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A pilot study of cognition and creativity among persons with HIV disease referred for neuropsychological evaluation

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Abstract
Creativity can help people to innovate, overcome obstacles, and successfully navigate challenges in daily life. Some aspects of creativity rely on the prefrontostriatal loops and executive functions, which can be compromised in persons with HIV (PWH). This pilot study examined whether neuropsychological functioning plays a role in creativity in PWH. A consecutive series of 41 PWH who were referred to an urban neuropsychology clinic in southeastern Texas were enrolled. Participants completed the Abbreviated Torrance Test for Adults (ATTA) to measure creativity, from which standardized creativity scores of fluency, originality, elaboration, and flexibility were derived. Participants also completed several measures of everyday functioning and a brief clinical neuropsychological battery measuring executive functions, motor skills, memory, and visuoconstruction. Global neuropsychological functioning showed a large, positive association with ATTA creativity performance that did not vary meaningfully by creativity domain and was independent of premorbid IQ. ATTA creativity scores were not associated with any measure of everyday functioning. Findings from this pilot study suggest that higher levels of neuropsychological functioning may support multiple dimensions of creativity in adults with HIV disease. Future studies might examine whether creativity moderates the association between HIV-associated neurocognitive impairment and various health behaviors (e.g., adherence, appointment attendance).

Keywords Creative thinking · Originality · Innovativeness · Positive psychology · Cognitive dysfunction

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In the 40 years since neuropsychological sequelae of HIV were first described (Snider et al. 1983), neuroAIDS researchers have primarily adopted a deficit-based approach to understanding HIV's effects on the brain. Approximately 30–50% of persons with HIV (PWH) have an HIV-associated neurocognitive disorder (HAND; Wang et al. 2020). HIV can cross the blood–brain barrier and adversely affects brain structure and function (Gonzalez-Scarano and Martin-Garcia 2005). HIV-associated neural injury tends to be most impactful on the frontostriatal and temporolimbic networks (Ellis et al. 2009); as such, the neuropsychological sequelae of HIV include mild-to-moderate deficits in executive functions, declarative memory, and psychomotor skills (Woods et al. 2009). These HIV-associated neuropsychological deficits can interfere with health behaviors (e.g., medication adherence),

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instrumental activities of daily living (e.g., financial management), and quality of life (Casaletto et al. 2017).

We know considerably less about the "positive neuropsychology" of HIV (Randolph 2018), which adopts a strength-based approach to examining factors that promote and protect brain wellness (Randolph 2018). The few positive neuropsychology studies of HIV to date have revealed the correlates of successful (e.g., Malaspina et al. 2011) and super (Saloner et al. 2019) cognitive aging in PWH. Positive psychological factors such as grit (Moore et al. 2018a) and resilience (Moore et al. 2018b) have been associated with better neuropsychological functioning in older PWH. In fact, higher levels of resilience are protective against the adverse effects of HIV-associated neuropsychological deficits on everyday functioning (Fazeli et al. 2019). Thus, examining the different aspects of positive neuropsychology in HIV may produce important insights on pathways to prevent, compensate, and remediate HAND.

Creativity is one aspect of positive psychology that warrants investigation in PWH. In the neuroscience literature, creativity describes "the new discovery, understanding, development and expression of orderly and meaningful relationships" (Heilman 2016). Although we often think of creativity in the context of novel artistic expression and influential breakthroughs, this multidimensional construct falls along a much broader continuum. Creativity is multidetermined and may play an important role in helping people to innovate, overcome obstacles, and successfully navigate many aspects of health (Heilman 2016). The neural substrates of creativity remain elusive, but neuroimaging and clinical group studies suggest that the prefrontal cortex and frontostriatal loops (e.g., de Souza et al. 2010; Miller et al. 2000) are important in the generativity, originality, and flexible aspects of creativity. There is also evidence to support the role of both the temporolimbic (e.g., Duff et al. 2013) and frontoparietal (e.g., Gansler et al. 2011) networks in creative processing.

