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Focus prosody in Fijian: *in-situ* focus marking

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In this paper we investigated the prosodic focus markers of Fijian, an understudied language in the focus prosody literature. Fijian is a verb-initial language in which narrow focus is typically marked by syntactic means (i.e., fronting), making prosodic cues to focus harder to identify. We tested 10 native speakers of Fijian, and elicited *in-situ* corrective focus by asking them to confirm the correct item sequences. The results showed that regardless of focus location, there is a general elevation of fundamental frequency (F0) and intensity compared with neutral focus, like in Tagalog–another verb-initial language. We argue that, in addition to fronting, Fijian uses F0 and intensity to mark focus.

KEYWORDS

Fijian, focus, MANOVA, prosody, verb-initial language

1 Introduction

In spoken communication, speakers often modify aspects of their voice, such as pitch, loudness, and duration, to highlight new or important information within an utterance. For instance, when correcting a prior statement, a speaker might emphasize the corrected information by employing a higher pitch, a louder voice and/or a longer duration, thereby directing focus to a specific part of the utterance (see Kügler and Calhoun, 2020 for an overview). These acoustic variations are applied to focused words or phrases to varying degrees across languages, an area of study known in the literature as "focus prosody".

Fijian, an Austronesian language spoken by approximately 400,000 individuals as a first language in Fiji, primarily exhibits a canonical verb-object-subject (VOS) word order, although alternative accounts exist (Geraghty, 2006). Despite some preliminary insights into its prosodic structure, systematic studies on focus marking mechanisms in Fijian are lacking. As mentioned in Schütz (1985), while the phrase peak, or phonological accent, typically occurs at the end of a sentence, it can shift when expressing a contrastive situation. This gap in the literature underscores the necessity for further investigation into Fijian focus prosody, particularly as it can enhance our understanding of prosody in lesser-studied languages and contribute to the broader typology of prosody.

Research on other languages has demonstrated that speakers employ diverse strategies for focus marking. For example, while languages like Mandarin, of which word order is fairly inflexible yet difficult to define (Li and Thompson, 1989), utilizes pitch (F0) and duration (see Xu, 2015 for a review), verb-initial languages often incorporate syntactic or morphological strategies alongside prosodic markers (Kügler and Calhoun, 2020), complicating their analysis. In Samoan, a verb-initial language (reasonably) close to Fijian, fronting of noun phrases can indicate (contrastive) focus (Kügler and Calhoun, 2020; Calhoun, 2015). Studies have shown that the initial phonological phrase in a sentence consistently carries the greatest prominence. As a result, when the focused element is

fronted, it attains maximal prominence. In VSO structures, both the verb and the agent are positioned in the initial phrase. While speakers tend to raise the F0 on the object in object focus and lower it in agent focus, this is not applied consistently. Notably, there could be an absence of prosodic marking for focus on the agent. Thus, in a verb-initial language like Fijian, speakers might depend less on prosodic cues for signaling focus, as noted in Schütz (1985). This introduces complexity into the study of focus prosody, as it complicates the comparison of prosodic cues across non-identical utterances. Such challenges may help explain why Fijian focus prosody has remained relatively understudied. To mitigate confounding factors arising from syntactic alterations, examining *in-situ* focus marking offers a solution. This approach facilitates a clearer understanding of the exclusive role of prosodic cues in focus marking, rendering Fijian an ideal language for the current study.

To achieve this, in this study we used an item sequence composed of three adjacent disyllabic noun phrases (NPs) rather than natural sentences, aiming to circumvent the syntactic fronting strategy and effectively elicit prosodic focus markers *in situ* in item sequences. Although it remains an open question whether the prosodic devices observed in this study can be generalized to focus marking in more naturalistic sentential contexts, the present study forms part of a broader research project studying Fijian focus prosody and represents one of the two experiments conducted within this framework. While the primary experiment involves a picture description task (Lee et al., 2023), designed to collect and analyze data on focus marking strategies in natural Fijian speech, particularly concerning the issue of initial focus in sentences, the item naming task employed in the current study provides enhanced experimental control.

