

## F0 characteristics of sexuality-diverse Australian adolescents with and without symptoms of depression in The Future Proofing Study Corpus

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Depression has a prevalence rate of 8%-15% among teenagers in Australia [1,2]. The Future Proofing Study (FPS) examines factors associated with mental health, including depression, among adolescents in Australia using big data [2]. FPS collected demographic and mental health surveys from 6388 adolescents, as well as smartphone speech recordings from 781 adolescents elicited with a series of tasks. As changes in speech, such as lower fundamental frequency (F0) and reduced F0 range are often symptoms of depression in adults, the FPS corpus may be used for developing speech-based automatic depression screening algorithms [3,4]. To improve validity and interpretability of such algorithms, phonetic analysis of the FPS corpus is required. Thus, we explored F0 patterns in this corpus in a retrospective study. Based on adult studies, adolescents with symptoms of depression were hypothesised to show lower F0 and reduced F0 range compared to those without depression [3].

Two tasks with large expected F0 range were selected from the corpus: 1) the prosodic sentences task consisting of two contrasting paired sentences; and 2) the affective sentences task with one positive, one negative, and one neutral valence sentence. 6,388 participants submitted survey data, 781 submitted speech data, and 106 submitted prosodic or affective sentences. To reduce non-depression related F0 variation, only Australian-born participants who speak English at home and reported no disabilities were considered. Out of these 69 speakers, 15 [male = 5, female = 10] reported symptoms of severe depression on the Patient Health Questionnaire for Adolescents (PHQA) [5]. All 5 boys were excluded due to their low numbers in the sample, and 3 girls were excluded due to low audio quality. The 7 included girls (mean age = 13.46) reported diverse sexualities (lesbian/bi-/pansexual = 5, straight = 2). The girls with depression were matched by 7 healthy girls according to age (mean = 13.34) and sexuality (diverse = 5, straight = 2), giving 14 speakers.

Minimum, maximum, range, mean, and standard deviation (SD) of F0 were extracted from a total of 14 (speakers) x 5 (sentences) = 70 sentences using Praat [6]. Presence of creak was marked based on auditory-visual observation. Due to the high number of F0 metrics, demographic variables, and low number of participants, the data were analysed using Pearson's correlation and significance testing was not conducted (Fig. 1). Increase in PHQA Total Score marks increased depression. PHQA CutPoint, with a threshold of 15 or above, indicates caseness of severe depression (coded as depressed = 1, not depressed = 0). Sexual orientation (coded as diverse = 1, straight = 0) was included, as 10 out of 14 girls in the sample reported being sexuality diverse. Age (years) was included to validate F0 metrics.

Puberty-related vocal effects were observed, as F0 mean and maximum decreased with age. Minimum F0 increased with age, potentially due to a decrease in the presence of creak [7]. In line with our hypothesis, depression was associated with lower minimum F0, potentially due to increased creakiness. Contrary to our hypothesis, depression was associated with increased mean, maximum, range, and SD. Sexuality diverse speakers were associated with higher minimum F0, potentially due to reduced creak, and with lower maximum, resulting in lowered range and SD of F0. Although the correlations were overall weak and the sample size small, the reduced range hypothesised for adolescents with depression instead characterised the group with diverse sexual orientations. Our results are consistent with reduced F0 range observed in American English-speaking lesbian adults [8,9].

Our F0 results, combined with the higher rates of depression for sexuality diverse adolescents in FPS corpus [2] may show the limits of convenience sampling for speech analysis of clinical- and minority populations and suggest that acoustic analysis is required prior to training automatic depression screening algorithms. Future work will involve further analysis of the FPS corpus to increase speaker numbers using different speech tasks.

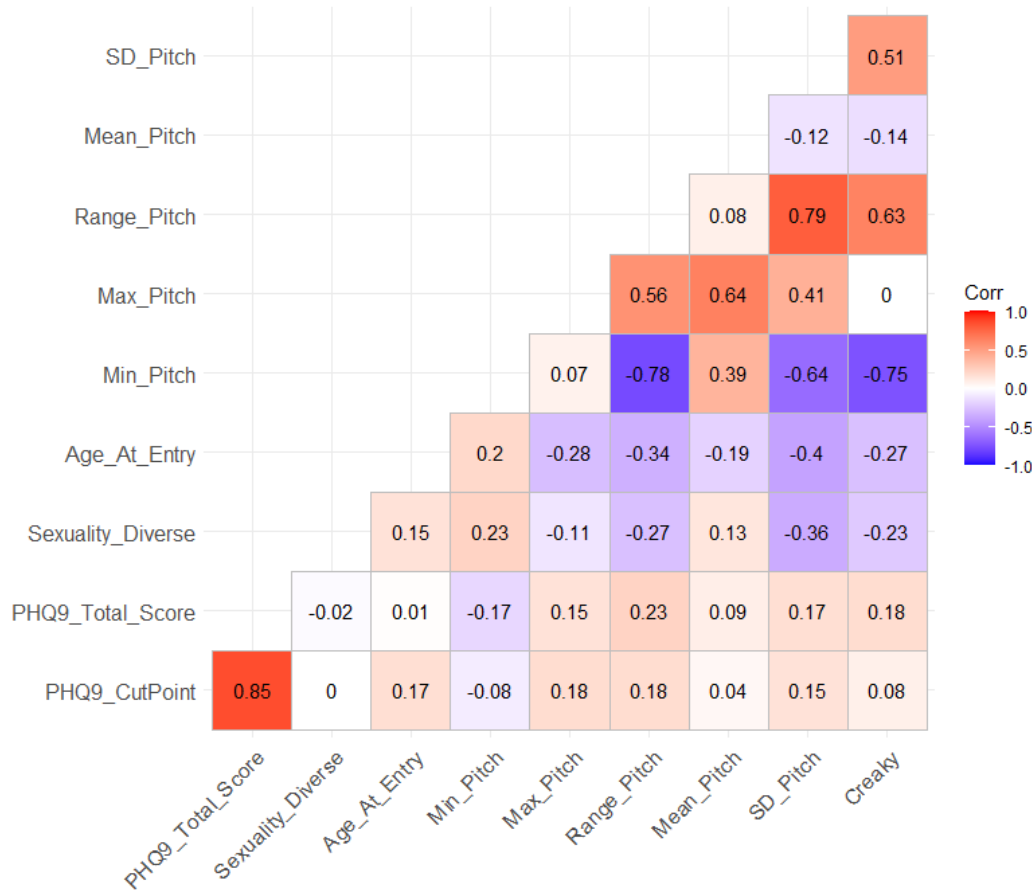


Fig. 1: Correlations between intonation characteristics, depression, and sexual orientation

### References

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