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( *e a*., 2009; A *e a*., 2010; , 2010; *e a*., 2010). - , , , . - , (A ) ( ) .

## METHODS

### Subjects

20 , (11 , 9 , : 23, : 21–26 ). A , . A - .

### Paradigm

#### *Experimental design*

312 . , , , ' ( , A , A, A), , . 10- - . A 24 (12 - 12 ) . 1 . A , , , 6 7 .

#### *Stimuli*

12 , , , , ( ). ( A ) ( A )'- ( , 1988). . A . : , .

### Behavioural tests

' ( ; , 1983) . - ( , 2006), .

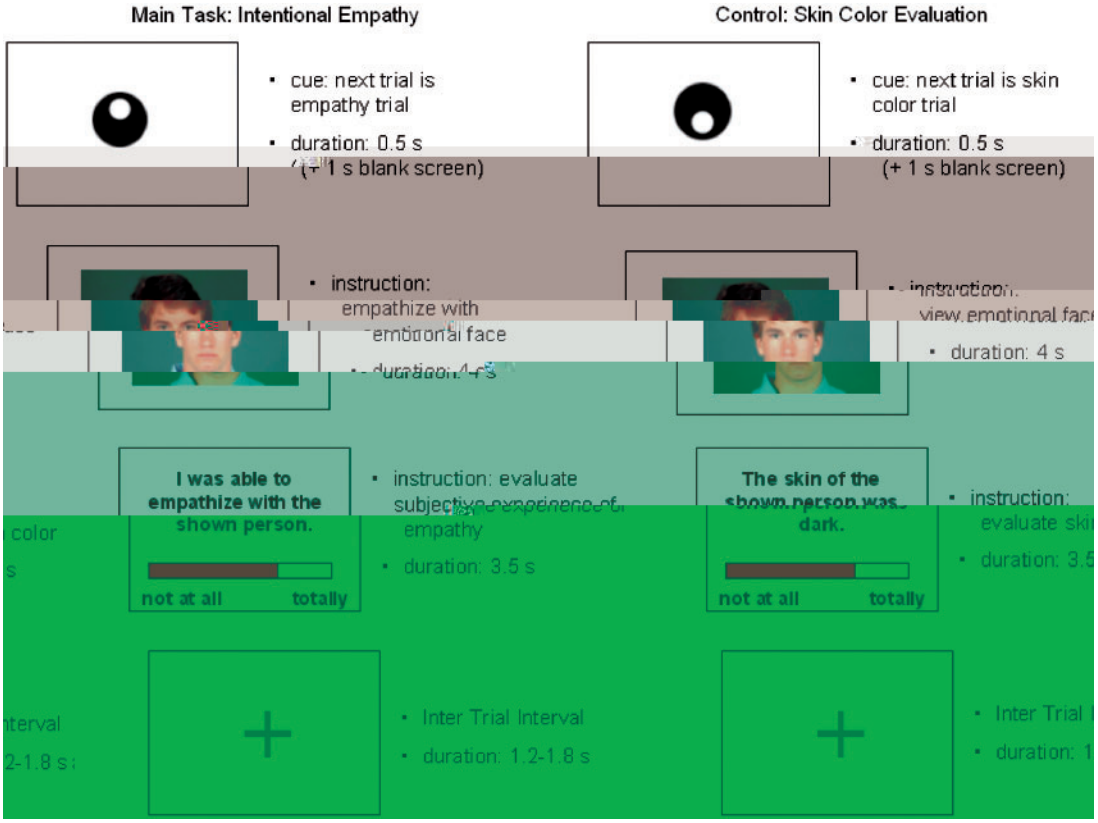


**Fig. 1** Paradigm. A black circle with a small white circle in the 'North'- or 'South'-position cued the task of the next trial. The white circle in the 'North' position indexed an intentional empathy trial; the white circle in the 'South' position cued a skin color evaluation trial. In 'intentional empathy trials' subjects were instructed to empathize with perceived emotional or neutral faces. After a 4-s lasting viewing period, subjects were supposed to rate their subjective impression of empathy capability in the evaluation period, which lasted for 3.5 s. By virtually moving a red bar, they were instructed to make a statement on a visual analogue scale. In 'control trials', subjects were instructed to concentrate on the skin color of the presented faces. Analogue to the intentional empathy task, a 4-s lasting viewing period was followed by a 3.5-s-lasting evaluation period. After every trial a short inter trial interval of 1.2–1.8-s duration was presented. The face stimuli consisted of familiar (Chinese) neutral and angry faces as well as unfamiliar (Caucasian) neutral faces.

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## Behavioural data analysis

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## fMRI data acquisition

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## fMRI data analysis

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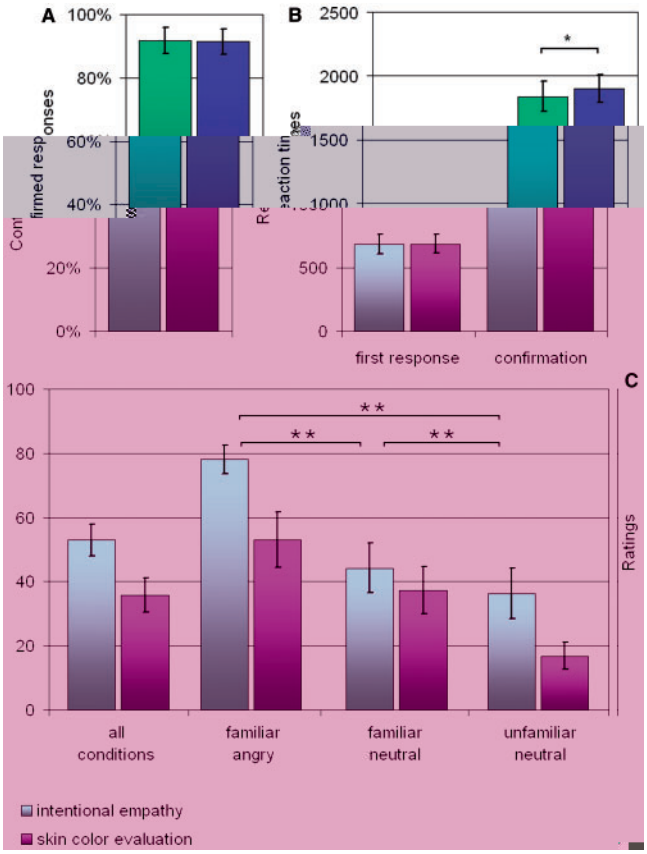