Moreover, after holding word order constant, we are interested in the relative contribution of each prosodic focus cue to variance explained in the data. This comparison might be interesting (especially when a given prosodic cue may appear to be insignificant to focus marking), and may offer insight into where Fijian stands in the typology of prosodic encoding of information structure (*cf.* Kügler and Calhoun, 2020).

2 Method

2.1 Participants

Ten students from the University of South Pacific (5 female, 5 male) were recruited in Fiji, their ages ranging from 21 to 40, all knew the interviewer as a lecturer. They are native speakers of Fijian, speaking English as an L2. They have no (history of) hearing or language impairments.

2.2 Materials

Native speakers of the Fijian language tend to signal corrective focus by adopting flexible word order in natural speech (Dixon, 1988). This implies that the location of corrective focus conditions in a sentence vary. In this study, we designed an utterance composed of three adjacent disyllabic NPs, i.e., *uvi*, *uto*, *dalo* "yam, breadfruit, taro", rather than using natural sentences as prompt and target stimuli. This methodological choice was made to elicit prosodic marking of corrective focus in the absence of syntactic fronting (sentence-level cues). The item sequence has three corrective focus conditions based on their locations, namely initial focus, medial focus, and final focus. The precursor question and target stimuli used in the study are listed in Supplementary Table 1, with focus (corrective vs. neutral) and focus locations labeled. There is also a baseline neutral focus condition, which refers to conditions containing no focused NPs as the order of items in the target stimuli is identical to that of the precursor question making it an echo answer to the question.

All focus conditions of the utterance were elicited by a precursor question asked by the interviewer (a linguist and Fijian native speaker). Altogether, we recorded 120 utterances (1 base utterance × 4 focus conditions × 3 repetitions × 10 speakers). All utterances were retained for analysis.

This paradigm enables the examination of the following research questions: (i) Is corrective focus different from neutral focus? (ii) Are different corrective focus conditions in a NP sequence marked differently? (iii) What acoustic cues (e.g., F0, intensity, duration) are employed to mark focus within a sequence of NPs?

2.3 Recording procedure

This was a fruit sequence naming task. The recording session was conducted in a multimedia studio in the University of the South Pacific in Fiji at the sampling rate of 44.1 kHz. Participants were shown three pictures showing yam, breadfruit and taro and were instructed to put the pictures in a specific order which they had to describe to the interviewer. The interviewer then pretended to mishear the picture order and asked the precursor question, starting with tags such as "Did you say…?" followed by the utterance targeting different focus conditions. In this way, the participants would need to correct the wrong information provided by the interviewer, thereby eliciting different focus locations. When responding to the precursor question, for all focus conditions, the participants were instructed to provide a complete answer in the form of *sega*/*io* "yes/no" plus the target item sequence (i.e., the correct order of fruits). Below is an example eliciting initial focus.

Interviewer: *O tukuna na '**uto**, uto, dalo'?*
"Did you say **breadfruit**, breadfruit, taro?"
Participant: *Io, **uvi**, uto, dalo.*
"No, **yam**, breadfruit, taro."

These four question-answer exchanges composed a dialogue, and the target sequences (initial, medial, final and neutral stimuli) for each participant were elicited within the dialogue (refer to Supplementary Table 1 for full version). Before the actual recording session, participants were asked if they understood the task to be performed.

2.4 Annotation and measurements

We first chunked the raw sound data into individual utterances, then labeled the answers by syllable with PRAAT (Boersma and

Weenink, 2012). Vocal pulses were manually checked and rectified. After annotation, we obtained the mean F0, time-normalized F0, mean intensity, time-normalized intensity and duration data of all six syllables in the target item sequence (three adjacent NPs) with ProsodyPro (Xu, 2013).

2.5 Data analysis

2.5.1 MANOVA

A Multivariate Analysis of Variance (MANOVA) was conducted using IBM SPSS Statistics 29 to examine the effect of focus location on mean F0, mean intensity, and syllable duration). Max F0 was not considered as it was highly correlated with mean F0 ($r = 0.996$). This approach was adopted to determine whether the different focus locations are signaled by distinct acoustic profiles, and to assess the relative contribution of each acoustic dimension to this differentiation within a unified model.

