Supplemental Materials

Learning Situated Emotions

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Learning Procedure and Practice

When learning began on the first day, participants were first told about the full and core versions of the situations, and why each version was necessary. On hearing each full situation, participants were asked to immerse themselves in it from the first-person perspective, to construct mental imagery of the situation as if it were actually happening, and to experience it in as much vivid detail as possible. On hearing each core version later, participants were asked to reinstate being in the original situation imagined earlier for the full version, with all of its vivid sensory detail. Participants in the physical harm condition only received the physical harm situations; participants in the social evaluation condition only received the social evaluation situations. E-Prime software controlled all phases of the experiment, during both the learning sessions and the scan session. Participants listened to stimuli for the mental state words and situations over headphones, and made their responses on either keyboards or button boxes, as specified later.

During instructions to participants, across the learning tasks and test session, *fear, anger, plan,* and *observe* were referred to as "mental states." On each trial, participants heard a mental state word first, followed immediately by a situation, and were asked to imagine experiencing the mental state in the situation over the course of listening to it. Participants were further asked to experience the situation from the first-person perspective, to construct mental imagery of the situation as if it were actually happening, and to experience the situation in as much vivid detail as possible. The goal of learning was to practice experiencing each mental state extensively in all 25 situations for one situation type or the other (physical or social). In each of the three learning tasks, participants received each of the 4 mental states once in each of the 25 situations, for a total of 100 learning trials.

During the first learning task on the first day of learning, participants made three memory ratings on the computer keyboard as they experienced each mental state in the full version of a situation. First, participants rated, "How familiar are you with this type of situation, where your familiarity could come, not only from experiencing the situation, but from reading about it, seeing it on TV, hearing someone else talk about it, and so forth." Participants responded using a 1 to 7 scale for familiarity, where 1 indicated no familiarity, 4 indicated average familiarity, and 7 indicated high familiarity. Second, participants rated, "Have you ever experienced this type of situation yourself or been present when someone else experienced it?" Participants responded yes (1) or no (0). Third, participants were asked, "When was the last time that you experienced this type of situation either yourself or with someone else?" Participants responded within the past month (5), within the past year (4), within the past five years (3), any other earlier time (2), or never (1). After participants completed the three ratings for one full situation, they proceeded to the next situation, until all 20 situations in their situation condition had been judged.

In the second learning task on the first day, participants received each mental state word with the core version of each physical or social situation, and were asked to reinstate the full version heard in the previous task. Again, participants were asked to experience each mental state while being in each situation with as much vivid sensory detail as possible. In this second task, participants rated the vividness of the imagery that they experienced for the mental state in the situation. Specifically, participants rated their experienced imagery on four modalities (always in the same fixed order): vision, audition, bodily, and thought (affect was not mentioned explicitly for thought). For each modality, participants entered a rating on the keyboard using a 1 to 7 scale, where 1 meant no imagery at all, 4 meant moderate imagery, and 7 meant highly vivid imagery.

As the first day of learning drew to a close, participants were told what would happen on the second day of the experiment. Specifically, they were told about the final learning task and practice, what to expect while being in the scanner, and the importance of not moving.

On the second day of the experiment (one to three days after the first day, typically two), participants performed a third learning task, again with the full versions of their respective situations (physical or social). Participants received the full versions of the 25 situations again, so that they could refresh their memories of all the details, before receiving the core versions soon thereafter in the scanner. Again, core versions were used in the scanner, to maximize the use of scanning time, with the full versions being used initially to make the situational experiences as rich as possible. In this third learning task, participants received each mental state word and rated how much they experienced being immersed in the imagined situation with the mental state. Specifically participants rated, "How much did you experience 'being there' in the situation?" Participants responded on the computer keyboard, using a 1 to 7 scale, where 1 meant not experiencing being in the situation at all, 4 meant experiencing being in the situation a moderate amount, and 7 meant experiencing the situation very much, as if actually being there.

Preprocessing and Analysis

All preprocessing and statistical analyses were conducted in AFNI (Cox, 1996). The first anatomical scan was registered to the second, and the two datasets averaged to produce a single high-quality anatomical volume. The averaged anatomical volume was then skull-stripped, aligned to the same functional volume used later for registering the functional volumes, and transformed to Talairach space with an automated procedure that used the TT_N27. The functional volume used as the registration base for both the anatomical and functional data was near the end of the final functional run, thereby minimizing the warping required for aligning the anatomical and functional volumes. The anatomical scan was registered to the functional data so as to minimize the number of transformations performed on the functional data.

For the functional volumes, slice-time correction was performed first, followed by volume registration and transformation to Talairach space in a single step, thereby reducing error that occurs when functional data are warped independently multiple times. Specifically, the transformation matrix used in this single step combined transformations matrices from the following three processes: (1) warping the anatomical volume to the registration base, (2) warping the anatomical volume into Talairach space, (3) temporarily warping the functional volumes to the same registration base during motion correction. During this combined processing step, the voxel dimensions for the functional volumes were resampled from 3.44 × 3.44 × 2 mm to 2 x 2 x 2 mm. Voxels outside the brain were removed from further analysis, as were high-variability low-intensity voxels likely to be shifting in and out of the brain due to minor head motion. The remaining functional data were smoothed using an isotropic 6 mm full-width-half-maximum Gaussian kernel. Finally, the signal intensities in each volume were divided by the mean signal value for the respective run and multiplied by 100 to produce percent signal change from the run mean. All later analyses were performed on the percent signal change data.

Regression analysis was performed on the data of individual participants using a canonical single-parameter Gamma function to model the hemodynamic response. To establish the activations for each of the four mental states relative to the fixation baseline, each mental state was modeled as a 3 sec block. Because participants anticipated the mental states for 3 sec prior to a possible situation that could follow, modeling each mental state as a 3 sec block was more justified than modeling it as a brief event that only occurred briefly at the start of the 3 sec period. The situations for each participant were also analyzed as blocks, but for 9 sec. Thus, for each participant, betas were calculated for five conditions, all modeled as blocks: the four mental states, and the one type of situation received.

Six regressors obtained from volume registration during preprocessing were included to remove any residual signal changes correlated with movement (translation in the X, Y, and Z planes; rotation around the X, Y, and Z axes). Scanner drift was removed by finding the best-fitting polynomial function correlated with time in the preprocessed time course data.