**Fig. 2** Behavioural results. (**A**) Confirmed responses. Confirmed responses required the press of the confirmation button after the right score on the visual analogue scale was chosen. The percentage of confirmed responses did not differ significantly between intentional empathy and skin color evaluation trials [$t(19) = 0.326$; $P_{[\text{two-tailed}]} = 0.748$]. (**B**) Reaction times. Reaction times for first responses (when the left or right button was pressed for the first time to move the bar of the visual analogue scale) and for confirmation responses (when the confirmation button was pressed to indicate the right position of the bar). There were no significant differences between the first responses of intentional empathy trials and skin color evaluation trials. However, comparing the confirmation responses showed significantly faster reaction times during intentional empathy trials compared to the skin color evaluation trials [$t(19) = -3.172$; $P_{[\text{two-tailed}]} = 0.005$**]. (**C**) Ratings. Intra-scanner empathy ratings for familiar neutral faces were significantly smaller relative to empathy ratings for familiar angry faces [$t(19) = 7.297$; $P_{[\text{two-tailed}]} < 0.001$**]. Ratings for familiar neutral faces where nevertheless larger compared to empathy rating for unfamiliar neutral faces [$t(19) = 4.914$; $P_{[\text{two-tailed}]} < 0.001$**]. Skin color ratings for familiar neutral faces were greater when compared to unfamiliar neutral faces [$t(19) = 5.183$; $P_{[\text{two-tailed}]} < 0.001$**] and smaller when compared to skincolor ratings of familiar angry faces [$t(19) = 9.713$; $P_{[\text{two-tailed}]} < 0.001$**]. In addition, skin color estimations of unfamiliar neutral faces were smaller than skin color scores of familiar angry faces [$t(19) = 7.926$; $P_{[\text{two-tailed}]} < 0.001$**]. (Error bars indicate the 95% CI. Not all significant differences are indexed in the diagram.)

## RESULTS

### Behavioural results

#### *Intra-scanner ratings*

#### *Results of the IRI*

: 18.0 (95% : 15.6–20.4), : 18.5 (95% : 17.2–19.8), : 18.5 (95% : 17.2–19.8) 12.6 (95% : 11.3–13.9).

### fMRI results

#### *SPM contrast [intentional empathy] > [baseline]*

#### *SPM contrast [intentional empathy] > [skin color evaluation]*

> $P \leq 0.001$.

### Analyses of fMRI raw data

3.

### SPM contrasts for the different emotion conditions

( , ). A $P < 0.001$ 10 , , .

### SPM contrast [familiar neutral] > [unfamiliar neutral]

( + )

. A $P < 0.001$ 10 , > . , > .

### SPM correlations using mean empathy ratings and IRI scores

, > , , $-34, -82, -20$, $(18) = 3.87$, $P < 0.001$, 10 , 4 . , , , $P < 0.001$ 10 .

## DISCUSSION

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**Fig. 3** Significant regions of the contrast [intentional empathy] > [skin color evaluation]. Three regions showed stronger hemodynamic responses during the intentional empathy task when compared to the skin color task: the left inferior frontal cortex [−48, 22, −2] (**A**), the right inferior frontal cortex [48, 28, 4] (**B**) and the right middle temporal gyrus [62, −54, 0] (**C**). SPM analysis was supplemented by an analysis of the raw fMRI signal data. The diagrams in the center of each line show the averaged time courses of the fMRI signal during intentional empathy and skin color evaluation for all conditions. The bar diagrams on the right depict the mean fMRI signal values (6–8 s after onset) for the average of all conditions as well as for the single conditions separately. Looking for modulations by emotion, we only found the right middle temporal gyrus with significant stronger hemodynamic responses during the empathic perception of familiar angry faces compared to familiar neutral faces [$t(19) = 4.277$, $P_{[\text{two-tailed}]} = 0.001$**, C]. The left and right inferior frontal cortex did not show any modulation by emotion during intentional empathy (A and B). In addition, none of the regions showed a significant difference between the neutral familiar and neutral unfamiliar condition. Surprisingly, we found a statistical trend for a modulation of hemodynamic responses during skin color evaluation caused by emotion in two regions: the left inferior frontal cortex (A) and right middle temporal gyrus (C) showed the tendency to respond stronger during skin color evaluation of familiar angry faces compared to familiar neutral faces [$t(19) = 1.855$, $P_{[\text{two-tailed}]} = 0.079$* and $t(19) = 2.011$, $P_{[\text{two-tailed}]} = 0.059$*]. Interestingly, we found significant deactivations in all three regions during all skin color evaluation conditions (all $P_{[\text{two-tailed}]} \leq 0.061$*]. (Error bars indicate the 95% CI).

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( *e a*., 1999; *e a*., 2003; , 2005; *e a*., 2005; , 2006; , 2006); , ( *e a*., 1996; *e a*., 1996; *e a*., 2001; *e a*., 2001; *e a*., 2003; , 2004). A -
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## CONCLUSIONS

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