Our understanding of the cognitive architecture of creativity is also still emerging. Creativity may involve divergent, associative, and convergent thinking skills that are supported by a variety of higher-order cognitive ability areas; these include intelligence, generativity, abstraction, novel problem-solving, cognitive flexibility, and working and declarative memory (Heilman 2016). Meta-analytic studies suggest that the relationship between intelligence and creativity is generally small, heterogeneous, and likely non-linear (e.g., Kim 2005). The results of correlational and experimental studies on the association between neuropsychological ability and creativity in both healthy and clinical samples are also mixed. Several studies nevertheless show that creativity may be supported by executive functions (e.g., de Souza et al. 2010; Sadana et al. 2017), working memory (e.g., De Dreu et al. 2012), and declarative memory (e.g., Rigon et al. 2020). Since HIV affects these same cognitive and neural systems, it is reasonable to hypothesize that neuropsychological functioning may play a role in creativity in PWH.

We currently know very little about creativity in HIV disease. The few studies published to date suggest that creativity may facilitate some aspects of psychological health in the broader context of HIV infection. For example, Neema et al. (2012) reported benefits of a creativity intervention in reducing HIV stigma and improving communication in PWH. The use of creative narratives has enhanced our understanding of the psychosocial aspects of HIV prevention (Singleton et al. 2021). Similarly, creativity emerged as an important theme in resilience in relation to HIV prevention (Buttram 2015; Kubicek et al. 2013). Building on this small literature, the current pilot study examined the hypothesis that higher levels of neuropsychological functioning are associated with greater creativity in PWH.

Method

Participants

Potential study participants were a consecutive series of 50 PWH referred for in-person neuropsychological evaluation at a community HIV clinic in southeast Texas between late June 2018 and early March 2020 (i.e., prior to the shutdowns related to the coronavirus pandemic in the USA). Participants were primarily referred by psychiatrists and infectious disease physicians for the differential diagnosis of HAND. The university and county health human subjects committees both approved the parent study (Woods et al. 2021). The creativity analyses reported herein have not previously been published. The study inclusion criteria were (1) HIV infection, per clinic record; (2) 18 + years old; (3) ability to provide informed consent; and (4) adequate English language skills. There were no a priori exclusion criteria. Forty-one (82%) of the potential participants were enrolled (see Table 1) and received nominal compensation. Nine potential participants were not enrolled due to limited English proficiency, inability to consent, fatigue, insufficient time, or physical limitations that precluded evaluation.

Study design and procedure

The study was cross-sectional and correlational. Enrolled participants provided written, informed consent prior to completing a health memory experiment, questionnaires, and neuropsychological measures (see Woods et al. 2021). All research measures were administered and scored by doctoral clinical psychology students supervised by the lead author.

Table 1 Participants' demographic and clinical information ($N = 41$)

Variable	M (SD) or %	Range
Psychosocial		
Age (years)	49.8 (10.0)	26–66
Gender (% women)	36.6	—
Education (years)	11.7 (2.9)	7–18
Ethnicity (%)		
Black	68.3	—
Hispanic	12.2	
White	17.1	
Other	2.4	
Handedness (% right)	90.2	—
Disability (% disabled)	80.5	—
Income (% < $20,000/yr)	73.2	—
Estimated IQ		
Test of premorbid functioning (TOPF)	80.2 (11.3)	53–100
Wechsler matrix reasoning (T-score)[a]	38.7 (12.6)	20–65
Psychiatric		
Brief Symptom Inventory – 18 (T-score)	60.0 (11.9)	33–80
AUDIT (of 10)	2.2 (3.2)	0–14
DAST (of 10)	0.9 (2.1)	0–9
General medical		
Charlson comorbidity index	4.6 (3.7)	0–12
Hepatitis C co-infection	15.0	
Cardiovascular disease[b]	63.4	
HIV disease		
Years diagnosed with HIV	14.6 (10.4)	0–39
Current CD4 count (cells/μL)	531.1 (346.4)	38–1694
Nadir CD4 count (cells/μL)	193.2 (212.8)	1–793
AIDS (%)	42.5	—
ART (% prescribed)	100	—
Plasma HIV RNA (% detectable)	22.0	—

AIDS acquired immune deficiency syndrome; *ART* antiretroviral therapy; *AUDIT* Alcohol Use Disorders Identification Test; *DAST* drug abuse screening test

[a] $n = 36$

[b] Include hypertension, hypercholesterolemia, coronary artery disease, and cerebrovascular accidents

