Supplemental Data

Complementary Systems for Understanding Action Intentions

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Supplemental Experimental Procedures

Behavioral Performance

Subjects were faster to judge the intentionality than the means of the action [Figure S1; $F_{(1,18)} = 23.1$; $p < 0.001$]. There was a Task × Stimulus interaction [$F_{(2,17)} = 9.4$; $p = 0.002$]. This interaction was driven by the fact that the significant difference in reaction time (RT) between the means and the intention task during fully normal actions ($T_{18} = 4.46$, $p < 0.001$) became significantly larger when the stimulus depicted an extraordinary intention ($T_{18} = 2.13$, $p = 0.047$) and became significantly smaller when the stimulus depicted an extraordinary means ($T_{18} = 3.01$, $p = 0.007$), thereby abolishing the RT difference between tasks for these stimuli ($T_{18} = 0.29$, $p = 0.77$). Together, these results indicate that the intentionality and means are both processed, irrespective of the task in which subjects are engaged. Overall, error rates (ERs) were not different between tasks [$F_{(1,18)} = 1.0$; $p = 0.34$]. There was a Task × Stimulus interaction for ERs [$F_{(2,17)} = 7.74$; $p = 0.004$], of the same shape as observed for the RTs, excluding the possibility that the behavioral differences are the result of a speed-accuracy trade-off.

Additional Analyses of RT Differences

There was a difference in RT between the two tasks (ΔRT = 0.12 s). To exclude the possibility that activation differences between tasks were driven by the RT differences, we carried out two control analyses:

1. A random-effects analysis, in which the individual RTs of each trial were convolved with the HRF, rather than the average RT of each subject. In this type of analysis, all differences in hemodynamic activity that are associated with RT differences are effectively removed, by appropriate scaling of the magnitude of the haemodynamic response of each trial. Any activity differences between tasks that remain in this model can therefore not be trivially related to RT differences between the tasks.
2. A correlation analysis, to see whether the subject-by-subject variability in ΔRT between tasks was correlated with the activity difference in the three regions that showed a task effect. If the RT differences are at the heart of the neural-activation differences, there should be a correlation between the behaviorally observed RT difference and the neural-activity difference between tasks.

Control analysis 1 showed significant activation in the same three areas as the original analysis (MPFC: [−8, 36, 2], $T = 3.92$, $p_{corrected} = 0.024$; PC: [4, −32, 38], $T = 3.59$, $p_{corrected} = 0.012$; pSTS: [48, −40, 6], $T = 4.10$, $p_{corrected} < 0.001$).

Control analysis 2 showed no significant subject-by-subject correlation between the neural-activity difference and the RT difference in these areas ($r_{MPFC,RT} = -0.15$, $p = 0.54$; $r_{PC,RT} = -0.21$, $p = 0.38$; $r_{pSTS,RT} = -0.20$, $p = 0.42$). Together, these results strongly suggest that our task differences are independent from the RT differences between tasks.

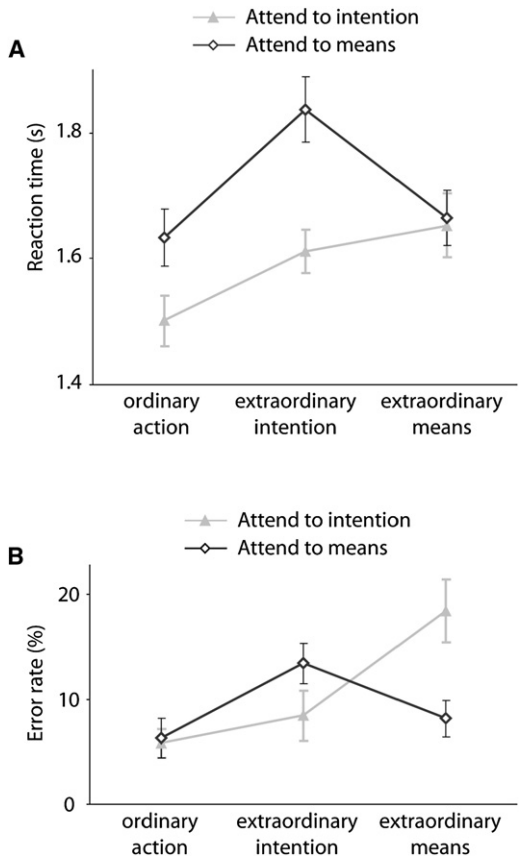

Figure S1. Behavioral Performance

(A) Reaction times (mean ± SEM) for the intention condition (gray triangles) and the means condition (white diamonds), for each of the stimulus types (indicated on the abscissa).

(B) Error rates (mean ± SEM) for the intention condition (gray triangles) and the means condition (white diamonds), for each of the stimulus types (indicated on the abscissa).

