

Functional Flexibility in the Vocalisations of Children and Adolescents with Non- or Minimally Verbal Autism

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Approximately 30% of individuals with autism are non- or minimally verbal (NMVA), often defined as lacking multiword utterances at school age or using fewer than 25 functional words [1,2]. Despite this prevalence, little is known about the communicative abilities of this population. In some early infant (0-3 months) studies (e.g., [3,4]), vocalisations have been categorised as fixed signals, which show relatively inflexible valence (e.g., cries are negative, laughs are positive), or protophones, which exhibit functional flexibility: the ability to occur across different affective states and communicative contexts [3,5]. Such flexibility may provide a foundation for more elaborate communicative patterns, subsequently protophones have been suggested as precursors to speech and later language [4-7].

To date, no study has examined whether NMVA individuals' vocalisations demonstrate functional flexibility. To address this gap, we analysed an existing dataset [8] comprising audio-video recordings ($M = 32$ minutes, $SD = 8.4$) of 22 NMVA individuals (5 f, age: $M = 11;5$, $SD = 3;11$), collected during Autism Diagnostic Observation Schedule (ADOS; [9]) or adapted ADOS [10] sessions in Barcelona. We adapted the functional flexibility framework developed for early infant vocalisations by Jhang and Oller (2017) for use with NMVA individuals. Following this framework, vocalisations were considered functionally flexible if they occurred across positive, neutral, and negative contexts. To operationalise this, we tested whether protophones were produced in more variable contexts than cries and laughs, i.e., occurring more frequently in neutral contexts than both cries and laughs; less frequently in negative contexts than cries; and less frequently in positive contexts than laughs [3,4].

Coded vocalisation types included cries and laughs (fixed signals) and protophones such as complex syllables (CVC or more elaborate), simple syllables (CV or VC), vocants (vowel-like sounds and closants), and groans. Valence (positive, neutral, negative) was inferred from facial expressions and the context in which they occurred. Inter-rater reliability was strong for both vocalisation type (Cohen's $\kappa = .81$) and valence (Cohen's $\kappa = .84$). Bayesian mixed-effect modelling was used to assess whether protophones differed in valence from cries and laughs, providing a robust test of functional flexibility. As an exploratory second analysis, we examined whether functional flexibility varied with phonological complexity (e.g., whether simple syllables were more flexible than vocants).

A total of 2783 vocalisations co-occurred with identifiable facial expressions ($M = 179.2$, $SD = 134.2$ per participant), consisting primarily of complex syllables, vocants, and simple syllables. Cries were mostly negative, whereas laughs were predominantly positive (Fig. 1). Protophones were more frequently neutral than the fixed signals, with lower levels of positive and negative than the fixed signals. Statistical analysis largely supported these patterns: vocants were more likely to be neutral than cries ($OR = 14.15$, 95% CI [3.06, 62.18] and laughs (albeit to a lesser degree) ($OR = 3.42$, 95% CI [0.51, 19.49]), less likely to be negative than cries ($OR = 20.09$, 95% CI [10.59, 38.61]), and less likely to be positive than laughs ($OR = 12.18$, 95% CI [7.69, 19.11]). Similar patterns were observed for groans, simple syllables, and complex syllables (Table 1), but no effect of phonological complexity was observed.

In sum, despite being non- or minimally verbal, NMVA individuals produce vocalisations that exhibit functional flexibility independent of phonological complexity, occurring across multiple affective states rather than being tied to a single valence. These findings provide novel insight into the communicative potential of NMVA individuals and may inform the development of improved communication support for this group.

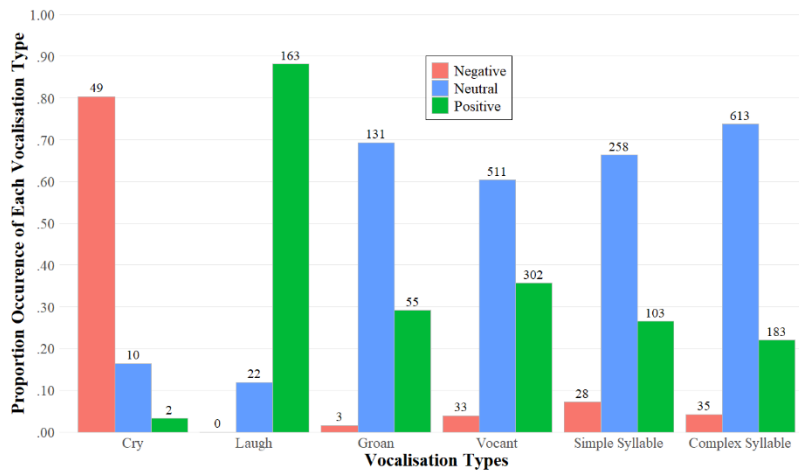


Fig. 1. Bar height reflects the proportion of occurrences for each valence per vocalisation type. Numbers on top of the bars show the total number of vocalisations of each protophone type within each valence category.

Table 1. Summary table for odds ratio results.

Predictions	Groan		Vocant		Simple Syllable		Complex Syllable	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Prot < cry in negativity	56.83	[20.49, 170.72]*	20.09	[10.59, 38.61]*	24.53	[12.42, 49.90]*	33.45	[16.61, 68.72]*
Prot > cry in neutrality	65.37	[11.47, 361.41]*	14.15	[3.06, 62.18]*	20.49	[4.26, 94.63]*	27.94	[5.70, 126.47]*
Prot < laugh in positivity	19.89	[11.47, 34.81]*	12.18	[7.69, 19.11]*	14.59	[8.85, 23.81]*	14.44	[9.03, 23.34]*
Prot > laugh in neutrality	15.80	[1.79, 144.43]*	3.42	[0.51, 19.49]	4.95	[0.68, 29.08]	6.75	[0.93, 40.45]

Note.* indicates 95% confidence interval excluding 1.

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