Description experiment

According to theories of embodied cognition, understanding emotions in others is grounded in simulations of actions, interoceptive sensations and introspective states (see Barsalou, 1999; 2009; Gallese & Lakoff, 2005; Gallese, Keysers & Rizzolatti, 2004). These theories further propose that processes such as mental imagery and language comprehension are also grounded in simulations of experiential states. The main aim of this fMRI experiment is to experimentally test the overlap between mental imagery and emotion understanding. If both imagery and emotion understanding are embodied (e.g., engage experiential systems in the brain associated with action, interoception and introspection), then it may be possible to use neural patterns associated with imagining experiences to decode different emotion understanding strategies.

In the first task in this study participants will be asked to imagine several different experiential states cued by short linguistic descriptions (see Appendix I for examples). For example, to cue the imagery of actions, participants will read descriptions such as "to run away"; to make a fist"; to scratch your head"; to cue the imagery of interoceptive sensations participants will read descriptions such as "a fast heart beat"; "a churning stomach"; "being short of breath"; and to cue the imagery of mental states participants will read descriptions such as "feeling miserable"; worrying for days"; "heavy disappointment". Since previous research has shown that language comprehension can lead to simulations in experiential neural systems (e.g., Oosterwijk et al., in prep) we predict that this imagery task will engage neural systems associated with action (e.g., supplementary motor area, inferior frontal gyrus, inferior parietal lobe), interoception (e.g., insular cortex, anterior cingulate cortex) and introspection (e.g., medial prefrontal cortex, posterior cingulate cortex, temporoparietal junction).

In the second task participants will view images of people in negative social situations (see for examples Appendix II) and will be asked to focus on *how* the target person is expressing their feelings, *what* the target person is feeling, and *why* the target person is feeling this. Previous research has shown that different patterns of brain activation are associated with these different mentalizing strategies (Spunt et al., 2010 Spunt & Lieberman, 2011). For example, regions associated with action representation are more active during the how strategy, and regions associated with introspection and self-relevant processing are more active during the why strategy. The images used in this task are selected from the International Affective Picture System database (IAPS, Lang, Bradley, & Cuthbert, 2008), the stimulus set of Kestas Kveraga (http://nmr.mgh.harvard.edu/~kestas/affcon) and the internet.

In our analyses we will try to predict the strategy in task 2 with the neural patterns generated by imagining different experiential states in task 1. If both imagining directed by

language and emotion understanding are embodied, then the neural patterns associated with imagining certain states should be predictive of a mentalizing strategy focusing on similar states in the other person. We have the following set of hypotheses:

1) The *how* strategy will be predicted by patterns of activation during action imagery (e.g., supplementary motor area, inferior frontal gyrus, inferior parietal lobe).
2) The *what* strategy will be predicted by patterns of activation during interoception imagery (e.g., insular cortex, anterior cingulate cortex) and introspection imagery (e.g., medial prefrontal cortex, posterior cingulate cortex, temporoparietal junction).
3) The *why* strategy will be predicted by patterns of activation during mental states imagery (e.g., medial prefrontal cortex, posterior cingulate cortex, temporoparietal junction).

Since the images and descriptions used in this study can be experienced as negative, we will warn participants about this in the information brochure. Participants will be recruited via the participant database of the Spinoza Center. Participants will receive a detailed information brochure about the scanning procedure and will be fully screened following the criteria of the Spinoza Center for MRI-compatibility (see Appendix III). Before the start of the scan session the will receive a short training to make sure they fully understand how to perform the task, including some practice trials. Finally, participants will be presented with a task measuring the success of our manipulation after the scan session is completed (i.e., they will view all images again and rate them on different dimensions). Furthermore, they will be asked to fill in an exit questionnaire.

All images and sentences will be pre-tested in a pilot study (EC protocol 2013-SP-3312). Since the final selection of images and sentences will not be made until the pilot study has been fully analyzed we cannot give a definitive overview of the stimulus materials at this point. The stimuli presented in Appendix I and II do, however, provide with some examples of what our stimulus set will be like.

Appendix I: Sentence examples for imagery task

Actie	Interoceptie (interne sensaties)	Introspectie
Hard wegrennen	Een brok in je keel	Terugkerende gedachte
Een klap uitdelen	Buiten adem zijn	Je afvragen waarom
Iemand wegduwen	Een versnelde hartslag	Minachting voelen
In de ogen wrijven	Hart klopt in de keel	Een sterke overtuiging
Aan je been krabben	Een diepe ademhaling	Grote ongerustheid
Iemand stevig vastpakken	Een snerpende pijn	Dagenlang piekeren
Gebaren maken	Een benauwd gevoel	Een beslissing nemen
Hoofd schudden	Een misselijk gevoel	Iemand veroordelen
Zwaaien met de armen	Een omdraaiende maag	Een standpunt bepalen
Ergens tegenaan schoppen	Een zwak en trillend lichaam	Woedend op iemand zijn
Wenkbrauwen optrekken	Licht in het hoofd	Overrompeld door verdriet
Terug deinzen	Een opgewonden gevoel	Ergens van walgen
Neus optrekken	Strak gespannen spieren	Zwaar teleurgesteld zijn
Ogen dichtknijpen	Het hart slaat over	Je schuldig voelen
Ogen wijd open sperren	Een stokkende ademhaling	Ergens bang voor zijn
Wenkbrauwen fronsen	Een pijnlijk lichaam	In paniek zijn

Appendix II: Examples of images for mentalizing task.









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Appendix III: Screening form Spinoza Center z.o.z