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How the songbird brain listens to its own songs

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Songbirds are capable of vocal learning and communication and are ideally suited to the study of neural mechanisms of auditory feedback processing. When a songbird is deafened in the early sensorimotor phase after tutoring, it fails to imitate the song of its tutor and develops a highly aberrant song. It is also known that birds are capable of storing a long-term memory of tutor song and that they need intact auditory feedback to match their own vocalizations to the tutor's song. Based on these behavioral observations, we investigate feedback processing in single auditory forebrain neurons of juvenile zebra finches that are in a late developmental stage of song learning. We implant birds with miniature motorized microdrives that allow us to record the electrical activity of single neurons while birds are freely moving and singing in their cages. Occasionally, we deliver a brief sound through a loudspeaker to perturb the auditory feedback the bird experiences during singing. These acoustic perturbations of auditory feedback reveal complex sensitivity that cannot be predicted from passive playback responses. Some neurons are highly feedback sensitive in that they respond vigorously to song perturbations, but not to unperturbed songs or perturbed playback. These findings suggest that a computational function of forebrain auditory areas may be to detect errors between actual feedback and mirrored feedback deriving from an internal model of the bird's own song or that of its tutor.