Algorithm 1: Self-Registration(E,T)

Input: E: the subject's epi sequence.
T: the subject's anatomical scan.
Result: E_T: the subject's epi sequence in anatomical space.

// brain-extract the T1w image since FLIRT likes brains, not skull-on images
1 $T_b = bet(T, -f0.3 - R - B - S)$
// do a 3d translational FLIRT. centers the epi brain with the T1w brain translationally; that is, places the x, y, and z of the epi brain in the optimal position with respect to the T1w brain (no reshaping/scaling)
2 $xfm1 = flirt(E, T_b, sch = 3dtrans.sch)$ // just does translations
// do a local-optimization FLIRT. does a very gentle 3D parameter search given the 3d translational search, and attempts to make the smallest scalings that maximize local fit (ie, brain boundary)
3 $xfm2 = flirt(E, T_b, init = xfm1, sch = simple3d.sch)$ // gentle reshaping
4 $E_{local} = applyxfm(E, T_b, xfm2)$
// do epireg using the bbr cost function. aligns the white-matter/gray-matter anatomical border to the most probable white-matter/gray-matter functional border, to align individual gyri between the t1w image and the epi image
5 $E_{bbr} = epireg(E_{local}, T, T_b)$
// resample to change the voxel space from the original epi coordinates to those of the t1w image, thereby giving us a up-sampled image since the epi image is a lower resolution than the t1w image.
6 $E_{bbr} = resample(E_{bbr}, T_b)$

Algorithm 2: Template-Registration(E,T,M)

Input: E: the subject's epi sequence in anatomical space.
T: the subject's anatomical scan.
M: the template MNI152-2mm brain; contains a $skull - on$ (M_s) $brain$ (M_b) and $mask$ (M_m) attribute
Result: E_T: the subject's epi sequence in anatomical space.

// brain-extract the T1w image since FLIRT likes brains, not skull-on images
1 $T_b = bet(T, -f0.3 - R - B - S)$
// Do a 12 DOF affine transformation using FLIRT to get a good affine guess at how the epi brain aligns to the template brain
2 $xfm1 = flirt(T_b, M_b)$
// using the best 12 DOF affine as our initial guess from FLIRT, estimate a non-linear warping from the T1w space to the MNI152 space
3 $warp1 = fnirt(T, M, guess = xfm1, mask = M.mask, config = MNI152 - 2mm)$
// Apply the warping from the epi image in T1w space to MNI152-2mm template space using the non-linear transformation estimated from the T1w space to MNI152-2mm space, giving us the epi image in MNI real space
4 $E_{nonlin} = applywarp(E, M, guess = warp1)$
// Resample to change voxel space from T1w to those of the template image, which will allow our downstream timeseries operations to be in the proper brain-space
5 $E_{nonlin} = resample(E_{nonlin}, M_b)$
6 $T_{nonlin} = resample(T_{nonlin}, M_b)$