Black is Angry, White is Scared: Evaluation of Pain Expressions in White and Black Faces

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Context

Studies have shown that pain experienced by Black individuals is systematically underestimated, leading to underdiagnosis and undertreatment[1, 2]. A partial explanation may reside in perceptual factors underlying the recognition of pain, a recent study by Mende-Siedlecki et al.[3] finding that pain detection thresholds are systematically higher in Black faces compared to White faces. This suggests that expectations regarding how pain is expressed by Black individuals may be different in White observers. The goal of the present study is to examine whether visual representations of pain, measured using *Reverse Correlation*, differ for Black and White faces.

Phase 1 – Objective Evaluation of CIs

30 White-Westerners and 30 Black-Africans completed the following task:

1) A *Reverse Correlation*[4] task, in which participants had to rate on a 0-to-10 scale, how the stimuli resembled their visual representation of pain.
2) The task had two different face ethnicities (Black or White), and both were presented for 500 trials, for a total of 1000 trials per participant.
3) Classification images (CI) were then created for both Black and White faces as the weighted sum of all noise patches, using a distribution of z-scores of participant ratings as weights.
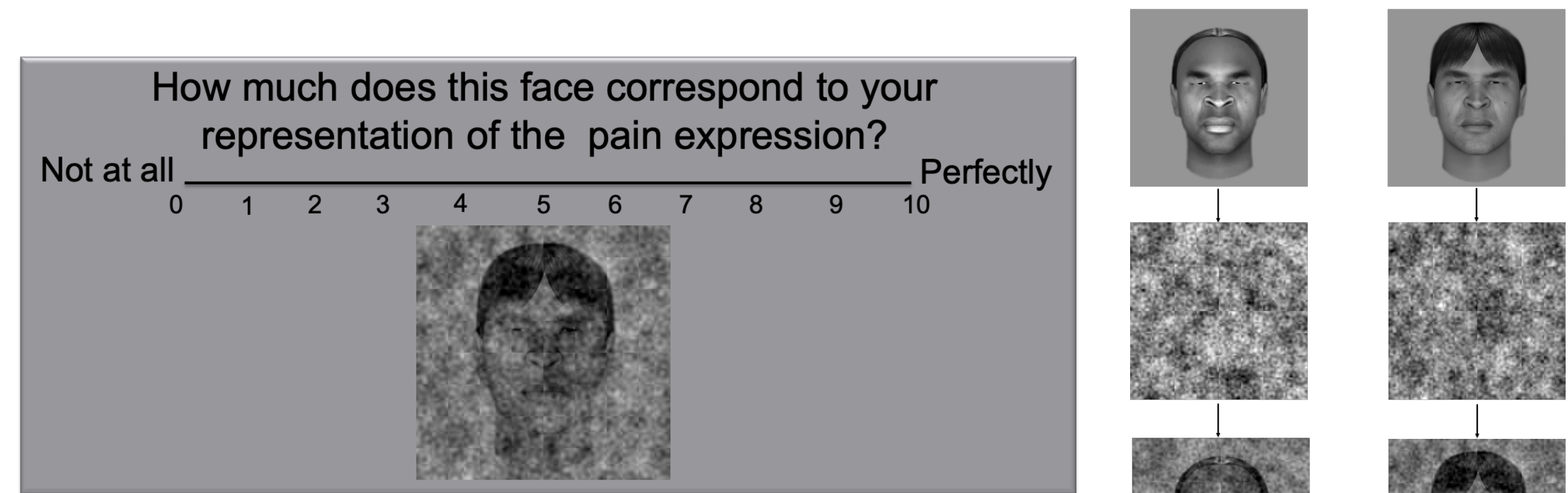

