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COMMENTS AND CORRECTIONS

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Several genetic analyses of creativity have recently been reported. A key finding is that dopamine might be related to ideational fluency (Runco, Noble, Reiter-Palmon, Acar, Ritchie, & Yurkovich, 2011) or even to creativity per se (Reuter, Roth, Holve, & Hennig, 2006). Previous analyses have ignored an important part of genetic theory, however, namely the likelihood of *polygenetic* contributions. Many human characteristics are polygenetic.

The present *CRJ Comment and Correction* reports reanalyses of the data used by Runco et al. (2011). The new analyses included interactions among the gene alleles. Interactions should speak to the polygenetic possibilities, mentioned earlier. Full-factorial MANOVAs tested the original five genes (D2 Dopamine Receptor [DRD2], Dopamine Transporter [DAT], Catechol-O-Methyltransferase [COMT], and Tryptophane Hydroxylase [TPH1], and Dopamine Receptor D4 [DRD4].) as predictors of the original six criteria (verbal fluency, verbal originality, verbal flexibility, figural fluency, figural originality, and figural flexibility). The main effects were, of course, virtually identical with what was reported in previous analysis: DAT, DRD4, and COMT were significantly related to fluency from the verbal DT tests ($Fs < 3.61$) and COMT, TPH1, and DRD4 were significantly related to fluency from the figural tests ($Fs < 3.16$). For originality, DRD2, DAT, and DRD4 were significantly related to the verbal DT tests ($Fs < 3.70$) and DAT and DRD4 were significantly related to the figural DT tests ($Fs < 3.1$). For flexibility, only DAT was related to verbal DT ($F = 4.1$).

Results from the new analyses and tests of polygenetic possibilities are presented in Table 1. This presents the *F*-values associated with significant, and nonsignificant, interactions using full-factorial MANOVAs. Both verbal fluency and verbal originality were related to significant interactions between DRD2 × DAT, DRD2 × DRD4, DAT × COMT, COMT × DRD4, DRD2 × DAT × COMT, and DRD2 × COMT × DRD4. The polygenetic contribution to verbal flexibility suggests a similar pattern but at a lower level of statistical significance, with nonsignificant interactions of DRD2 × DRD4 and DAT1 × COMT. The tests of polygenetic contributions to figural fluency and originality were quite limited (see Table 1) and there were no significant interactions among the five genes examined and figural flexibility.

A second set of reanalyses examined specific divergent thinking (DT) tasks instead of the composite scores (averaged across tasks). There is, of course, good reason to use composites (e.g., they tend to be more reliable than individual test items), but "alpha if item deleted" pointed to one question ("list things that move on wheels"), with reliability improving from .62 to .71 when it was removed. And analyses removing that one item proved to be informative. When "Move on Wheels" was removed from the analysis of verbal fluency, the relationship of DRD2 that was originally marginal (in Runco et al., 2011; $F(3, 53) = 2.62$, $p = .06$) indicated

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TABLE 1
F- and *p*-Values Associated With MANOVA Interactions

Polygenetic Interactions									
Dependent Variable	*DRD2* × *DAT1*	*DRD2* × *DRD4*	*DAT1* × *COMT*	*DAT1* × *TPH1*	*COMT* × *DRD4*	*DRD2* × *COMT*	*DAT1* × *DRD4*	*DRD2* × *DAT1* × *COMT*	*DRD2* × *COMT* × *DRD4*
Verbal fluency	16.40***	14.04***	11.16***	3.37*	17.01***	1.85	0.15	27.81***	21.08***
Verbal originality	12.61***	10.40***	9.10***	2.38	12.88***	2.09	0.15	17.42***	15.55***
Verbal flexibility	4.42**	1.42	2.36	1.56	3.81*	.32	1.19	3.87*	3.76*
Figural fluency	0.75	1.74	0.21	1.22	3.08*	0.78	2.41	1.5	.14
Figural originality	0.45	1.15	2.7	1.69	2.14	2.81*	3.34*	0.73	0.26

Note. All $df = (3, 53)$, except for verbal flexibility (3, 56). Only results from analyses that had at least one significant interaction are presented. $^{*}p < 05$. $^{**}p < .01$. $^{***}p < .001$.

significant group differences, $F(2, 58) = 4.30$, $p = .018$. Additionally, a full-factorial MANOVA without "Move on Wheels" as a part of the DT composite score suggested an even stronger association between DAT1, COMT, and DRD4 with verbal fluency than indicated using the original composite (Runco et al., 2011): *F*s(2, 58) for DAT1, COMT, and DRD4 were 22.23, $p < .001$, 3.78, $p = .029$, and 16.60, $p < .001$, respectively. As in the original analyses, TPH1 was non-significant $F(2, 58) = .30$, $p = .744$, even with the removal of "Move on Wheels."

In addition, the original MANOVA examining verbal originality as the criterion and the five genes as the predictors increased from $F(1, 53) = 2.47$, $p = .072$ to $F(2, 58) = 3.22$, $p = .047$ for COMT when "Move on Wheels" was omitted. As with verbal fluency, the removal of "Move on Wheels" from the DT composite scores provided even stronger evidence for the association between genes and verbal originality. Within this reanalysis, significant group differences were found for DRD2, DAT1, COMT, and DRD4; *Fs*(2, 58) = 4.69, $p = .013$, $F(2, 58) = 17.07$, $p < .001$, $F(2, 58) = 3.22$, $p = .047$, $F(2, 58) = 14.31$, $p < .001$. As in the original analyses, there were only nonsignificant group differences for TPH1.

The significant main effects of DAT1, DRD2, DRD4, and COMT on verbal originality, in addition to the significant interactions between verbal originality and the genes included in this research (see Table 1), suggest that Runco et al.'s (2011) conclusion (i.e., dopamine is related mostly to fluency, and not as strongly to originality) be examined further. This is a critical question, given that originality is more indicative of creativity than is fluency (Runco & Jaeger, 2012).

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