Measurement of creativity

Creativity was the primary dependent (i.e., criterion) variable in this study. Participants were administered the Abbreviated Torrance Test for Adults (ATTA; Goff and Torrance 2002) according to the procedures outlined in the test manual. Participants completed three creative activities, each of which had a 3-min time limit (see Fig. 1). The first activity required participants to write down all of the potential difficulties that they might encounter if they had the ability to walk on air or fly. The second activity had participants draw unusual and interesting pictures around two incomplete figures. The third activity had participants draw as many titled pictures as they could on a page that displayed a group of triangles arranged in a three-by-three pattern. The three activities were scored across 15 dimensions of creativity (e.g., richness and humor), which were used to generate the following scores: (1) fluency, which measures the quantity of the ideas that were produced; (2) originality, which measures the number of uncommon ideas that were produced; (3) elaboration, which measures the extent to which ideas were embellished with details; and (4) flexibility, which measures the extent to which the participant generated different ideas based on the same stimulus. A second rater independently scored a random sample of 25% of the cases and achieved strong reliability ($rs = .88–.95$). Raw scores were converted to 9-point standard scores (Cronbach's alpha = .833; see Table 2).

Neuropsychological assessment

Global neuropsychological functioning was the primary independent variable (i.e., predictor) in this study. It was measured by averaging the sample-based z-scores of 9 indices drawn from clinical tests of executive functions, memory, motor skills, visuospatial abilities, and information processing speed (see Table 2; alpha = .797). The specific measures were (1) total score from the International HIV Dementia Scale (iHDS; Sacktor et al. 2005), which includes a 4-item list recall task, alternating hand sequences measures, and finger tapping; (2) total correct words from action (verb) fluency (Piatt et al. 1999); (3) completion times from the dominant and non-dominant hand trials of the Grooved Pegboard Test (Klove, 1963); (4) total correct scores from the filled dots, empty dots, and switching trials of the design fluency subtest of the Delis-Kaplan Executive Function Scale (D-KEFS; Delis et al. 2001); and (5) total accuracy scores from the command and copy trials of the Executive Clock Drawing Task (CLOX; Royall et al. 1998). Thirty-two (78%) participants scored < 11 on the iHDS, which is a commonly used cut point for HAND.

Everyday functioning

The World Health Organization's (2012) Disability Assessment Schedule (WHODAS 2.0) is a 12-item self-report questionnaire on which participants rated their level of difficulty completing various physical, social, and cognitive activities on a scale from 0 (none) to 4 (extreme, cannot do) over the past month. The total WHODAS 2.0 score ranged from 0 to 36 (alpha = .855). The Karnofsky Performance Status Scale (KPSS; Karnofsky and Burchenal 1949) is a clinician-rated measure of a global functioning over the past month. The KPPS uses a 0 (mortality) to 100 (normal) scale assigned by the senior author based on a chart review (range = 40–90). We also extracted the percentage of recent missed clinic visits from the electronic medical record (Fazeli et al. 2020), which ranged from 3 to 56%.