As described in the main text, the catch trial design allowed us to separate activations for the mental states from activations for the subsequent situations that followed immediately (with no random jitter in between). Each of the four mental state conditions was modeled by creating one regressor that included mental state blocks from both complete trials and catch trials. Using a single regressor to model blocks from both trial types for a given mental state made it possible to mathematically separate activations for the mental state blocks from activations for the subsequent situation blocks. Thus, activations from the subsequent situation blocks were *not* included in the activations for each mental state condition. For each mental state, a total of 32 blocks was used to estimate its regressor (i.e., from 20 complete trials and 12 catch trials).

Two ANOVAS (analyses of variance) were performed on the betas of individual participants, one for each learning group (i.e., participants trained with physical harm situations vs. participants trained with social evaluation situations). In each random effects analysis, the only factor included was mental state, with four levels (*fear, anger, plan,* and *observe*). A voxel-wise significance level of $p < .005$, with a spatial extent threshold of 221 functional voxels, was used to threshold the resulting t maps, yielding a whole-brain threshold of $p < .05$, corrected for multiple comparisons. The spatial extent threshold was established using ClustSim in AFNI, which runs Monte Carlo simulations to estimate extent thresholds needed to exceed cluster sizes of false positives at a given voxel-wise threshold.

In additional analyses, lower spatial extent thresholds of 110 and 60 functional voxels were implemented to assess the robustness of the results observed at the 221 voxel threshold. Of interest was whether including smaller clusters at lower thresholds would significantly alter the conjunction analyses that assessed overlap for an emotion across situations.

Conjunction Analyses

Situation overlap analysis. As just described in the section on Preprocessing and Analysis, each conjunction analysis was performed once at an extent threshold of 221 voxels ($p < .05$), and again at lower extent thresholds of 110 and 60 voxels (to see if the conjunction results were robust when smaller clusters were included). To provide a thorough inventory of potentially relevant clusters, Tables 4 and 5 in the main text, and Tables S2 and S3 here, list the clusters from the analyses that used the 60-voxel threshold. Cluster listings from the 221 and 110-voxel analyses are largely the same, except for the absence of clusters below 221 and 110 voxels, respectively. Figure 2 in the main text displays the results for the 221-voxel threshold.

Note that when a conjunction analysis divided a significant cluster into one part that occurred in one situation and into another part that occurred in both situations, clusters could become smaller than the original extent threshold of 60 voxels. Thus, Tables 4, 5, S2, and S3 include cluster fragments down to 20 voxels. Although cluster fragments smaller than 20 voxels are not included in these tables, all fragments, no matter how small, were included in the voxel counts and overlap reported in Tables 6 and S4 (also in Figure 2). Thus, the voxel counts in Tables 4, 5, S2, and S3 do not add up to those in Tables 6 and S4.

Table 6 summarizes the voxel counts and overlaps across clusters for *fear*, *anger*, *plan*, and *observe* from Tables 4, 5, S2, and S3, once for each cluster threshold. As can be seen, lowering the spatial extent threshold from 221 voxels to 110 to 60 voxels had little effect on the overlaps observed for all four mental states

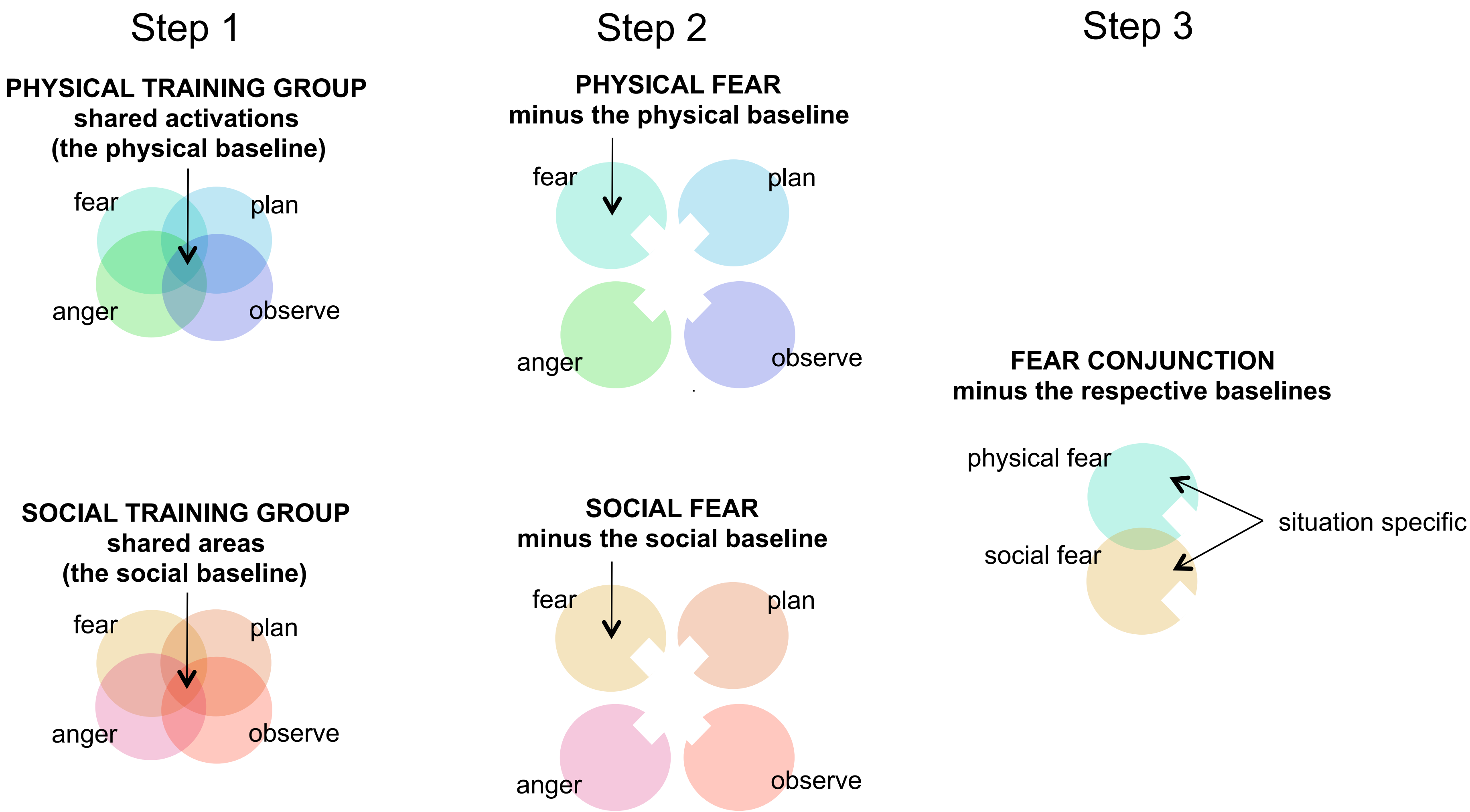

Figure S1. The process for computing the situation-specific, shared, and unique activations for a mental state (*fear, anger, plan,* or *observe*) across the physical and social training groups. In Step 1, shared activations across all four mental states in each training group are computed in a four-way conjunction analysis, establishing the physical vs. social baselines, respectively. In Step 2, the baseline activations for each training group are removed for each mental state in the same training group. In Step 3, the conjunction for each mental state across the physical and social training groups is computed, minus the respective baselines (shown only for *fear*), to establish shared and unique activations across training groups.

