## Supplementary media

**Video 1: Dysarthric speech of the participant.** This video shows the participant, who has severe dysarthria due to ALS, attempting to speak the sentences cued on the screen. The participant's speech is unintelligible to naïve listeners. From post-implant day 27.
Link to view online: https://ucdavis.box.com/s/p8197z804du92225ff0o06l263tjhxcb

**Video 2: Closed-loop voice synthesis during attempted vocalized speech.** This video shows 13 consecutive closed-loop trials of instantaneous voice synthesis as the participant attempted to speak cued sentences. The synthesized voice was played back continuously in real-time through a speaker. From post-implant day 179.
Link to view online: https://ucdavis.box.com/s/esulu85i7meojqnpphr65ioq9pui9xbq

**Video 3: Closed-loop voice synthesis with simultaneous brain-to-text decoding.** This video shows 15 consecutive closed-loop trials of instantaneous voice synthesis with simultaneous brain-to-text decoding that acted as closed-captioning as the participant attempted to speak cued sentences. From post-implant day 110.
Link to view online: https://ucdavis.box.com/s/mw6h5pzvvy6d9kzrt7ayzg1wiag7nxrv

**Video 4: Closed-loop voice synthesis during attempted mimed speech.** This video shows 10 consecutive closed-loop trials of instantaneous voice synthesis with audio feedback as the participant "mimed" the cued sentences without vocalizing. The decoder was not trained on mimed speech neural data. From post-implant day 195.
Link to view online: https://ucdavis.box.com/s/wpvbw5wogy5kvoalknomfgmf56kxnxmm

**Video 5: Closed-loop voice synthesis during self-initiated free responses.** This video shows 9 closed-loop trials of instantaneous voice synthesis with audio feedback as the participant responded to open-ended questions or was asked to say whatever he wanted. We used this opportunity to ask the participant for his feedback on this brain-to-voice neuroprosthesis. A brain-to-text decoder was used simultaneously to help with understanding what the participant was saying. From post-implant days 172, 179, 186, 188, 193 and 195.
Link to view online: https://ucdavis.box.com/s/bl24hf5kojnz5lm7b6rfq6ejxcm82f0o

**Video 6: Closed-loop own-voice synthesis during attempted speech.** This video shows 9 consecutive closed-loop trials of instantaneous speech synthesis in a voice that sounds like the participant's own pre-ALS voice as he attempted to speak cued sentences. From post-implant day 286.
Link to view online: https://ucdavis.box.com/s/0vbppq1bevhhblrdfs465fdwuvcn06nd

**Video 7: Closed-loop voice synthesis of pseudo-words.** This video shows 5 consecutive trials of closed-loop synthesis of made-up pseudo-words using the brain-to-voice decoder. The decoder was not trained on any pseudo-words. From post-implant day 179.
Link to view online: https://ucdavis.box.com/s/4qhzyvr0i364xsvaej8zicaf5na4zr44

**Video 8: Closed-loop voice synthesis of interjections.** This video shows 5 trials of closed-loop synthesis of interjections using the brain-to-voice decoder. The decoder was not trained on these words. From post-implant day 186.
Link to view online: https://ucdavis.box.com/s/m234b9ilqpmmcv1yyrmqvchq1z8k3ttl

**Video 9: Closed-loop voice synthesis for spelling words.** This video shows 7 trials of closed-loop synthesis where the participant was spelling cued words one letter at a time using the brain-to-voice decoder. The decoder was not trained on this task. From post-implant day 186.
Link to view online: https://ucdavis.box.com/s/cv8l2ef2t5u4i2km4lwi122z67mxckie

**Video 10: Closed-loop question intonation.** This video shows 10 selected trials where the participant modulated his intonation to say a sentence as a question (indicated by '?' in the cue) or as a statement by using an intonation decoder that modulated the brain-to-voice synthesis in closed-loop. From post-implant day 286.
Link to view online: https://ucdavis.box.com/s/67xnduo76355v93nzjuvez5utll5qung

**Video 11: Closed-loop word emphasis.** This video shows 8 selected trials where certain (capitalized) words in the cued sentences were emphasized by the participant by using an emphasis decoder that modulated the brain-to-voice synthesis in closed-loop. From post-implant day 286.
Link to view online: https://ucdavis.box.com/s/s7crvym9q9dro5mo9a6wmlltjuy0c88f

**Video 12: Singing three-pitch melodies in closed-loop.** This video shows 3 consecutive trials where the participant sung short melodies with three pitch targets by using a pitch decoder that modulated the brain-to-voice synthesis in closed-loop. At the start of each trial, an audio cue plays the target melody. The on-screen targets then turn from red to green to indicate that the participant should begin. The vertical bar on the left of the screen shows the instantaneous decoded pitch (low, mid, high). Additionally, interactive visual cues for each pitch target are shown on the screen. These cues show the note in the melody that the participant is singing, providing visual feedback. From post-implant day 342.
Link to view online: https://ucdavis.box.com/s/quj4z50adoibkfysgse21b6t5jzk7xmp

**Video 13: Singing three-pitch melodies in closed-loop using a unified brain-to-voice decoder.** This video shows 3 trials where the participant sung short melodies with three pitch targets by using a single unified brain-to-voice decoder that inherently synthesizes intended pitch in closed-loop. At the start of each trial, an audio cue plays the target melody. The vertical bar on the left of the screen shows the instantaneous decoded pitch (low, mid, high) for visual feedback only and the decoded pitch is not used in the unified brain-to-voice model. Interactive visual cues show the note in the melody that the participant is singing, providing visual feedback. From post-implant day 342.
Link to view online: https://ucdavis.box.com/s/qu5nwz8qg6hpxtqnvjqkxla1mhoic99c

**Video 14: Closed-loop voice synthesis in session 1.** This video shows 3 closed-loop trials of instantaneous voice synthesis from the participant's first day of neural recording (post-implant day 25). The brain-to-voice decoder was trained during this session using 190 sentence trials from a limited 50-word vocabulary recorded earlier on the same day. The second part of the video shows the same three trials reconstructed offline using an optimized brain-to-voice decoder (i.e., the algorithm used throughout the rest of this manuscript), which has improved intelligibility.
Link to view online: https://ucdavis.box.com/s/aw59fr2kddxkyagw7phmobg1d1hiwp9d

**Audio 1: Acausal speech synthesis by predicting discrete speech units.** This audio shows 3 example trials of speech reconstructed offline using the approach of predicting discrete speech units acausally at the end of the sentence using CTC loss. From post-implant day 25.
Link to view online: https://ucdavis.box.com/s/b0r5n00n0rss0fjdk4b1xuzf1gvy3mwn