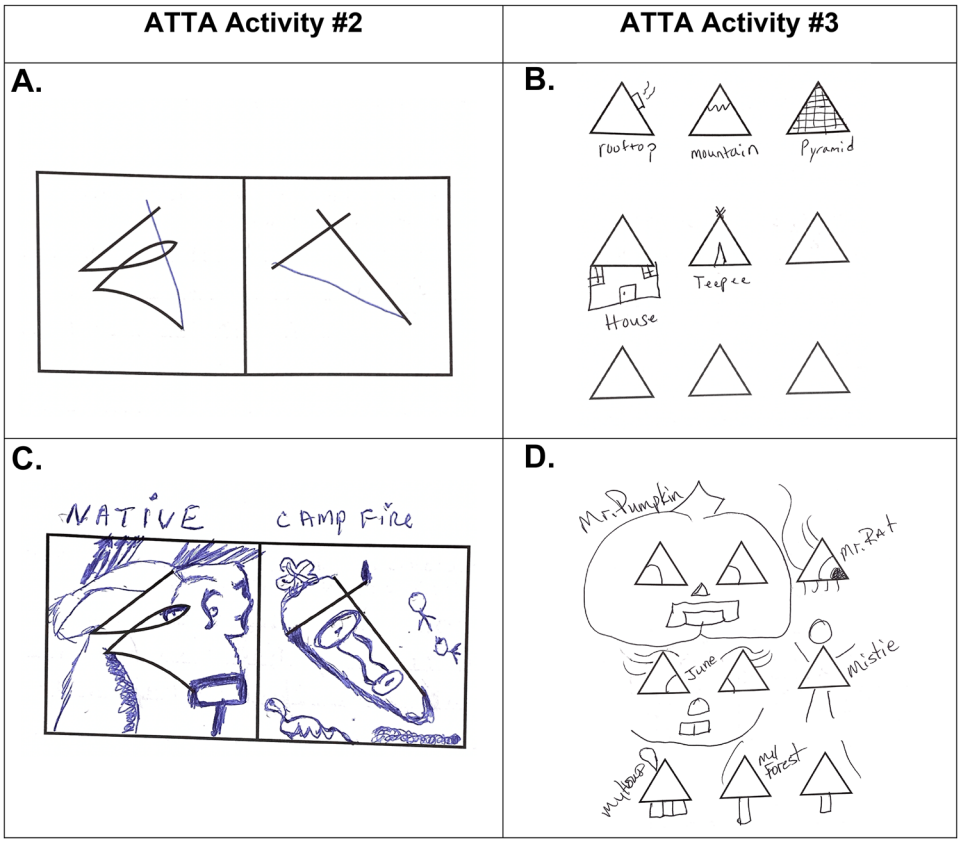

Fig. 1 Sample participant responses from activities on the Abbreviated Torrance Test for Adults (ATTA). The top two responses (panels **A** and **B**) are from participants with a clinical diagnosis of mild neurocognitive disorder and the bottom two responses (panels **C** and **D**) are from participants without a clinical neurocognitive disorder. Note that ATTA Activity #2 and ATTA Activity #3 are reprinted with permission of Scholastic Testing Service, Inc

Table 2 Descriptive data for participants' creativity and neurocognitive test scores ($N=41$)

Variable	M (SD)	Range
ATTA creativity (of 19)		
Fluency	14.2 (2.5)	11–19
Originality	14.9 (2.6)	11–19
Elaboration	15.1 (3.0)	11–19
Flexibility	14.2 (2.3)	11–19
iHDS total score (of 12)	7.9 (2.7)	2–12
Grooved Pegboard Test (sec)		
Dominant hand	108.1 (35.9)	62–201
Non-dominant hand	130.2 (48.9)	69–239
CLOX (of 15)		
Trial 1: command	10.6 (2.4)	5–14
Trial 2: copy	12.6 (2.1)	7–15
Action (verb) fluency (raw total)	12.7 (5.4)	4–27
D-KEFS Design Fluency Test (raw total)		
Filled dots	6.0 (3.3)	1–16
Empty dots	6.3 (3.7)	0–17
Switching	4.0 (3.2)	0–14

ATTA Abbreviated Torrance Test for Adults; *iHDS* International HIV Dementia Scale; *CLOX* Executive Clock Drawing Task; *D-KEFS* Delis-Kaplan Executive Function System

Premorbid IQ estimation

Premorbid IQ was estimated with a composite score that combined educational attainment with two widely-used tests. All participants were administered the Test of Premorbid Functioning (Pearson Assessment 2009), which is a measure of oral word reading. Thirty-six participants also received the Matrix Reasoning subtest of either the Wechsler Adult Intelligence Scale-Fourth Edition ($n=18$; Wechsler 2008) or Wechsler Abbreviated Scale of Intelligence-Second Edition ($n=18$; Wechsler 2011). These variables were converted to population-based z-scores and averaged to create a composite (mean $r=.50$).

Sample characterization

Sociodemographics were obtained by self-report. All participants were part of the same large county health system and medical variables were derived from the electronic health record. Additional measures included the Brief Symptom Inventory (BSI-18; Derogatis 2001) to assess mood (alpha = .900), the 10-item Alcohol Use Disorders Identification Test (AUDIT; Saunders et al. 1993) to measure problematic alcohol use (alpha = .704), and the Drug Abuse Screening Test (DAST; Skinner 1982) to assess problematic drug use (alpha = .916).

Data analysis

The primary study hypothesis was that better neuropsychological functioning is associated with greater creativity in HIV. This hypothesis was tested using a multivariate regression, where the four standardized variables from the ATTA were the dependent, within-subjects factor (i.e., criterion). The independent variable for this model (i.e., the predictor) was the continuous global neuropsychological z-score. Note that, all of the everyday functioning measures were non-normally distributed (Shapiro–Wilk W Test $ps < .05$) and analyses related to those variables were conducted with non-parametric measures. In contrast, both the global neuropsychological z-score and the summary ATTA variable had normal distributions (Shapiro–Wilk W test $ps > .05$) and were suitable for parametric tests. While there was a mix of normal (e.g., fluency, visuoconstruction) and non-normal (e.g., motor) distributions among the domain-level neuropsychological test scores, the magnitude and pattern of associations did not change whether parametric or non-parametric tests (e.g., Spearman's rho) were used. The critical alpha was set at .05 for the primary study analyses and were adjusted with Benjamini–Hochberg false discovery *p*-values for post hoc tests.

