables, whereas for the Javanese-based stimuli they seemed to be more accepting of alternate stress assignment patterns. The authors indicate that this might be because of the difference of exposure to Indonesian these listeners might have, as all but one of the Toba-Batak listeners lived in Jakarta at the time, where a large percentage of the city's populace are L1 standard Indonesian speakers. The significance of this study in particular is the finding that the Javanese participants seem insensitive to stress and its position in both Javanese and Toba-Batak. The authors indicate that, as they do not seem to perceive stress, they have no preference on where it lands as they do not deem such instances as unacceptable. Contrastively Toba-Batak speakers follow the pattern of Javanese when they are listening to a speaker of Javanese and accept stress on any syllable.

Table4: 2x2 design of participants' perception toward their stress in their substrate and of stress in the other groups' substrate (Adapted from: [19]).

	Javanese	Toba-Batak
Javanese	Insensitive	Insensitive
Toba-Batak	Free-stress	Penultimate-stress

These findings provide strong evidence that substrates clearly behave differently from one another and that they also interact with one another. Furthermore, the influence of Javanese in Indonesian confounds a large portion of findings on Indonesian as they tend to co-exist in speakers.

The findings presented in the current review show that conventional methods are inadequate when it comes to controlling for confounding factors such as substrate (Section

2.4). A possible explanation for these findings is posited by Steinhauer (1980:366), who describes Indonesian as ranging from a local-dialect to a malay-based creole. As such, Indonesian is at best primarily a second language, where most people speak one of the other Austronesian languages as at home and simultaneously acquire Indonesian as an L1 through contact outside their home. This lack of isolated, standard Indonesian speakers is likely the source of the many confounds in findings on Indonesian stress, as the ideal participant group consists of a very small subset of the population and is thus rather hard to find. Even in metropolitan cities like Jakarta where most speakers of standard Indonesian are located, it is very difficult to find the participants who do not introduce substrate confounds.

This issue is acknowledged by [12], who posit that controlling participants substrate is not enough, and that the substrate of their parents also has to be controlled. The authors of [12] attempt to control for parental substrate by screening participant and their parents' substrate languages. However, of the 10 participants there was only one parent who exclusively spoke standard Indonesian, indicating that 19 out of 20 parents spoke another substrate. The report by [10] characterises the methodological issues encountered when investigating the status of stress in Indonesian, as the frequency of isolated L1 speakers of standard Indonesian is incredibly low compared to the prevalence of substrate languages. However, the many studies reporting on substrate behaviour show that it is possible to map out substrate behaviour when it comes to stress in Indonesian. However, the isolated-speaker issue persist for substrates as well, as some of them co-exist in a large sample of speakers e.g. Javanese and Betawi-Malay. As such, further investigations on Indonesian stress would be aided by a better understanding of the interplay between substrates and Indonesian. Specifically which factors underlie the effect of a substrate's stress patterns on the stress system of a superstrate language such as Indonesian.

In sum, synthesising the relevant body of research onto Indonesian stress indicates that, attempting to generalise Indonesian stress as one pattern may not be relevant to discussion. As there is a very limited set of isolated set of speakers of standard Indonesian (Steinhauer, 1981), with most speakers of Indonesian being L2 speakers, or simultaneous bilinguals/multilinguals who behave differently depending on their substrate language/s.

## **5. Conclusion**

The present review sought to provide a state-of-the-art account on what is known about Indonesian stress, to identify gaps in the present body of research and to review what caused the confounds in earlier studies, leading to contradicting accounts of how the Indonesian stress system works. The present review sought to answer these questions by identifying, analysing and synthesising all the relevant research conducted on Indonesian stress, by ways of a systematic review. Following these methods, all three review questions have been answered. Firstly, what we know of Indonesian stress is that it seems to be affected by speakers' substrate language. Secondly, the primary gap on Indonesian stress includes the exact mapping of what each substrate's influence is on Indonesian stress. Furthermore, and most importantly, that generalising Indonesian speakers' stress patterns, may not be relevant, as a standard Indonesian stress cannot be determined as of yet.