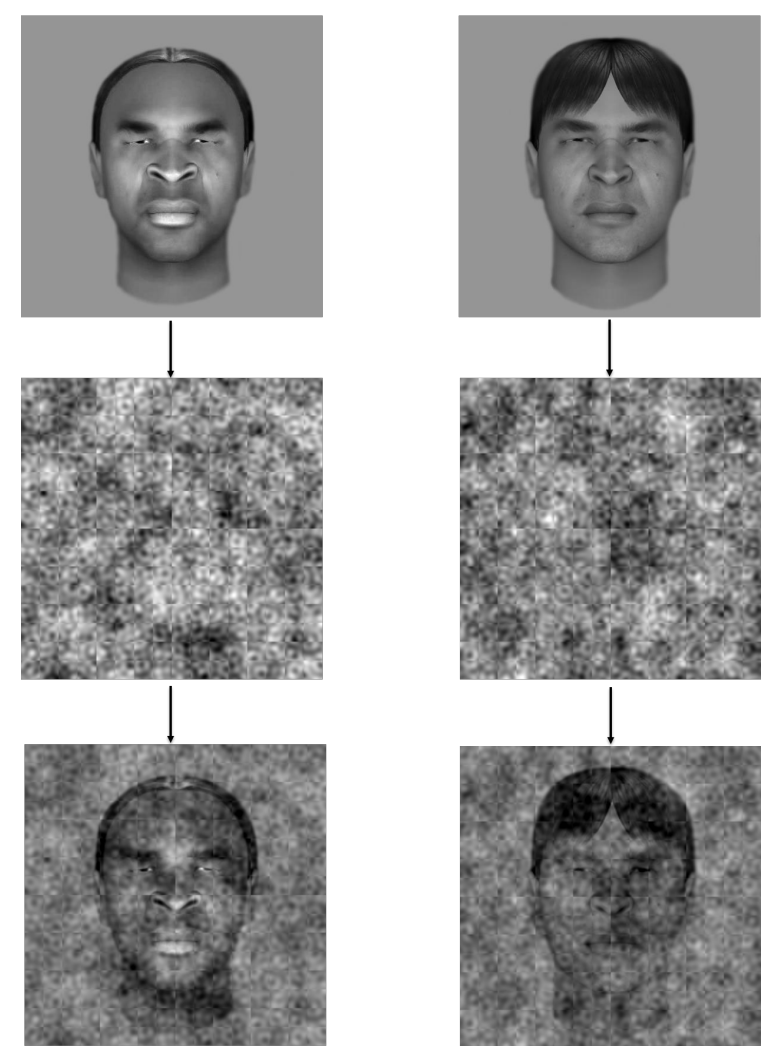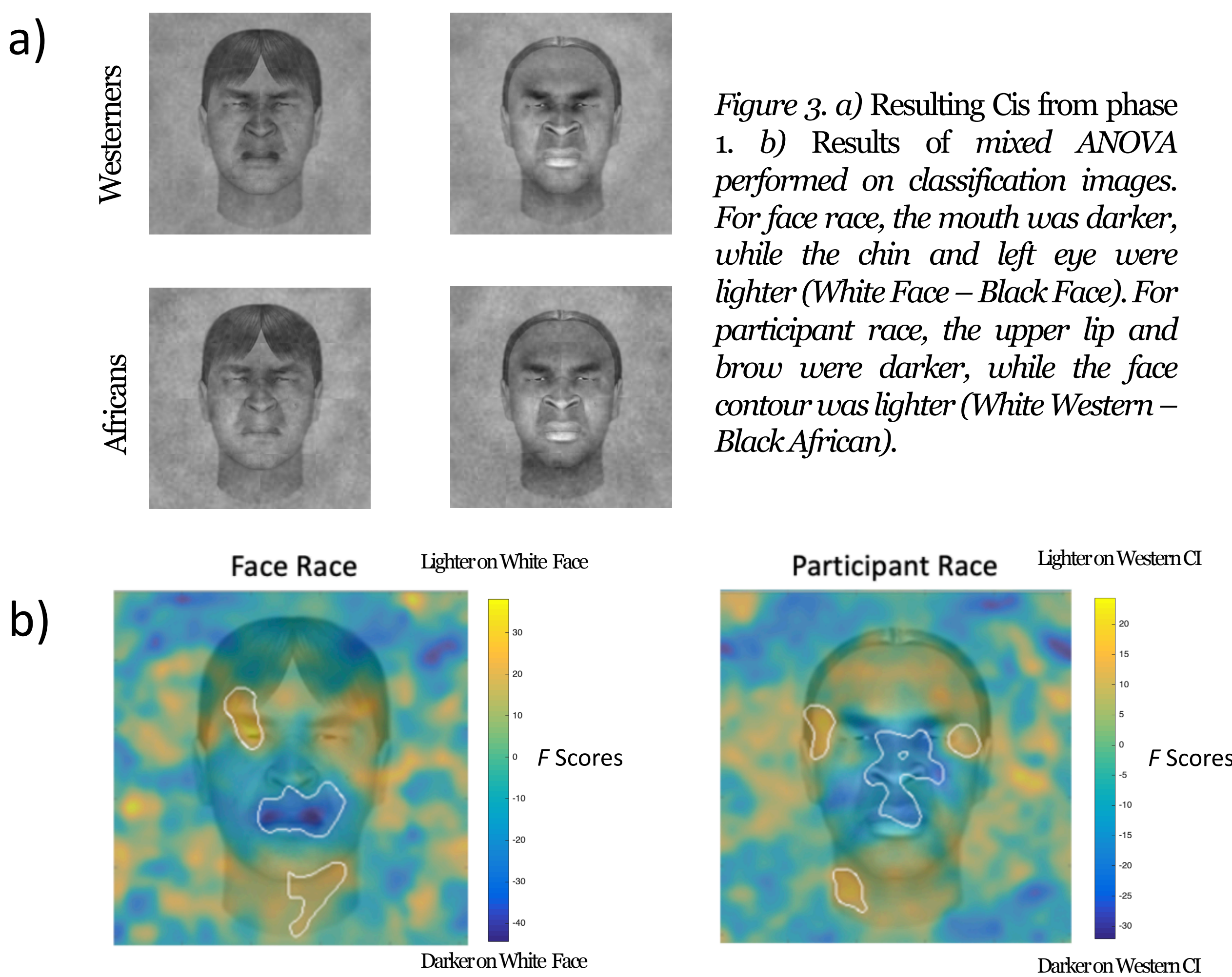*Figure 1.* Example of a trial from the experimental task.