Table S1. Shared activations during the mental state phase in the physical and social baselines, from one conjunction analysis across the *fear*, *anger*, *plan*, and *observe* for each situation learning group (physical vs. social).

			Fear				Anger				Plan				Observe			
		Cluster	Max	Voxel			Max	Voxel			Max	Voxel			Max	Voxel		
Brain Region	Brodmann Area	Volume	Intensity *t*	x	y	z	Intensity *t*	x	y	z	Intensity *t*	x	y	z	Intensity *t*	x	y	z
Physical Situations Baseline																		
R STG	21/22/41/42	2,952	12.52	61	-11	6	14.32	63	-5	0	12.56	61	-9	6	14.86	51	1	-4
R posterior insula	13																	
L STG	21/22/41/42	2,313	10.15	-49	-15	6	14.27	-51	1	0	10.75	-31	-29	10	12.14	-49	-17	8
L posterior insula	13																	
Social Situations Baseline																		
R STG	21/22/41/42	2,614	18.98	61	-25	4	15.65	61	-25	4	21.47	63	-11	-2	19.46	49	-31	12
R posterior insula	13																	
L STG	21/22/41/42	2,285	16.59	-45	-15	8	17.68	47	-13	8	12.95	-47	-13	6	14.22	-57	-29	10
L posterior insula	13																	

Note. Activations were obtained using an independent voxel threshold of $p < .005$ and a cluster threshold of 221 voxels in each situation learning group (clusters larger 221 voxels or larger are significant at $p < .05$). R is right, L is left, and STG is superior temporal gyrus.

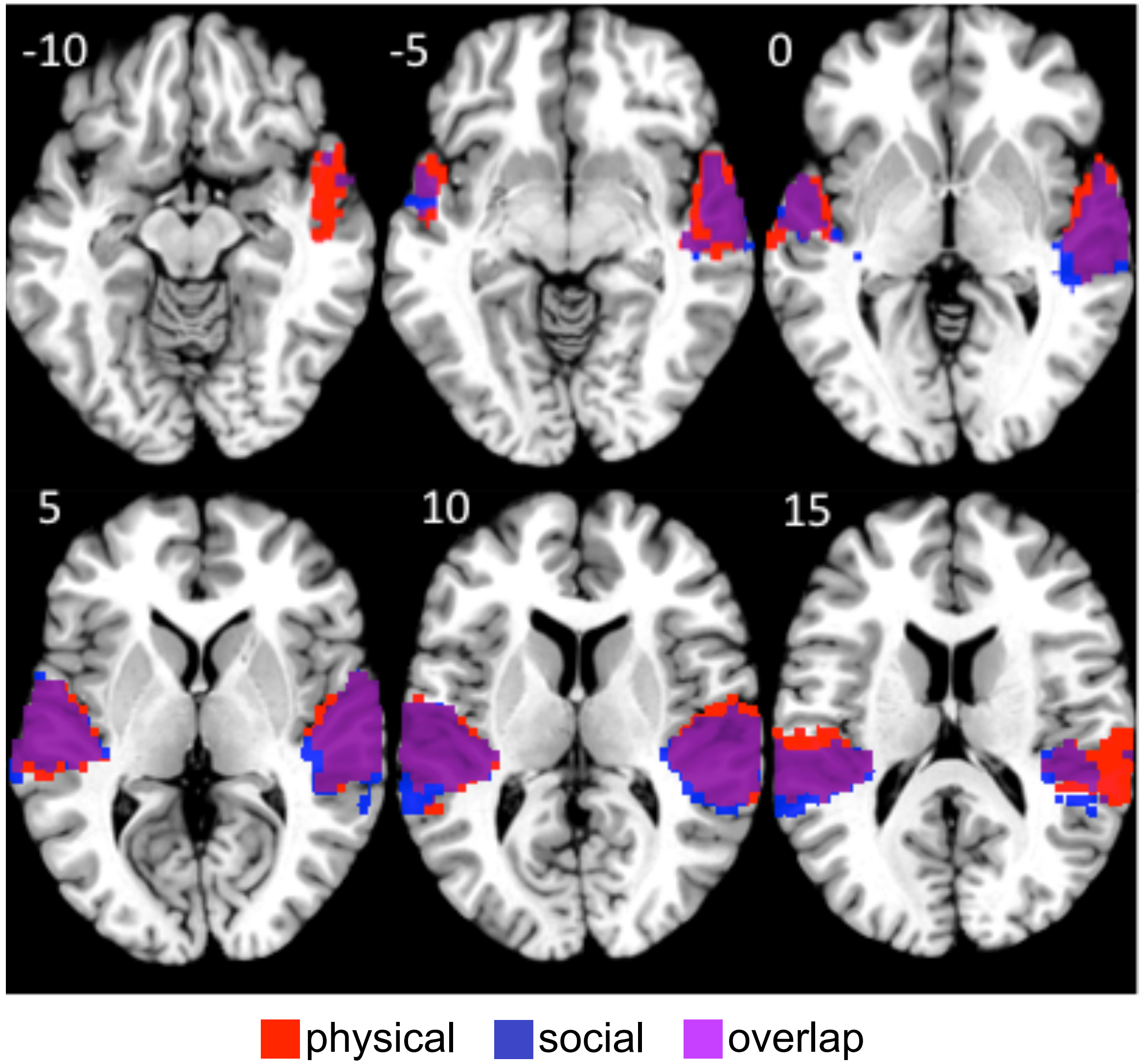

Figure S2. Activations from the mental states phase of the scanning trials for the physical and social baselines (i.e., neural areas active across all four mental states in a learning condition, most likely associated with auditory processing of the test cues). Unique physical activations (red), unique social activations (blue), and shared activations (purple) are shown. Full listings of activations can be found in Table S1. The supplementary text and Figure S1 provide detailed descriptions of how the baselines were computed and used.

Table S2. Unique and shared activations for *plan* from a conjunction analysis across activations in the physical and social learning groups.

