

# Caregiver prosody is contingent on infant sustained visual attention

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## Highlights

1. Caregivers naturally modulate the pitch of their utterances into 4 different prosodic contours during naturalistic free-play with their infants: hill, rise, fall, and valley.
2. Time-series analysis reveals that sustained visual attention in infants coincides with specific utterance prosodies
3. Linear mixed-effects models reveal that percentile SVA duration decreases between 12-15 months and 21-24 months, and that valley-type prosodic contours decrease the percentile duration of infant SVA

## Natural clusters of caregiver vocalization

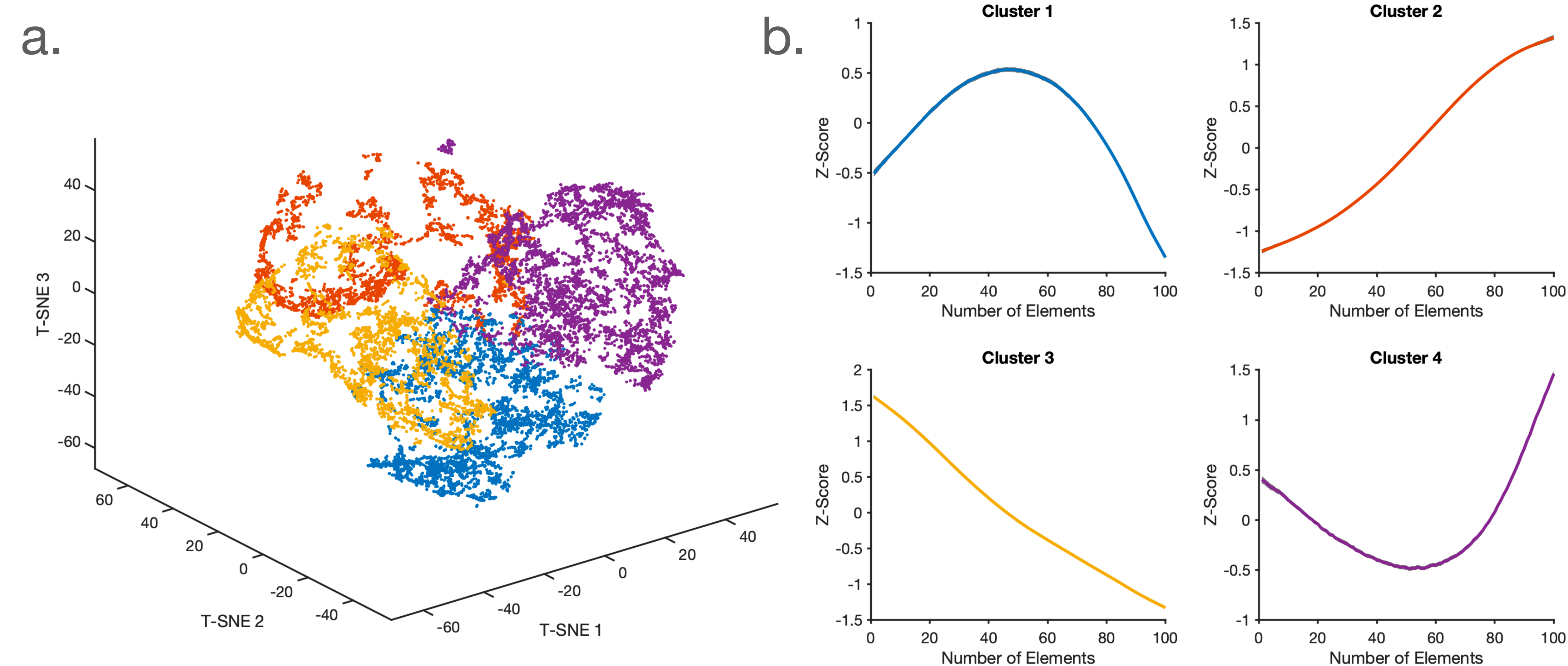


Figure 2a. T-Stochastic Neighbor Embedding (TSNE) coordinates ( $N = 18,248$ ) of naturalistic caregiver vocalizations, using Dynamic Time Warping (DTW) as a distance metric. Figure 2b. Averaged pitch contours corresponding to each cluster.

## Introduction

During infancy, caregivers play an instrumental role in scaffolding infant behaviors that ultimately cascade into significant developmental achievements. Of these behaviors, sustained visual attention (SVA) is crucial. According to extant research, caregivers support SVA through strategic manipulation of the environment and speech. This research also suggests that infants pay more attention to objects when caregivers are not only holding them, but also talking about them (Suarez-Rivera et al., 2019). However, the exact mechanism of how caregivers modulate the prosodic structure of their voice to influence infant SVA during naturalistic play is unknown.

## Methods



Figure 1. Caregiver and infant engaged in naturalistic free-play.