Figure 2. Creation of experimental stimuli for the *Reverse Correlation* method. They are created from a base face (a 3D avatar), on which a random patch of sinusoidal white noise is added.

References

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2. Green, C. R., Anderson, K. O., Baker, T. A., Campbell, L. C., Decker, S., Fillingim, R. B., Kaloukalani, D. A., Lasch, K. E., Myers, C., Tait, R. C., Todd, K. H., & Vallerand, A. H. (2003). The Unequal Burden of Pain : Confronting Racial and Ethnic Disparities in Pain. *Pain Medicine*, 4(3), 277-294. https://doi.org/10.1046/j.1526-463
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4. Mangini, M. C., & Biederman, I. (2004). Making the ineffable explicit: Estimating the information employed for face classifications. *Cognitive Science*, 28(2), 209-226.
5. Chauvin, A., Worsley, K. J., Schyns, P. G., Arguin, M., & Gosselin, F. (2005). Accurate statistical tests for smooth classification images. *Journal of vision*, 5(9), 1-1.

Results – Phase 1

1) A pixel-by-pixel mixed ANOVA was performed on the resulting CIs, with face race as the *within-subject* factor and participant race as the *between-subjects* factor. The *Stat4CI*[5] was used to determine minimal cluster size necessary for statistical significance, given a minimum F value of 7 (F_{crit}=7.0, k=246, p<0.025). Figure 3b shows significant clusters with a white outline.

a)

Figure 3. a) Resulting CIs from phase 1. *b)* Results of *mixed ANOVA performed on classification images. For face race, the mouth was darker, while the chin and left eye were lighter (White Face – Black Face). For participant race, the upper lip and brow were darker, while the face contour was lighter (White Western – Black African).*

b)

Phase 2 – Subjective Evaluation of CIs

1. In order to better understand how these differences in visual representations affect perception, a new sample of 107 participants completed an online survey to evaluate the degree to which they felt the CIs expressed pain and 5 other basic emotions (joy, fear, anger, disgust & sadness).

Considering the face below, answer, on a 0-to-10 scale:
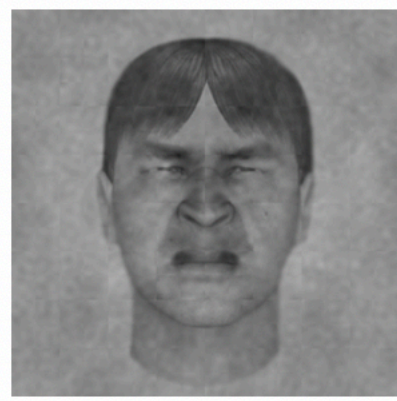
	0	1	2	3	4	5	6	7	8	9	10
How much is this face in pain?	O	O	O	O	O	O	O	O	O	O	O
How much is this face angry?	O	O	O	O	O	O	O	O	O	O	O
How much is this face disgusted?	O	O	O	O	O	O	O	O	O	O	O
How much is this face sad?	O	O	O	O	O	O	O	O	O	O	O
How much is this face happy?	O	O	O	O	O	O	O	O	O	O	O
How much is this face fearful?	O	O	O	O	O	O	O	O	O	O	O

Figure 4. Example of questions in the online survey. These questions were asked for all of the 4 CIs displayed on figure 3a.

Results – Phase 2

1) Main effects of emotion ($F(5, 505)$ = 211.60), face race ($F(1, 101)$ = 107.51) and participant race ($F(1, 101)$ = 57.61) were all significant (p<.001). The three-way interaction between factors was also significant ($F(5, 505)$ = 31.56; $p < .001$). To decompose this interaction, a 2-by-6 ANOVA was performed (face race x emotion) separately for each group. For both Western CIs and African CIs, the main effect of emotion, $Fs(5, 505)$ = 213.4 and 123.7; of face race, $Fs(1, 101)$ = 82.5 and 45.4; and the interaction, $Fs(5, 505)$ = 43.6 and 73.1, were significant (all $ps < .001$).

2) Post-hoc paired *t*-tests revealed that for both White-Western and Black-African groups, White faces appeared to feel significantly more pain and less anger than Black faces.

Emotion	White Westerners		Black Africans	
	t	*p*	*t*	*p*
Pain	**14.6996**	**< .001**	**6.5975**	**< .001**
Anger	**-5.5172**	**< .001**	**-10.7643**	**< .001**
Disgust	**7.9092**	**< .001**	- .4630	.643
Sadness	2.4306	.015	**14.2752**	**< .001**
Joy	.2701	.787	-.2701	.787
Fear	2.6235	.009	**4.5140**	**< .001**

Table 1. Results of post-hoc paired *t*-tests. A positive *t* value means the emotion was more present in the white face. A negative *t* value means the emotion was more present in the Black face.

Discussion

The present study has shown that significant differences exist in the way pain is represented when it is expressed by a White or a Black face. These differences also change the perception of the expression, leading to perceiving emotions more associated with social proximity (fear, sadness) in white faces, while Black faces seem more associated with threat (anger). However, only the perceptions of White Western observers were taken into account in these results. Data collection has started on a Black African sample to see if culture might lead to different perception of the CIs. Another interesting topic to explore would be to see if cultural attitudes toward pain affect what emotions are perceived in the CI.

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