Brain Region	Brodmann Area	Cluster Volume	Max Intensity t	Voxel x	y	z
Unique Activations in the Physical Learning Group						
R mid-temporal	21	605	8.60	47	3	-12
L mid-temporal	22	511	6.70	-29	-27	8
R temporal	22	429	6.95	57	-37	18
R supramarginal	40					
R caudate		423	6.22	21	15	32
R ACC	32					
L mid-temporal	21/22	375	6.88	-51	-1	-8
L temporal pole	38					
R frontal pole	10	224	8.12	27	55	22
L occipital lobe	17/18	159	5.54	-19	-87	-4
B thalamus (L anterior, R MD nucleus)		139	4.91	3	-1	10
R prefrontal cortex	9/10	70	4.64	19	33	30
L caudate body		66	5.07	-17	25	8
L cerebellum		63	5.87	-15	-57	-24
L mid-temporal	21	62	5.37	-63	-29	2
L supramarginal gyrus	40	20	4.36	-39	-39	30
Unique Activations in the Social Learning Group						
R occipital	18	386	5.65	25	-91	20
L fusiform gyrus (FFA)	19/37	359	7.52	-37	-73	-12
L precuneus		337	6.60	-25	-61	42
L occipital	18/19	195	5.24	-13	-83	30
R temporal	41/42	194	5.86	45	-37	14
R frontal	6	169	6.70	31	-7	60
L posterior insula		157	5.72	-37	-11	-6
B post-central	4	153	5.32	-3	-33	60
R fusiform (FFA)	19/37	140	7.49	41	-67	-12
R mid-cingulate	24/31	130	4.59	27	-7	34

L superior temporal	22	103	8.21	-33	-39	20
R fusiform	37	90	5.11	37	-51	-2
L ACC		89	5.78	-15	13	28
R occipital	18	79	4.25	23	-71	-10
L caudate		75	7.17	-21	-25	24
R cerebellum		72	5.29	1	-37	-4
R precuneus	7	63	5.36	33	-65	30
R ACC	32	49	4.75	21	37	14
L STG	22	34	4.28	-63	-1	0
L cingulate gyrus	23	22	4.44	-21	-11	28
L insula	13	21	4.81	-41	-13	10
Shared Activations Between the Physical and Social Learning Groups						
L caudate		110	6.56 (6.66)	-17 (-17)	-9 (-13)	30 (30)
L STG	22	34	7.21 (4.82)	-49 (-43)	-5 (-3)	-6 (-6)
R insula	13	28	4.86 (6.74)	31 (33)	-29 (-23)	18 (16)
L transverse temporal gyrus	42	22	5.63 (8.80)	-29 (-35)	-31 (-37)	10 (20)
L insula	13	21	5.09 (4.62)	-39 (-37)	-17 (-17)	-2 (-2)
R STG	22	20	5.67 (4.53)	53 (51)	1 (7)	4 (0)
L mid-occipital	18	20	4.88 (4.27)	-25 (-25)	-93 (-89)	6 (2)

Note. Activations were obtained using an independent voxel threshold of $p < .005$ and a cluster threshold of 60 voxels, in each of the two situation learning. Clusters having 221 voxels or larger are significant at $p < .05$. Smaller clusters are shown to provide a sense of weaker activations. Clusters smaller than 60 voxels resulted from the conjunction analysis producing cluster fragments, when different parts of a cluster were shared vs. unique. Cluster fragments smaller than 20 voxels are not shown. R is right, L is left, B is bilateral, dlPFC is dorsolateral prefrontal cortex, PCC is posterior cingulate cortex, STG is superior temporal gyrus, lOFC is lateral orbitofrontal cortex, ACC is anterior cingulate cortex, STG is superior temporal gyrus.

Table S3. Unique and shared activations for *observe* from a conjunction analysis across activations in the physical and social learning groups.

Brain Region	Brodmann Area	Cluster Volume	Max Intensity *t*	Voxel x	Voxel y	Voxel z
Unique Activations in the Physical Learning Group						
R lOFC	47	1,323	9.55	49	11	-12
posterior insula	13					
temporal pole	38					
superior temporal	22					
inferior frontal gyrus	6					
L posterior insula	13	1,112	8.33	-49	-13	-4
temporal pole	38					
L superior temporal	22					
R fusiform gyrus	20/37	226	6.62	43	-43	-24
L caudate		217	6.82	-15	25	10
R frontal cortex	6	111	4.88	43	5	42
L cerebellum		104	5.65	-35	-65	-18
R frontal pole	10	86	6.08	21	63	18
B cerebellum		66	4.93	1	-35	-8
L STG	42	41	5.85	-67	-19	10
L STG	22	30	6.59	-51	-35	6
Unique Activations in the Social Learning Group						
L mid-temporal	22	467	7.14	-65	-45	16
R mid-temporal	22	454	6.81	43	-13	-8
L mid-occipital	18/19	137	5.31	-43	-81	12
R thalamus (medial geniculum)		117	5.74	7	-35	4
R precuneus	7	113	4.72	27	-61	36
R frontal	6/9	90	4.66	35	7	30
R temporal pole	38	87	6.57	53	9	-10
L STG	22	40	5.01	-53	9	-2
L insula	13	40	5.38	-27	-29	20
R mid-temporal	21	37	5.87	67	-13	-8

Shared Activations Between the Physical and Social Learning Groups

L mid-temporal	22	78	5.56 (6.12)	-51 (-37)	-33 (-31)	4 (6)
R mid-temporal	22	63	5.55 (5.26)	51 (43)	-33 (-25)	-2 (-4)
L insula	13	36	5.24 (5.29)	-27 (-29)	-31 (-29)	24 (22)
L STG	22	28	6.07 (4.76)	-51 (-53)	5 (7)	0 (0)
R temporal pole	38	21	10.42 (6.41)	53 (53)	17 (17)	-12 (-10)

Note. Activations were obtained using an independent voxel threshold of $p < .005$ and a cluster threshold of 60 voxels, in each of the two situation learning groups. Clusters having 221 voxels or larger are significant at $p < .05$. Smaller clusters are shown to provide a sense of weaker activations. Clusters smaller than 60 voxels resulted from the conjunction analysis producing cluster fragments, when different parts of a cluster were shared vs. unique. Cluster fragments smaller than 20 voxels are not shown. R is right, L is left, B is bilateral, lOFC is lateral orbitofrontal cortex, and STG is superior temporal gyrus.

