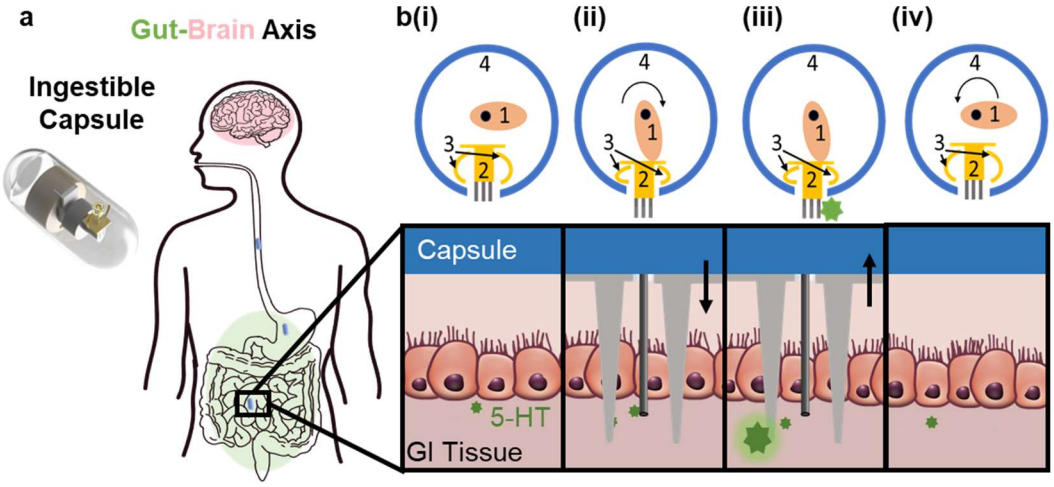
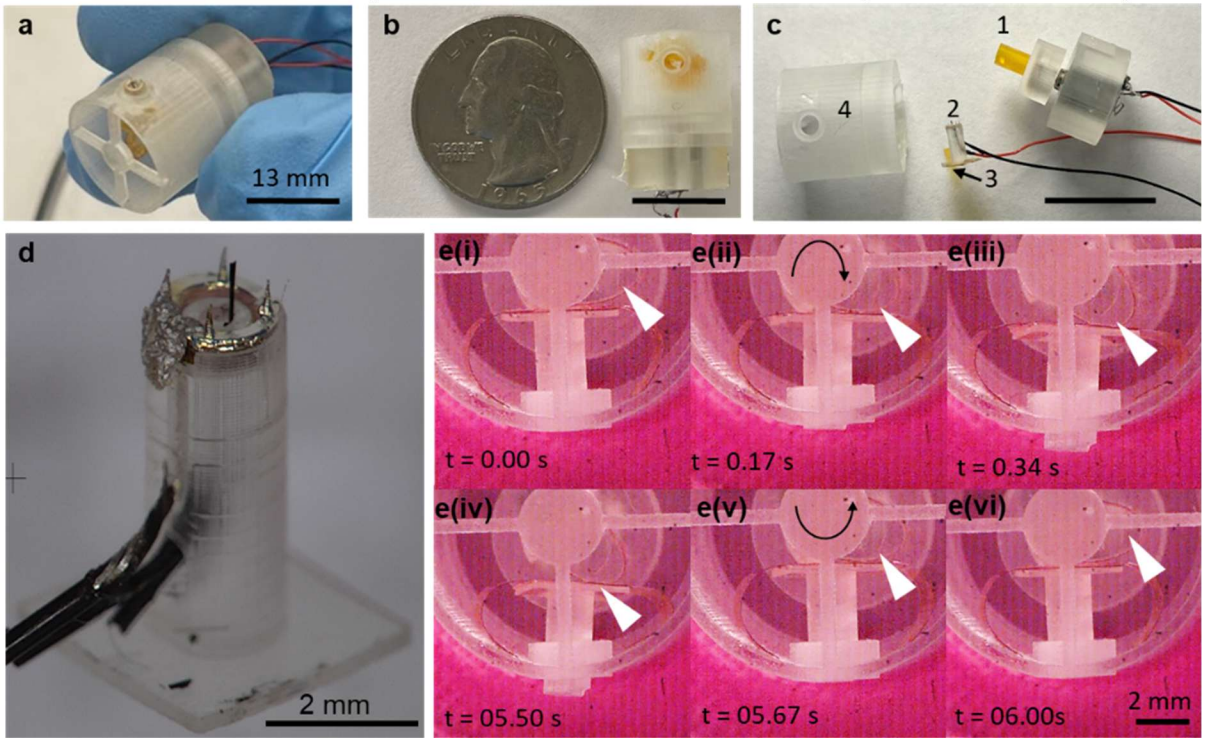
Supplementary Fig. S1: (a) An overview of the ingestible capsule approach for investigating the GBA where MN achieve access to subepithelial 5-HT concentrations. (b) The CnF is comprised of (1) cam, (2) follower with biosensor, (3) Kapton spring, and (4) capsule housing. Its operation can be summarized by: (i) drive the cam, (ii) raise the biosensor out of the capsule, (iii) perform an electrochemical measurement, and (iv) turn off motor to retract the biosensor into the capsule.



Supplementary Fig. S2: (a-b) Images of biosensing module. (c) Exploded view of module with cam (1), follower (2), Kapton® spring (3), and capsule shell (4). (d) Image of the fabricated biosensor. (e) Slow-motion capture of the CnF actuation mechanism. (i) Before actuation such that the biosensor is inside capsule. (ii-iii) During actuation the follower is pushed outside of the capsule until spring compression prevents further cam rotation and causes the biosensor to remain outside of the capsule. (iv-vi) Micromotor turned off, returning the biosensor inside capsule.



Supplementary Fig. S3: (a) Experimental results showing the actuation force of the CnF (red line required insertion force of MN on biosensor). (b) Measurement of the maximum force exerted by the follower shows a consistent actuation force for consecutive measurements. (c) Quantification of biologically relevant concentration of 5-HT in tissue phantom via CV, where an oxidation peak current at 0.4V vs Ag/AgCl.