The analysis included 120 observations, corresponding to the original utterances from the 4-level focus factor (initial, medial, final, and neutral). An initial check of three acoustic variables confirmed they were largely independent, with Pearson's r ranging from 0.042 to 0.163. The overall model revealed a significant multivariate effect of focus location, as indicated by Roy's Largest Root, $\Theta = 0.125$, $F_{(3,116)} = 4.834$, $p = 0.003$. This specific pattern of significance, where Roy's Largest Root was significant while other statistics were marginal, suggests that the experimental manipulation influenced the dependent measures primarily through a single, dominant discriminant function (Field, 2009).

Discriminant analysis extracted one significant function, which accounted for 85.3% of the between-group variance (canonical $R^2 = 0.11$). The test of functions showed that while the overall multivariate effect was marginal (Functions 1-3: $\Lambda = 0.87$, $\chi^2(9) = 16.08$, $p = 0.065$), this effect was concentrated entirely in the first discriminant function. The remaining functions (2 through 3) contributed no significant discriminatory power, $\Lambda = 0.98$, $\chi^2(4) = 2.47$, $p = 0.649$, indicating that Function 1 captured the primary—and essentially only—meaningful dimension separating the groups.

The structure matrix, which displays the correlations between the original variables and the discriminant function, showed that all three acoustic variables contributed substantially to this primary function (loadings: mean F0 = 0.634, intensity = 0.458, duration = 0.546). This indicates that the primary acoustic correlate distinguishing focus locations in Fijian is a general prosodic prominence signal to which fundamental frequency, intensity, and duration all contribute, rather than a process governed by a single acoustic parameter.

2.5.2 Main analysis – linear mixed-effects models

We then fitted linear mixed effects models to the original acoustic data (syllable mean F0, syllable mean intensity and syllable duration) using the R *lmerTest* package (Kuznetsova et al., 2017). Focus Location was added to each model as a fixed effect, with neutral focus set as the baseline level. Each corrective focus condition was compared to this baseline, forming neutral-initial, neutral-medial, and neutral-final pairs. The significance of the fixed effect was assessed using a likelihood ratio test via the *anova()* function, which compares models fitted with maximum likelihood (ML). The final model was fitted with restricted maximum likelihood (REML), and the resulting fixed effect p-values were obtained using Satterthwaite's approximation. Post-hoc pairwise comparisons among Focus Location levels were conducted with the *emmeans* package (Lenth, 2020) using Tukey adjustment, with degrees of freedom estimated via the Kenward-Roger method. The model formulas for the original acoustic variables are listed in Supplementary Tables 2-4.

The decision to include only a random intercept for Speaker was informed by preliminary analyses that indicated fitting a random slope for Speaker led to convergence issues. To ensure model stability and interpretability, we opted to include only the random intercept. This choice allowed us to maintain a focus on the primary fixed effects of interest while avoiding complications associated with singular fits.

2.5.3 Generalized additive mixed models

Generalized Additive Mixed Models (GAMMs) were also fitted to the time-normalized F0 and intensity data using the R package *mgcv* (Wood, 2017) to visualize the effect of different focus locations. The modeling strategy was based on the method presented by Lee et al. (2024), incorporating Focus Location (simple-coded) as a fixed effect in both models. A smooth term for the predictor Time by Focus Location was specified using thin-plate regression splines with 60 basis functions. A random effect for Speaker was modeled for Focus Location. An additional by-speaker random smooth for Time by Focus Location was modeled using factor-smooth regression splines and first-derivative penalties, also employing 60 basis functions. The adequacy of spline complexity was confirmed using the *gam.check* function. Although the k-index for the intensity model was 0.99 (smaller than 1), the GAMM revealed significant non-linear effects of time on intensity across focus locations ($p < 0.001$), with substantial between-speaker variability (random smooths $p < 0.05$). The k-index (0.99) and residual diagnostics supported model adequacy.