Brain Areas Included in the Limbic 1 and Limbic 2 Masks

The Yeo et al. (2011) mask for the limbic network (what we call "Limbic 1") contains the following anatomical regions: temporal pole, superior temporal gyrus, parahippocampal gyrus, inferior temporal gyrus including fusiform gyrus, inferior frontal gyrus, middle frontal gyrus, lateral and medial orbitofrontal cortex, ventromedial prefrontal cortex, and ventral anterior cingulate cortex.

The more complete limbic mask that LFB's lab developed ("Limbic 2") shares the following anatomical regions with Yeo et al'.s Limbic 1 mask: temporal pole, superior temporal gyrus, parahippocampal gyrus, fusiform gyrus, middle frontal gyrus, lateral and medial orbitofrontal cortex, ventromedial prefrontal cortex, and ventral anterior cingulate cortex. The additional anatomical regions in Limbic 2 include: insula, uncus, hippocampus, amygdala, caudate, putamen, dorsal anterior cingulate cortex, middle cingulate cortex, and posterior cingulate cortex.

Monte Carlo Simulations to Assess Random Overlap

Conjunction analyses for the same mental state across situations. Additional analyses assessed the possibility that the overlapping activations across physical and social situations for a given mental state occurred by chance. Consider the voxel overlap for fear in Figure 2 and Table 6. Of the 132,105 possible voxels assessed in the conjunction analyses, 10,656 were significantly active for fear in social situations and 3,496 were active in physical situations, with 610 overlapping voxels. In each of 10,000 Monte Carlo simulations, we randomly sampled 10,656 voxels of the 132,105 possible for social fear, and then randomly sampled 3,496 voxels for physical fear (i.e., simulating the random activation of voxels in each condition). We then established the number of overlapping voxels active in both sets. Across 10,000 simulations, the average number of overlapping voxels was 61.67, with the 95% confidence interval ranging from 47 to 77.5 voxels. Not a single simulation produced an overlap equal to or greater than the observed value of 610 voxels, such that the probability of observing this value was $p < .00001$. Thus, the observed value probably did not occur by chance, but was more likely to reflect regularities associated with assembling processes for fear across different situations.

When analogous simulations were run for anger, plan, and observe, similar results were obtained. For anger, the observed overlap of 350 voxels fell outside the 95% confidence interval for random overlap that ranged from 1 to 10 voxels, with a mean of 5.4. For plan, the observed overlap of 292 voxels fell outside the 95% confidence interval for random overlap that ranged from 23 to 46 voxels, with a mean of 34.14. For observe, the observed overlap of 306 voxels fell outside the 95% confidence interval for random overlap that ranged from 13 to 32 voxels, with a mean of 21.81. In every case, not a single simulation fell above the observed value, indicating that its chance occurrence was $p < .00001$. Again, the observed value for each mental state probably reflected regularities associated with assembling processes for it across situations.

Conjunction analyses of fear and anger across the same learning condition.

Monte Carlo analyses assessed the likelihood that the overlapping activations across fear and anger within a given situation type occurred by chance (analogous to analyses reported earlier). For physical situations, the observed overlap of 228 voxels between fear and anger fell outside the 95% confidence interval for random overlap that ranged from 13 to 31.5 voxels, with a mean of 21.95. For social situations, the observed overlap of 3,494 voxels between fear and anger fell outside the 95% confidence interval for random overlap that ranged from 222 to 285 voxels, with a mean of 252.96. In both cases, not a single simulation fell above the observed value, indicating that its chance occurrence was $p < .00001$. Thus, the observed value for overlapping voxels in a given situation type probably reflected regularities associated with assembling processes within it across fear and anger.

Assessing overlap of fear and anger across learning groups

Figure S3 illustrates the three steps of the analysis process, with Steps 1 and 2 being the same as in Figure S1. Again, Steps 1 and 2 used conjunction analyses to remove irrelevant activations associated with auditory processing from the activation maps for *fear* and *anger* (i.e., activations common to *fear, anger, plan*, and *observe* in a given situation learning condition). Specifically, the physical baseline was removed from the activation maps for *fear* and *anger* in the physical learning group, and the social baseline was removed from the activation maps for *fear* and *anger* in the social learning group. Again, these subtractions removed common activations whose inclusion would distort conjunction analyses assessing the critical hypotheses. The images for the physical learning group in Figure 2 show the clusters in the physical baseline, and the images for the social learning group in Figure 2 analogously show the clusters in the social baseline (both in green).

As Step 3 in Figure S3 illustrates, the two new activation maps created for *fear* and *anger* in the same learning group were submitted to a conjunction analysis, once for the social learning group, and once for the physical learning group. In each of these analyses, three types of voxels were identified: (1) voxels active only for *fear*, (2) voxels active only for *anger*, and (3) voxels active for both *fear* and *anger*. As described earlier, each conjunction analysis was performed once at an extent threshold of 221 voxels ($p < .05$), and again at lower extent threshold of 110 and 60 voxels (to see if the conjunction results were robust when smaller clusters were included). Figure 5 in the main text displays the results for the 221-voxel threshold.

To provide a thorough listing of relevant clusters, Tables S4 and S5 list the clusters from the analyses that used the 60-voxel threshold. Cluster listings from the 221-voxel and 110-voxel analyses are largely the same, except for the absence of clusters below 221 and 110 voxels, respectively. Note that when a significant cluster was divided into parts that occurred simultaneously in one situation and in both, clusters could become smaller than the original extent threshold of 60 voxels. Thus, Tables S4 and S5 include cluster fragments down to 20 voxels. Although cluster fragments smaller than 20 voxels were not included in these tables, all fragments, no matter how small, were included in the voxel counts and overlap reported next. Thus, the voxel counts in Tables S4 and S5 do not add up to those in Table S6.

Table S6 summarizes the voxel counts and overlap across clusters in each learning group from Tables S4 and S5, once for each cluster threshold.