Results

Determining covariates

Any descriptive variable in Table 1 that was significantly associated with both the dependent and independent variables was included as a covariate (Field-Fote 2019). Of the variables in Table 1, global neuropsychological functioning was significantly associated with all three indicators of estimated premorbid IQ, including education ($r = .34$), TOPF reading ($r = .67$), and WAIS Matrix Reasoning ($r = .42$; all $ps < .05$). Likewise, ATTA creativity total score was also robustly associated with education ($r = .38$), TOPF reading ($r = .43$), and WAIS Matrix Reasoning ($r = .60$; all $ps < .05$). Neither creativity nor cognition was associated with any other variables in Table 1, including HIV disease factors ($ps > .05$). Given the small sample size and the conceptual and statistical collinearity between education, TOPF scores and WAIS Matrix Reasoning, we used a single sample-based z-score composite of estimated premorbid IQ from these three measures as a covariate (see details in Methods). No other variable met our a priori inclusion criteria for covariates.

Primary analyses of cognition and creativity

A regression model predicting ATTA creativity from global neuropsychological functioning and estimated premorbid IQ was conducted. The model showed a significant relationship between global neuropsychological functioning and ATTA Creativity ($F(1,38) = 8.7$, $p = .005$), but no interaction by creativity domain ($F(3,36) = .9$, $p = .461$). The effect sizes are displayed in Table 3. There was also a main within-subjects effect of ATTA Creativity domain ($F(3,36) = 5.9$, $p = .002$), which was driven by lower ATTA fluency versus both originality ($p = .013$, Cohen's $d = .28$) and elaboration ($p = .015$, $d = .33$; all other $ps > .05$). There was a main effect of estimated premorbid IQ ($F(1,38) = 8.7$, $p = .005$; see Table 3), which was tempered by a significant interaction ($F(3,36) = 3.5$, $p = .026$) such that IQ was associated with all aspects of the ATTA ($ps < .01$; Table 3) except originality ($p = .07$). Data are displayed graphically in Figs. 2 and 3.

Planned post hoc analyses of cognition and creativity

Planned post hoc analyses examined the correlation between the specific neuropsychological measures and the ATTA creativity score, which were adjusted for type I error. First, we used the ATTA creativity total score since there was no interaction between the global neuropsychological z-score and ATTA creativity domains. Second, we combined the raw sample-based z-scores from the neuropsychological measures into four practical domains of (1) cognitive fluency (i.e., action and design fluency); (2) motor skills (i.e., Grooved Pegboard); (3) visuoconstruction (i.e., CLOX); and (4) general cognition (i.e., iHDS). Third, we used

Table 3 Correlation matrix for measures of creativity, premorbid IQ, and global neuropsychological functioning in 41 persons with HIV disease

Measure	1	2	3	4	5	6
1. ATTA fluency	-	-	-	-	-	-
2. ATTA originality	.77	-	-	-	-	-
3. ATTA elaboration	.70	.45	-	-	-	-
4. ATTA flexibility	.71	.46	.78	-	-	-
5. Premorbid IQ	.53	.29	.64	.46	-	-
6. Global NP score	.58	.32	.59	.63	.58	-

ATTA Abbreviated Torrance Test for Adults; *IQ* intelligence quotient; *NP* neuropsychological