Pairwise contrasts between corrective and neutral focus conditions, as well as among the corrective focus conditions were then visualized using the R *itsadug* package. Model predictions were extracted over a 100-point Time grid, and pairwise differences were calculated alongside 95% Bayesian credible intervals. Time regions where the credible intervals excluded zero are interpreted as showing statistically meaningful differences between conditions.

3 Results

The linear mixed-effects models revealed that the main focus cues in Fijian *in-situ* focus marking are carried by F0 and intensity. Regarding syllable duration, our analysis showed no statistically significant effect of Focus Location on *in-situ* focus marking in Fijian NP sequences.

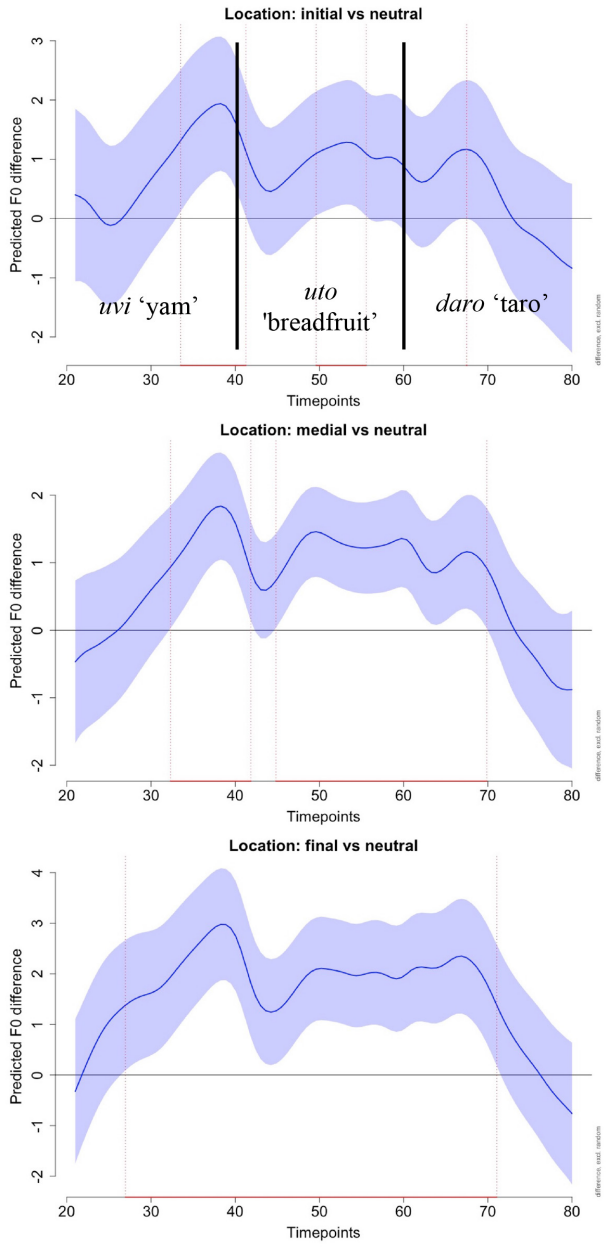

FIGURE 1
Focus location effect on time-normalized F0 (corrective focus conditions – neutral focus).

3.1 F0

The main effect of Focus Location on mean F0 was significant, $X^2(3) = 125.36$, $p < 0.001$. The *post-hoc* Tukey test revealed that the three corrective focus conditions had significantly higher F0 than neutral focus (all $p < 0.0001$). The GAMM plot (Figure 1) which compares time-normalized F0 between neutral focus and corrective focus, corroborates this pattern. Time windows, which exclude zero on the y-axis, are where the differences occur.

Among the corrective focus conditions, only final focus had a significantly higher F0 than initial focus ($p = 0.0001$). However, note that the short time window in the bottom panel in Supplementary Figure 3 where final focus and initial focus briefly appear to be significantly different in F0 suggests that this effect may not be reliable.