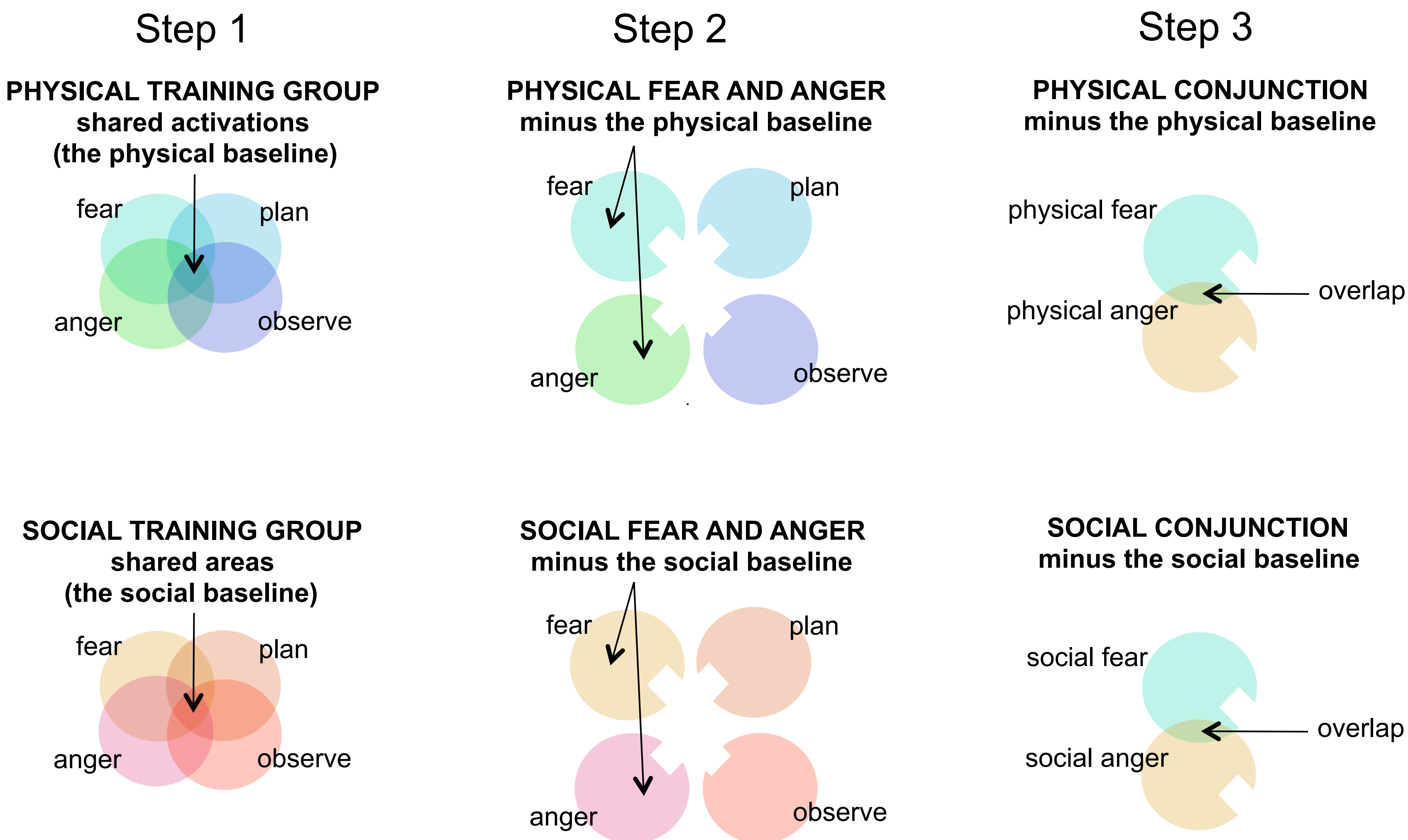

Figure S3. The process for computing the situation-specific, shared, and unique activations for *fear* and *anger* within either the physical or social training groups. In Step 1, shared activations across all four mental states (*fear, anger, plan,* or *observe*) in each training group are computed in a four-way conjunction analysis, establishing the physical vs. social baselines, respectively. In Step 2, the baseline activations for each training group are removed for each emotion (*fear* or *anger*) in the same training group. In Step 3, the conjunction of *fear* and *anger* either in the physical or social training group is computed, minus the respective baseline, to establish shared and unique activations across the two emotions.

Table S4. Unique and shared activations for *fear* and *anger* from a conjunction analysis in the physical learning group.

Brain Region	Brodmann Area	Cluster Volume	Max Intensity *t*	Voxel x	y	z
Unique Activations for Fear						
R superior/middle temporal	21/22	829	8.51	45	1	-8
R insula	13					
B caudate/caudate head/ACC		811	9.72	-1	21	10
B culmen/ brainstem/pons		592	8.63	-1	-31	-6
mammillary body						
L superior temporal	22	269	6.93	-45	-31	4
L cuneus	18	216	5.00	-19	-97	-2
R superior/middle frontal	6	209	7.52	31	1	42
L cingulate gyrus	23/24	146	6.83	-23	-15	32
L insula/pre-central/	13	113	6.72	-59	-7	12
post-central	43					
R superior temporal	38	111	5.77	53	19	-10
lOFC	47					
L precuneus	7	107	6.00	-3	-77	42
L cingulate gyrus	24	105	5.76	-9	7	54
L cerebellum (culmen)		65	5.21	-9	-45	-6
L parahippocampal gyrus		64	6.56	-29	-55	2
L superior temporal	38	62	5.39	-49	3	-8
L mid-frontal gyrus	6	56	4.73	-41	-1	46
L insula	13	26	4.59	-41	-7	0
Unique Activations for Anger						
L superior temporal lobe	22	236	7.36	-55	9	-2
L posterior insula	13	179	6.44	-29	-23	26
L superior temporal	22	119	6.03	65	1	-2
L mid-temporal	21					
L superior temporal	22	109	4.98	-59	-39	20
angular gyrus						
R insula	13	102	6.30	43	-15	-8
claustrum						

R superior temporal	22	68	5.34	67	-39	12
R mid-frontal	9	66	4.64	43	23	30
R pre-central	6	64	5.14	27	1	26
L mid-frontal gyrus	6	48	4.94	-43	1	54
R STG	22	42	5.05	53	-37	18
R mid-frontal gyrus	6	42	5.26	35	3	48
L STG	38	39	5.78	47	9	-10
R insula	13	39	5.63	25	-29	22
R mid-temporal gyrus	21	26	5.69	53	-21	-6
Shared Activations for Fear and Anger						
R mid/superior frontal	6	84	5.96 (7.45)	33 (37)	1 (5)	44 (46)
R mid-temporal	21	79	6.29 (4.96)	45 (47)	-25 (-43)	0 (8)
L insula	13	54	4.76 (5.92)	-43 (-47)	-23 (-11)	2 (-4)
R STG	22	41	4.78 (5.18)	53 (59)	-41 (-43)	12 (10)
R dlPFC	9	40	4.31 (5.08)	47 (39)	17 (21)	30 (30)
L insula	13	36	5.16 (5.19)	-41 (-43)	-37 (-37)	22 (22)
L mid-frontal gyrus	6	36	5.22 (4.83)	-39 (-41)	-1 (1)	48 (54)
L cingulate gyrus	23	33	5.93 (4.39)	-19 (-19)	-9 (-7)	34 (32)
R STG	38/22	31	5.79 (9.16)	51 (51)	17 (15)	-8 (-10)
L STG	22	21	5.34 (5.17)	-65 (-61)	-39 (-39)	16 (20)

Note. Activations were obtained using an independent voxel threshold of $p < .005$ and a cluster threshold of 60 voxels, in each of the two situation learning groups. Clusters having 221 voxels or larger are significant at $p < .05$. Smaller clusters are shown to provide a sense of weaker activations. Clusters smaller than 60 voxels resulted from the conjunction analysis producing cluster fragments, when different parts of a cluster were shared vs. unique. Cluster fragments smaller than 20 voxels are not shown. R is right, L is left, B is bilateral, ACC is anterior cingulate cortex, lOFC is lateral orbitofrontal cortex, and STG is superior temporal gyrus.