## Results

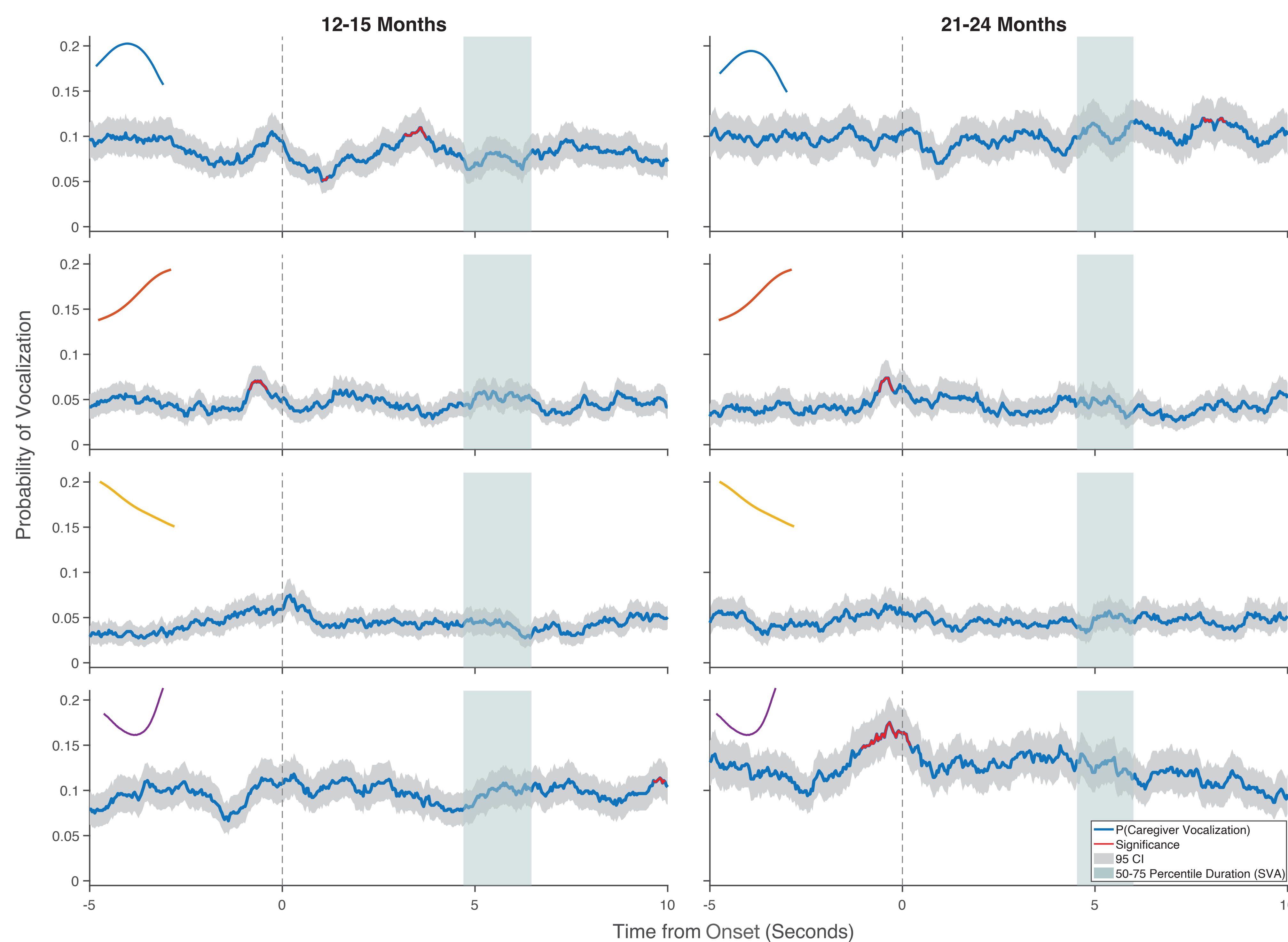


Figure 3. Probability of a caregiver vocalization given an onset of infant SVA according to vocalization cluster.

## Mixed Effects Models

1. Decrease of percentile SVA duration during valley vocalizations independent of age ( $\beta = -0.014$ ,  $p = 0.022$ )
2. Overall decrease of percentile SVA duration between 12-15 months and 21-24 months of age ( $\beta = -0.035$ ,  $p < 0.001$ )

## Conclusion

Caregivers organize the prosodic modulation of utterances into 4 distinct clusters, which may differentially influence infant SVA.

For younger infants, rising contour utterances coincided with the onset of SVA. For older infants, rise and valley contours coincided with SVA onset.

Valley type vocalizations decrease the duration of infant SVA, suggesting that these prosodic contours may be used to re-direct infant attention.

Future directions will determine whether utterance prosody impacts the behavioral state of the infant.

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