encoded, single-component magnetogenetic system has yet to be applied to the nervous system of behaving vertebrates. Here we have expanded on these strategies by engineering a magnetogenetic actuator through fusion of the nonselective cation channel TRPV4 (refs. 13–15) to the paramagnetic protein ferritin[16]. We have successfully applied this actuator to the nervous system and validated it using *in vitro* calcium imaging, brain slice electrophysiology, *in vivo* electrophysiology and acute modulation of behavior in freely moving zebrafish and mice.