Table S5. Unique and shared activations for *fear* and *anger* from a conjunction analysis in the social learning group.

Brain Region	Brodmann Area	Cluster Volume	Max Intensity *t*	Voxel x	y	z
Unique Activations for Fear						
R precuneus/angular gyrus	7/39	3,778	7.36	13	-73	34
R cuneus	18/19					
R fusiform gyrus/lingual/	37					
R parahippocampal gyrus/						
R cerebellum (declive)						
L precuneus	7					
L cuneus/L lingual	18/19					
R superior/middle temporal	21/22/40/42	980	7.37	43	-21	-8
R insula	13					
L insula	13	526	7.29	-65	-41	18
L pre/post-central	43					
superior temporal	22					
L fusiform gyrus	37	393	5.77	-31	-69	-22
cerebellum (culmen)						
R pre-central	6	383	5.78	35	7	40
R mid/inferior frontal	9/46	349	5.88	43	19	26
R pre-central	6					
anterior insula	13					
R thalamus (medial geniculum body)		172	5.43	11	-25	-2
parahippocampal gyrus	27					
L pre-central	6	126	5.41	-43	-9	42
L posterior insula	13	118	6.72	-29	-35	18
L cuneus	19	110	5.32	-45	-71	-8
L fusiform	18	109	5.33	-23	-61	-10
lingual gyrus	19					
L cingulate gyrus	24	106	8.13	-23	-5	28
L pre-frontal	10	94	8.53	-35	55	24
R pre-frontal	10	92	5.64	35	43	14
L PCC	23	72	5.09	-5	-31	28
L precuneus	7	72	5.14	-17	-51	36

L OFC	47	63	5.46	-13	31	6
ACC	24					
R dorsal anterior cingulate gyrus	32	55	5.03	11	7	42
R STG	22	53	5.52	61	3	6
L precuneus	7	50	4.36	-5	-53	52
L mid-temporal	21	20	3.97	-67	-31	2
Unique Activations for Anger						
L cerebellum (declive)		1,194	6.83	-37	-69	-4
L cuneus/lingual gyrus	17/18					
R fusiform gyrus	37	673	7.72	37	-53	2
R cuneus/ lingual gyrus	17/18					
L cingulate gyrus	23	516	7.25	-11	-13	32
L superior parietal	7/40					
R cingulate gyrus	23	386	7.78	23	-19	34
R pre-central	6	381	5.25	29	5	26
R mid-frontal	9/45					
L superior temporal	22/38	337	6.57	-41	3	-10
L mid-temporal	22	253	5.82	-35	-37	20
posterior insula	13					
R superior temporal	22/38	231	6.75	53	1	-14
R mid-temporal	21					
L mid-frontal	9	187	6.81	-31	7	26
R fusiform	19/37	115	5.42	41	-65	-10
L medial frontal	6	111	6.63	-15	-3	48
R cuneus	19	102	4.56	25	-89	28
R precuneus	7/31	81	4.88	15	-61	32
L posterior cingulate	29	66	6.27	-13	-41	10
L thalamus (medial geniculum body)		61	6.30	-13	-25	-2
R mid-temporal gyrus	21	56	4.62	59	-43	2
R precuneus	7	56	4.76	-1	-49	48
R declive		26	4.56	17	-61	-16
R declive		22	4.99	19	-67	-20

Shared Activations for Fear and Anger

R mid/superior temporal	21/22	727	8.39 (10.94)	45 (49)	-17 (-5)	-10 (-6)
L fusiform gyrus/	37	718	6.80 (7.24)	-29 (-25)	-69 (-55)	-20 (-6)
cerebellum (declive)/						
cuneus	19					
R cuneus	18	444	7.25 (5.28)	33 (11)	-73 (-79)	0 (16)
R mid-frontal	9	267	5.95 (5.89)	39 (41)	5 (1)	30 (38)
L superior temporal	22	196	8.16 (6.59)	-63 (-57)	-41 (-45)	18 (18)
L mid-frontal	9	188	5.29 (8.30)	-35 (-35)	3 (3)	30 (28)
L precuneus	7	159	6.42 (6.82)	-27 (-29)	-67 (-59)	34 (36)
L superior temporal	22	154	6.20 (6.42	-35 (-59)	-21 (-25)	14 (2)
insula	13					
R cuneus	18	94	5.64 (5.17)	41 (47)	-63 (-77)	-14 (-8)
fusiform gyrus	19					
R cerebellum		73	5.16 (5.48)	23 (21)	-61 (-61)	-20 (-20)
R inferior parietal/precuneus	7	67	5.94 (5.13)	23 (29)	-53 (-49)	40 (38)
L superior temporal	38	60	5.19 (7.16)	-49 (-61)	3 (3)	-6 (-2)
L cingulate gyrus	29	60	6.39 (4.62)	-29 (-23)	-31 (-31)	28 (26)
L cingulate gyrus	29	54	6.04 (5.73)	-23 (-19)	-7 (-13)	30 (34)
L STG	22	45	5.55 (4.74)	-67 (-67)	-5 (-7)	6 (8)
L declive		34	4.48 (5.18)	-5 (-9)	-67 (-65)	-16 (-16)
L precuneus	7	31	5.37 (4.97)	-3 (-3)	-49 (-49)	52 (50)
R inferior parietal	40	29	5.38 (7.64)	29 (27)	-29 (-29)	26 (26)

Note. Activations were obtained using an independent voxel threshold of $p < .005$ and a cluster threshold of 60 voxels, in each of the two situation learning groups. Clusters having 221 voxels or larger are significant at $p < .05$. Smaller clusters are shown to provide a sense of weaker activations. Clusters smaller than 60 voxels resulted from the conjunction analysis producing cluster fragments, when different parts of a cluster were shared vs. unique. Cluster fragments smaller than 20 voxels are not shown. R is right, L is left, B is bilateral, ACC is anterior cingulate cortex, PCC is posterior cingulate cortex, OFC is orbitofrontal cortex, and STG is superior temporal gyrus.