3.2 Intensity

Our linear mixed effects models indicated a significant main effect of Focus Location on mean intensity, $X^2(3) = 37.34$, $p < 0.001$. The *post-hoc* Tukey test showed that medial focus ($p = 0.0025$) and final focus ($p < 0.0001$) had greater intensity compared to neutral focus, while no significant difference in intensity was observed between neutral and initial focus. The exclusion of zero on the y-axis by the credible interval in Figure 2 confirms the pattern. More specifically, the plot demonstrated that the difference occurred mainly in NP3 (time windows 66.3 to 75.2 for medial-neutral comparison, 65.1 to 80 for final-neutral comparison).

Regarding the corrective focus conditions, the statistical analysis and the GAMM plot (see Supplementary Figure 4) showed inconsistent results. While the *post-hoc* Tukey comparisons indicated medial focus had greater intensity than initial focus ($p = 0.0301$) and intensity of final focus had no difference from medial focus ($p = 0.2178$), the GAMM plot showed the opposite. As for the final vs. initial focus comparison, a result similar to F0 counterpart was observed–although the *post-hoc* Tukey test indicated an elevated intensity in final focus than initial focus ($p < 0.0001$), some of the time regions in the GAMM plot may be too brief to conclude that the effect is stable.

3.3 Syllable duration

The main effect of Focus Location on syllable duration was not significant, $X^2(3) = 5.70$, $p = 0.1274$. Figure 3 illustrates the non-significant difference in syllable duration across focus locations. This non-significant univariate result stands in contrast to the substantial contribution of duration to the primary discriminant function as revealed by MANOVA (*cf.* Section 2.5.1).

4 Discussion

4.1 Summary of findings

This study aimed to address the following research questions: (RQ1) Is corrective focus different from neutral focus?; (RQ2), Are different corrective focus conditions in a NP sequence marked differently?; (RQ3) What acoustic cues (e.g., F0, intensity, duration) are used to mark focus within a sequence of NPs?. Our findings revealed significant F0 and intensity elevation in corrective focus conditions compared to neutral focus, thereby supporting RQ1 and answering RQ3. However, significant F0 and intensity elevation was not observed among the corrective focus condition pairs, thus refuting RQ2.

