Supplementary Materials for

Error Related Brain Activity Reveals Self-Centric Motivation: Culture Matters

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Supplementary Results

Behavioral Performance: Response Time

We conducted a 2 Culture x 2 Condition x 2 Congruency x 2 Response accuracy x 2 Condition order x 2 Key assignment ANOVA on response time. Overall, Asians were faster than European Americans (238.23 vs. 279.55), $F(1, 27) = 9.69$, $p < .005$, $\eta_p^2 = .26$. Additionally, both cultural groups were faster on error trials than on correct trials (229.58 vs. 288.20), $F = 106.45$, $p < .001$, $\eta_p^2 = .80$. As in prior studies, the response time was shorter on congruent trials than on incongruent trials (248.27 vs. 269.51), $F = 54.90$, $p < .001$, $\eta_p^2 = .67$, but this congruency effect was greater for correct trials (269.17 vs. 307.23) than for error trials (227.37 vs. 231.79) [Congruency x Response accuracy interaction], $F = 30.58$, $p < .001$, $\eta_p^2 = .53$. This interaction, however, was quite pronounced for Americans, $F = 21.97$, $p < .001$, but relatively weak, although still significant for Asians, $F = 6.75$, $p < .02$. This pattern resulted in a significant interaction involving culture, congruency, and response accuracy, $F = 9.86$, $p < .005$, $\eta_p^2 = .27$.

Furthermore, the main effects of response accuracy and congruency were qualified by higher order interactions involving either condition order or key assignment. In all cases, however, the key main effects were evident across the board, but subtle variations of the main effects due to either condition order or key assignment resulted in significant interactions. First, a Condition order x Response accuracy x Condition interaction was significant, $F = 9.79$, $p < .01$, $\eta_p^2 = .27$, showing that although incorrect responses were faster than correct responses across the board, the exact difference depended on both condition (self vs. friend) and the order by which the two conditions appeared. Likewise, while responses were faster on congruent trials than on incongruent trials, the exact difference depended on both condition, and the order by which the two conditions appeared, resulting in a significant Condition order x Congruency x Condition interaction $F = 4.67$, $p < .05$, $\eta_p^2 = .15$. The same response time difference between congruent trials and incongruent trials also depended on key assignment and condition,

resulting in another 3-way interaction, $F = 4.21$, $p = .05$, $\eta_p^2 = .14$. No interpretation was deemed possible for any of these interactions.

Error-Related Negativity

Two additional interactions involving condition order proved significant. Specifically, the Condition order x Condition interaction ($F = 5.51$, $p < .05$, $\eta_p^2 = .15$) resulted from the fact that collapsing across culture, the ERN (vs. CRN) was somewhat stronger in the self-condition than in the friend-condition, but the pattern was more pronounced in the self-first condition than in the friend-first condition. The Condition order x Culture interaction ($F = 4.72$, $p < .05$, $\eta_p^2 = .13$) showed that collapsing across condition (self vs. friend), the ERN (vs. CRN) was stronger for European Americans than for Asians in the self-first condition, but the cultural difference was reversed in the friend-first condition. These interactions are neither interpretable nor relevant in interpreting the key Culture x Condition interaction.

The Absence of the Mediation Effect in the Post-Error Slowing Measure

The cultural difference in the self-centric effect in the ERP measure was significantly mediated by interdependent self-construal. However, the corresponding mediation was not statistically significant for post-error slowing. The effect of interdependent self-construal on the self-centric effect on post-error slowing becomes non-significant when culture is entered as a joint predictor, $b = -7.57$, $t(35) = -1.27$, $p > .21$ (the 95% bootstrapping CI does include zero, [-1.23, 14.55]). Unlike in the ERN, the negative correlation between interdependent self-construal and the self-centric effect in the post-error slowing was tenuous at best within each cultural group, particularly for European Americans (rs = -.10 and -.30, for European Americans and Asians, respectively). This contributed to the failure to establish the predicted mediation. This finding may suggest that the ERN might be more sensitive than the post-error slowing as a measure of self-centric effect. Alternatively, the especially low correlation between interdependence and the self-centric effect in post-error slowing among European Americans might be due in part to the low reliability of this scale for this group of participants ($\alpha = .54$).

Supplementary Discussion

Potential Heterogeneity of the Present Asian Sample

We should hasten to add that our data does not preclude potential heterogeneity of the Asian population. The size or even the direction of the self-centric effect might depend on the specific country of origin (e.g., China vs. Korea) as well as the degree of acculturation in the U.S. This important issue could not be tested in the current work due to small sample size. Future work should address this issue.

Fast Asian Response Time as a Potential Alternative Interpretation of the Cultural Difference in the ERN Self-Centric Effect

Given the observation that response time in the flanker task was significantly faster for Asians than that for European Americans, one might suggest that the cultural difference in the ERN self-centric effect could be an artifact of the response time difference. Previous work shows that the size of the ERN decreases as the speed of response becomes shorter (Falkenstein, Hohnsbein, & Hoormann, 1995; Gehring, Goss, Coles, Meyer, & Donchin, 1993). If the ERN were in fact smaller for Asians than for European Americans, any difference in the ERN between the self-condition and the friend-condition should also be less for Asians than for European Americans. Consistent with this line of argument, we did observe that the absolute magnitude of ERN (vs. CRN) was associated negatively with the mean RT (r = -.42, p < .01). Importantly, however, the two cultural groups did not differ in their absolute magnitude of ERN (vs. CRN) (-10.33 vs. -9.77, for European Americans and Asians, respectively), $F(1, 37) < 1$, *ns.*

While we are not sure why Asians are faster than European Americans, this cultural difference appears quite widespread. We searched for cross-cultural experiments comparing Western participants and East Asian participants with respect to RT in relatively simple cognitive tasks. Among 8 such experiments identified, all but two showed a faster RT for East Asians than for European Americans. The tasks used in these studies were quite diverse, including a Stroop interference task (Ishii, Reyes, & Kitayama, 2003), a lexical judgment task (Na & Kitayama,

2011), and a simple concentration task (Miyamoto & Schwarz, 2006). Hence, this cultural difference appears quite general, not limited to a particular flanker task we used.

Supplementary References

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