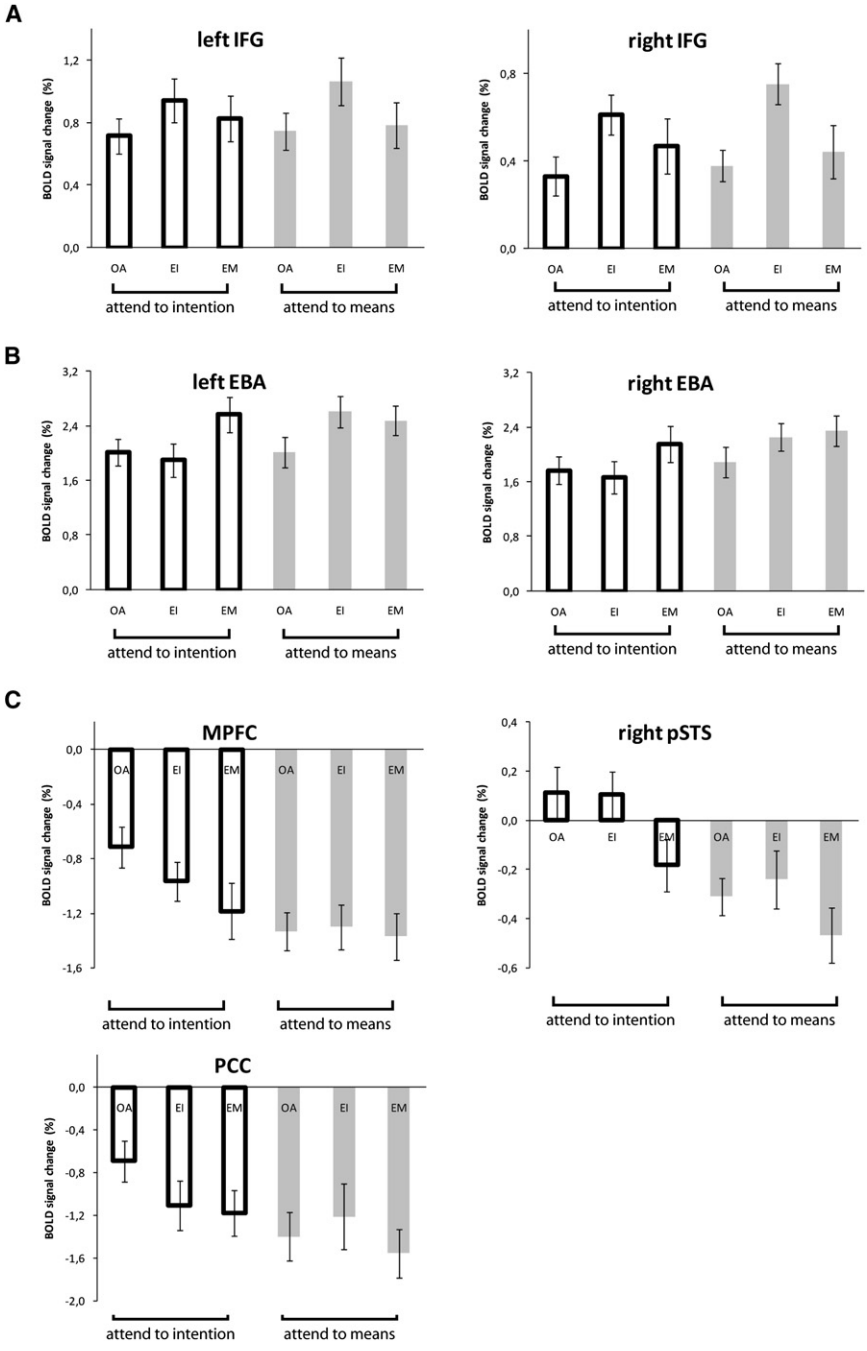

Figure S2. Neural-Activity Profile

The BOLD signal change (percentage signal change with respect to global mean signal; ± SEM) for all tasks and stimulus types is plotted for all the regions showing a stimulus- or task-related activity difference. White bars adhere to the task in which subjects had to attend to the intention of the action. Gray bars adhere to the task in which subjects had to attend to the means of the action. OA denotes ordinary action, EI denotes extraordinary intention, and EM denotes extraordinary means.

(A) Left and right inferior frontal gyrus (IFG) showed significantly larger activity for extraordinary intentions (EI) compared to ordinary actions (OA). This difference was similar for both tasks.

(B) Left and right extrastriate body area (EBA) showed significantly larger activity for extraordinary means (EM) compared to ordinary actions (OA). This difference was similar for both tasks.

(C) Medial prefrontal cortex (mPFC), right posterior superior temporal sulcus (pSTS), and posterior cingulate cortex (PCC) showed larger activity when attending to the intention of the action, compared to attending to the means of the action.

Table S1. Localization of Brain Activations

Contrast	Anatomical Region	*T*-Value	Cluster Size	Corrected p Value	Stereotactic Coordinates (x y z)		
Extraordinary Intention > Ordinary Action							
	inferior frontal gyrus (IFG)	4.1	240	0.029	−36	20	22
	inferior frontal gyrus (IFG)	4.8	279	0.016	28	26	−6
Extraordinary Means > Ordinary Action							
	lateral occipitotemporal cortex (EBA)	4.9	321	0.008	−50	−70	−6
	lateral occipitotemporal cortex (EBA)	4.0	222	0.038	50	−60	−6
Attend to Intention > Attend to Means							
	medial prefrontal cortex (mPFC)	4.6	376	0.004	−4	36	2
	posterior superior temporal sulcus (pSTS)	4.1	376	0.004	48	−40	6
	posterior cingulate cortex (PC)	3.8	233	0.032	0	−32	40

Spatial coordinates of the local maxima of regions showing significant stimulus- or task-related effects. All results are corrected for multiple comparisons via family-wise error (FWE) correction with a threshold of $p < 0.05$. Stereotactic coordinates correspond to the standard Montreal Neurological Institute (MNI) brain.

Table S2. List of Actions

Action
Drinking from a coffee cup
Making a photograph
Combing hair
Putting on glasses
Playing a musical instrument
Making a phone call
Eating with a spoon
Using a hairdryer
Speaking in a microphone
Looking through a binocular
Listening to a radio
Using a magnifying glass

Description of the actions that were displayed as the stimulus material.