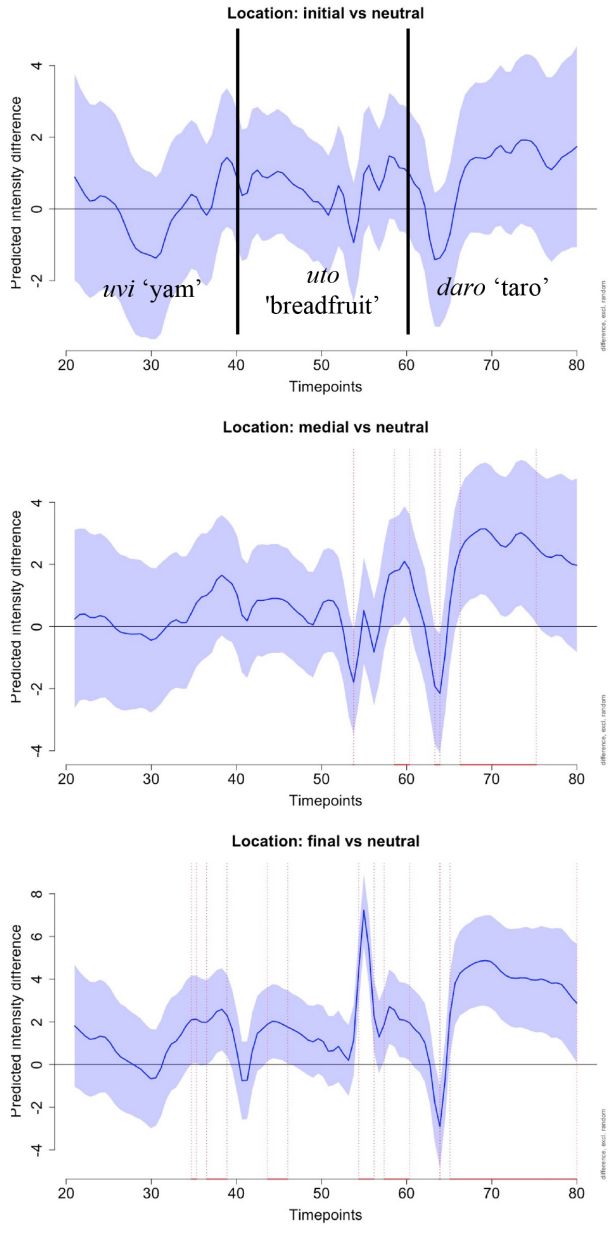

FIGURE 2
Focus location effect on time-normalized intensity (corrective focus conditions – neutral focus).

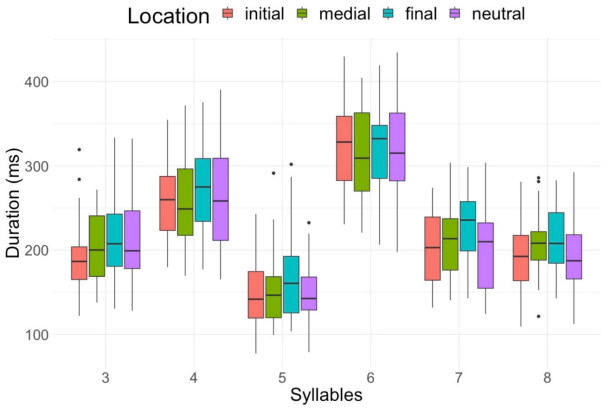

FIGURE 3
Syllable duration of different focus locations.

4.2 Differences in focus (corrective focus vs. neutral focus)

As expected, the linear mixed effects models demonstrated that the corrective focus utterances in Fijian are acoustically distinct from neutral focus utterances, as evidenced by significant differences in mean F0 and mean intensity. This pattern suggests that Fijian speakers employ variations in F0 and intensity to signal information structure changes. The elevation of F0 in corrective focus conditions aligns with the perceptual salience of pitch in marking focus, a phenomenon widely documented in focus prosody research. Specifically, stressed-based phonetic cues such as higher F0 and increased intensity have been shown to enhance the prominence of focused words (Kügler and Calhoun, 2020). For example, the specific finding that on-focus mean F0 in VP focus was significantly higher than in corresponding neutral focus (Lee et al., 2023) extends our understanding of how F0 functions as a key acoustic cue for focus marking in Fijian. This consistency with previous findings underscores the role of F0 as a salient marker in cross-linguistic focus prosody.

4.3 Differences among focus locations (initial vs. medial vs. final)

Our analysis also examined whether acoustic patterns differ among the corrective focus conditions. By analyzing Focus Locations within the item utterance (initial, medial, and final positions), intriguing results emerged. While the overall effect of Focus Location on F0 and intensity were inconclusive, *post-hoc* Tukey comparisons identified significant F0 and intensity differences between initial and final focus locations (mean F0 data, $p = 0.0001$; time-normalized F0 data, $p < 0.0001$; mean intensity data and time-normalized intensity data, both $p < 0.0001$). This suggests a potential systematic variation in F0 and intensity realization across different focus locations within the utterance.

Interestingly, while unexpected, this result mirrors results from a study on the marking of sentence focus, predicate focus and argument focus (narrow focus conditions), as well as all-old contexts (broad focus) in canonical verb-predicate clauses in Tagalog, another Austronesian language (Nagaya and Hwang, 2018)[1]. In Nagaya and Hwang (2018), F0 and intensity were significantly higher in all focused conditions compared to neutral contexts, yet differences among focused conditions were not substantial. The authors attributed this pattern to between-speaker variation, based on a sample size of five participants. Since a similar pattern is observed in the current study, despite the sample size

1 We would like to express our appreciation to Ms. Alessa Farinella for pointing out this study.

of speakers being doubled, this suggests that there may be other underlying factors contributing to this phenomenon.