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## Appendix A:

Table5: Mapping of open-question variables

Number	Author	Date	Method	Experiment	Variety of stimuli	Sample
1	Adisasmito-Smith, N., & Cohn, A. C.	1996	Production	reiterant speech	U.I	U.I
2	Athanasopoulou, A., Vogel, I., & Pincus, N.	2021	Production	Picture naming	Jakartan	10
3	Cohn, A. C.	1989	Introspection	OT analysis	U.I	4
4	Cohn, A. C.	1993	Introspection	OT analysis	U.I	U.I
5	Cohn, A. C., & McCarthy, J. J.	1998	Introspection	OT analysis	U.I	U.I
6	Goedemans, R. W. & van Zanten, E.	2014	Introspection	Stresstyp 2 analysis	U.I	U.I

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7	Goedemans, R., W. & Van Zanten, E.	2007	Perception and production	Reading aloud, Judgement task	U.I	33
8	Halim, A. A.	1981	Introspection	none	U.I	U.I
9	Halle, M., & Idsardi, W. J.	1994	Introspection	OT analysis	U.I	U.I
10	Heuven, V. J., & Faust, J.	2009	Perception	Judgement task	Dutch	26
11	Laksman. M.	1994	Production	Reading	Jakartan	1
12	Odé, C., Van Heuven, V. J., & Van Zanten, E.	1994	Perception	Listening	Jakartan	10
13	Poedjasoedarmo, S.	1982	Introspection	U.I	U.I	U.I

14	Rahmani, H., Rietveld, T., & Gussenhoven, C.	2015	Perception	Judgement task	non-word	150 (30 Indonesian)
15	Roosman L. M.	2006	Perception and Production	Reading aloud, judgement task	Jakartan/Dutch	6
16	Roosman L. M.	2007	Production	Reading	Reading	8
17	Roosman L. M.	2009	Production	Repetition	Dutch	8
18	Van Heuven, V. J., & Van Zanten, E.	1997	Perception	Judgement task	Jakartan	37
19	Van Zanten, E., & Goedemans, R.	2009	Perception and production	Reading aloud, judgement task	Jakartan	2
20	Van Zanten, E., & Heuven, V. J.	1998	Perception	Gating experiment	Balinese	12
21	Van Zanten, E., & Van Heuven, V. J.	2004	Perception	Judgement task	Balinese	8

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22	Van Zanten, E., Goedemans, R., & Pacilly, J. J. A	2003	Perception and production	Reading aloud, Judgement task	Javanese & Toba-Batak	Production: 2, perception
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table6: Conditionally formatted variables

Number	Introspection	Production & Perception	Perception	Production	Judgement task	Reading	report: f0	Report: duration	Report: intensity	Report: quality [ə]	Stress	penultimate-stress	final-stresses
1	0	0	0	0	0	1	1	1	1	0	1	1	0
2	0	0	0	0	0	0	1	1	1	1	0	0	0
3	1	0	0	0	0	0	0	0	0	0	1	1	1
4	1	0	0	0	0	0	0	0	0	0	1	1	0
5	1	0	0	0	0	0	0	0	0	0	1	1	1
6	1	0	0	0	0	0	1	1	1	1	1	1	1
7	1	0	0	0	0	0	0	0	0	0	1	0	0
8	0	0	1	0	1	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	1	1	0
10	0	0	1	0	0	0	1	1	1	1	1	1	0
11	1	0	0	0	0	0	0	0	0	0	1	1	0
12	0	0	1	0	1	0	0	0	0	0	0	0	0
13	0	0	0	0	0	1	1	1	1	0	0	0	0
14	0	0	0	1	0	1	1	0	0	0	0	0	0
15	0	1	0	0	1	1	1	1	1	0	0	0	0
16	1	0	0	0	0	0	0	0	0	0	0	0	0
17	0	1	0	0	1	1	1	1	1	0	0	0	0
18	0	1	0	0	1	1	1	1	1	1	0	0	0

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19	0	0	1	0	1	0	1	0	0	1	0	0	0
20	0	0	1	0	1	0	0	1	0	0	0	0	0
21	0	0	1	0	1	0	1	1	0	0	0	0	0
22	0	1	0	0	1	1	1	1	1	0	0	0	0