Table S6. Proportions of shared (non-baseline) voxels for *fear* and *anger* in either the physical or social learning group, together with the relevant voxel frequencies.

	Fear				Anger			
Learning Group	Proportion Shared Voxels	Shared Non-Baseline Voxels	Unique Voxels	Total Voxels	Proportion Shared Voxels	Shared Non-Baseline Voxels	Unique Voxels	Total Voxels
Cluster Threshold = 221 Voxels								
Physical learning	.08	288	3,208	3,496	.24	288	909	1,197
Social learning	.33	3,494	7,162	10,656	.42	3,494	4,833	8,327
Cluster Threshold = 110 Voxels								
Physical learning	.12	449	3,442	3,891	.30	449	1,043	1,492
Social learning	.32	3,548	7,440	10,988	.42	3,548	4,890	8,438
Cluster Threshold = 60 Voxels								
Physical learning	.12	544	3,847	4,391	.30	544	1,263	1,807
Social learning	.31	3,602	7,866	11,468	.42	3,602	5,052	8,654

Note. All voxels from the physical and social baselines for the mental states have been removed from this analysis (5,265 voxels from the physical baseline, 4,899 voxels from the social baseline). Only non-baseline voxels are included. Voxel totals in Tables S4 and S5 do not add up to the totals here, because fragments from the conjunction analysis smaller than 20 voxels were not included in the earlier tables, but were included here (see the text for details).

Situation Anticipation Analysis

Whereas all other results reported in this article address activations for the mental states during the initial 3 sec period of the scanning trials, this analysis addresses activations for the situations during the subsequent 9 sec period.

Each analysis was analogous to the baseline analysis for the mental state cues illustrated in Step 1 of Figure S1, except that it was performed on the 9 sec activations for the situations, rather than on the 3 sec activations for the mental states. Because of the catch trial design, activations for the mental states were removed from the activations for the situations assessed here.

To establish activations for the physical situations, a conjunction analysis identified clusters that were significantly active for the physical training group following each of the four mental state conditions (fear, anger, plan, observe). To analogously establish activations for the social conditions, a conjunction analysis identified clusters that were significantly active for the social training group following the four mental states. Table S7 presents the results of these two conjunction analyses.

Table S7. Shared activations during the 9 sec situation period in a conjunction analysis across *fear*, *anger*, *plan*, and *observe* for each learning group.

			Fear				Anger				Plan				Observe			
		Cluster	Max	Voxel			Max	Voxel			Max	Voxel			Max	Voxel		
Brain Region	Brodmann Area	Volume	Intensity *t*	x	y	z	Intensity *t*	x	y	z	Intensity *t*	x	y	z	Intensity *t*	x	y	z
Physical Learning Group																		
L posterior insula	13	3,189	12.82	-37	-25	14	10.65	-35	-25	12	13.01	-37	-25	14	13.27	-37	-25	14
superior temporal lobe	22/38/41/42																	
L anterior insula	13	3,064	8.71	-41	25	28	7.48	-39	7	46	10.14	-47	23	30	8.64	-41	21	28
IFG	46																	
superior frontal	6/8/9																	
post-central gyrus	4																	
R posterior insula	13	2,785	15.51	49	-17	10	15.02	51	-17	10	14.41	51	-17	10	15.52	51	-17	10
superior temporal	22/38/41/42																	
L precuneus	7	131	5.36	-29	-55	42	5.00	-21	-63	30	5.37	-29	-65	38	4.97	-31	-57	42
L thalamus/brainstem		98	8.73	-9	-27	-4	5.87	-9	-25	-4	5.15	-17	-23	0	6.40	-9	-27	-2
R anterior insula	13	70	7.19	33	25	10	5.04	31	23	8	6.22	31	25	10	5.85	33	23	8
R mid-frontal gyrus	46	65	5.70	49	25	30	4.95	45	23	26	4.68	53	23	34	4.99	47	21	26
Social Learning Group																		
L superior temporal	22/38/41/48	8,627	13.64	-45	-13	8	13.62	-47	-13	6	15.54	-63	-23	8	15.13	-63	-23	8
posterior insula	13																	
IFG	45/47																	
mid-frontal	46																	
superior frontal	9																	
pre-central	4/6																	
post-central	2/3																	
inferior parietal	40																	
superior parietal	7																	

R posterior insula	13	3,585	15.71	41	-19	8	18.15	41	-19	8	16.61	41	-19	8	15.27	41	-19	8
superior temporal	22/38/41/42																	
B brain stem		1,687	12.35	5	-39	18	19.596	-3	-9	12	13.11	-9	-25	-4	10.38	13	-23	-2
pulvinar																		
mammillary body																		
thalamus																		
PCC	23/29																	
B medial frontal	6/32	1,535	7.62	-3	11	42	9.72	1	-1	66	9.05	-1	11	44	9.55	-9	3	56
cingulate gyrus	24																	
R mid-frontal gyrus	9/46	869	7.70	53	21	28	7.84	43	7	40	7.41	51	25	34	9.76	51	21	28
superior frontal	6																	
pre-central	6																	
R. cerebellum/declive		776	9.08	3	-73	-18	12.05	5	-67	-14	8.17	13	-67	-20	9.28	29	-49	-24
occipital lobe	18																	
B precuneus	7	547	8.24	-1	-75	48	9.28	-1	-67	44	11.76	-5	-65	34	7.44	-3	-75	50
L cerebellum/declive		299	7.29	-31	-51	-24	10.58	-27	-55	-20	6.63	-21	-61	-22	8.25	-27	-51	-22
fusiform gyrus	37																	
R supramarginal gyrus		148	5.69	33	-51	34	7.69	35	-51	42	5.70	37	-53	42	11.19	33	-51	36
R anterior insula	13	117	7.04	29	23	6	6.16	31	21	8	7.20	33	23	6	13.78	29	23	8

Note. Activations were obtained using an independent voxel threshold of $p < .005$ and a cluster threshold of 60 voxels, in each situation training . Clusters having 221 voxels or larger are significant at $p < .05$. Smaller clusters are shown to provide a sense of weaker activations. R is right, L is left, B is bilateral, IFG is inferior frontal gyrus, PCC is posterior cingulate cortex.

Reference

Cox, R. W. (1996). AFNI: Software for analysis and visualization of functional magnetic resonance neuroimages. *Computers and Biomedical Research, 29,* 162-173.