4.4 Acoustic cues utilized in focus marking

While MANOVA shows that F0, intensity, and duration all contributed substantially to the primary discriminant function, the univariate linear mixed effects models revealed that F0 and intensity are the most prominent acoustic markers of corrective focus in Fijian *in-situ* focus marking. This is evidenced by significant differences between the initial and final focus positions for both F0 and intensity (mean and time-normalized data).

Regarding the mean syllable duration data, the absence of significant main effect or *post-hoc* comparisons in the model suggests that duration may indeed play a non-significant role in *in-situ* focus marking in Fijian. This non-significant effect resonates with studies such as Liberman and Pierrehumbert (1984), where certain intonational cues, namely F0 contours in the article, were found to exhibit invariance despite manipulations in pitch range and utterance length. It highlights the complexity and multifaceted nature of acoustic signaling in prosody. These results suggest that while F0 and intensity serve as robust cues for focus marking in Fijian, duration may require further investigation to fully understand its role and limitation within the language's prosodic framework.

4.5 Caveats and limitations

As a first systematic production study of Fijian focus prosody, this pilot study explores the correlates of focus in scripted utterances, facilitating condition comparisons. However, eliciting scripted data with a single template may impose task-specific constraints, potentially limiting the capture of a full range of intonational patterns and focus marking strategies. Information structure categories, established on subtle meaning distinctions (see Lambrecht, 1994), are difficult to capture in a laboratory context. Consider the interplay of "newness" for instance, the condition on which narrow focus is based, and "contrast", the updating of the shared presupposition between the speakers that underpins corrective focus. How new can the information be when participants have been involved in the task already? Nonetheless, this study forms part of a larger project (Lee et al., 2023). The item naming task served as a control experiment, as focus marking in natural utterances may vary and could be independent of acoustic cues, such as fronting. Since a recording session consisted of three repetitions, involving both natural utterances in a picture description task and scripted utterances in an item naming task in each round, the time needed for one recording session could be too long and scared away potential participants. Consequently, collecting a sizeable database of natural utterances may necessitate sacrificing the number of observations in this control experiment. A further factor that may have influenced the production of the participants is cultural: the participants may have tempered their responses as they were addressing their professor, a person they respect which in the Fijian context is not trivial. Further studies of lesser-studied languages need to consider such aspects in the experimental design.

5 Significance and implications

This research constitutes a significant advancement in the field of Fijian linguistics, marking the first systematic investigation into focus marking in the language. Although the generalizability of the present study's results may be limited by the nature of the target stimuli, this work helps establish a foundational basis for subsequent research exploring the intersection of prosody and information structure within Fijian discourse. Additionally, our pilot study, which served as a control experiment within a larger project (Lee et al., 2023), contributes to the broader study of prosody typology, offering insights that inform theoretical frameworks of focus prosody across diverse languages. Importantly, our examination of focus prosody in a lesser-studied language carries substantial implications for language documentation and preservation efforts, thereby supporting the preservation of linguistic diversity and cultural heritage.

6 Conclusion

In conclusion, this study demonstrates that Focus (neutral vs. corrective focus), rather than Focus Location (initial vs. medial vs. final focus), significantly influences *in-situ* prosodic focus marking in Fijian. Furthermore, the Fijian language does not appear to utilize duration as a primary prosodic cue for focus marking in NP sequences. Instead, raised F0 and intensity serve as the phonetic cues for marking focus, regardless of the location of the corrective focus. To deepen our understanding of Fijian *in-situ* focus prosody, further research should aim to recruit a larger and more diverse sample of native Fijian speakers. This approach would enhance the generalization of findings. Additionally, employing a broader array of stimuli that encourage the use of acoustic cues while minimizing reliance on syntactic means (e.g., fronting) would be beneficial.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

The studies involving humans were approved by Human Research Ethics Committee, Research and Development Office, The Education University of Hong Kong. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

Author contributions

SM: Writing – original draft, Writing – review & editing. CS: Writing – review & editing. AT: Writing – review & editing. AL: Writing – original draft, Writing – review & editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declared that generative AI was used in the creation of this manuscript. We used generative AI to assess the caveats and limitations of our study.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/flang.2025.1655620/full#supplementary-material

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