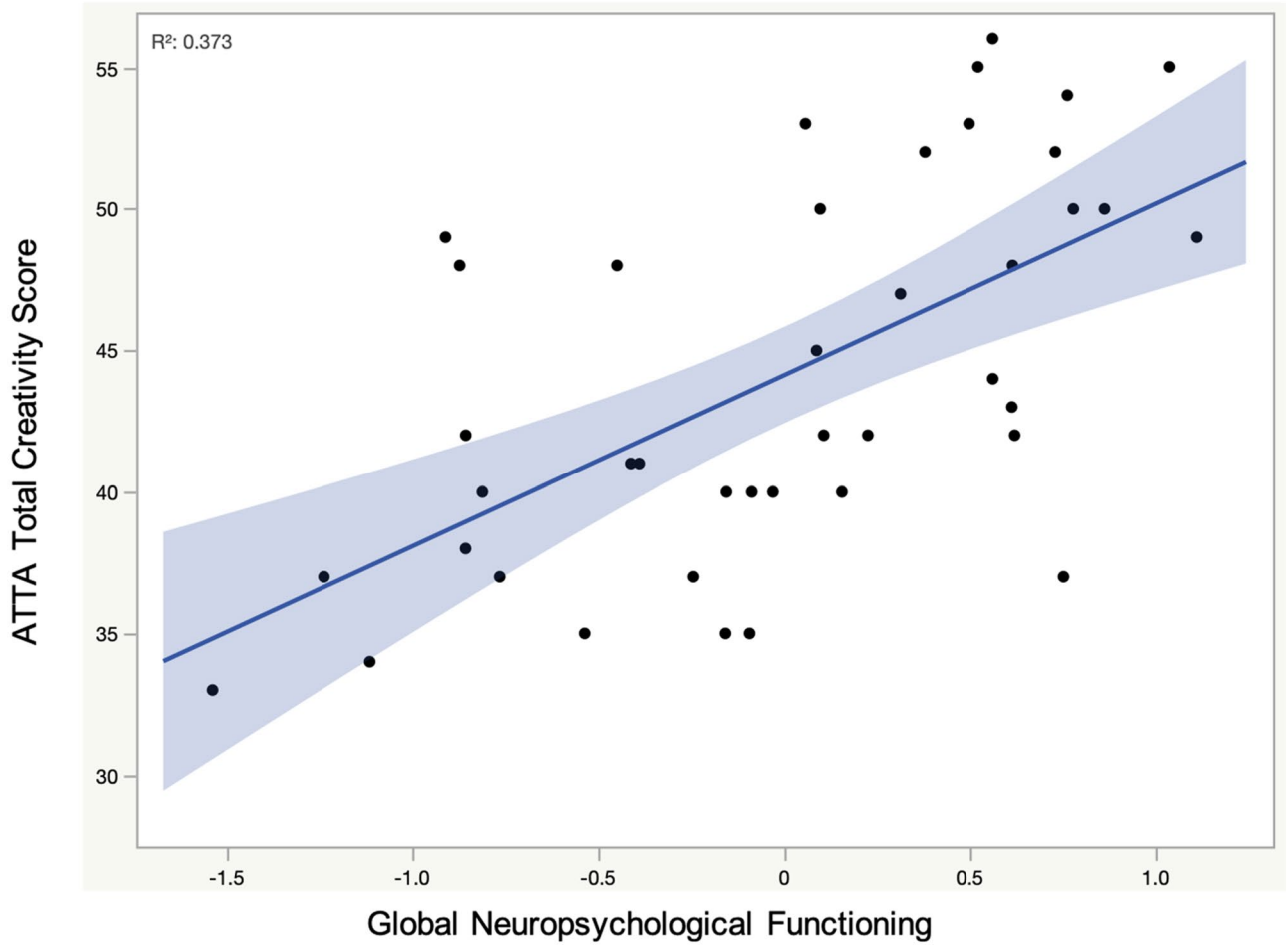

Fig. 2 Scatterplots of the relationship between global neuropsychological functioning (z-score) and creativity as measured by the Abbreviated Torrance Test for Adults (ATTA). The primary regression model showed that higher global neuropsychological scores were associated with better creativity similarly across all ATTA scores, covarying for estimated premorbid IQ. The lower score range of the Y-axis was truncated to match the score range of the dataset

Benjamini–Hochberg adjusted *p*-values. ATTA creativity showed a large effect size association with cognitive fluency ($r = .64$, $p < .001$) and medium effect size relationships with motor skills ($r = .39$, $p = .045$), visuoconstruction ($r = .33$, $p = .049$), and the iHDS ($r = .32$, $p = .043$). Data are displayed graphically in Fig. 4.

Planned analyses of creativity and everyday functioning

The measures of everyday functioning were all non-normally distributed (Shapiro–Wilk *W* test $ps < .05$), so we examined their association with the ATTA creativity total score using Spearman's rho and Benjamini–Hochberg adjusted *p*-values. ATTA creativity total score was not significantly associated with missed clinic appointments (rho = .04, $p = .778$), WHODAS 2.0 total (rho = .25, $p = .171$), or Karnofsky Performance Status Score (rho = .26, $p = .321$).

Discussion

HIV is associated with injury to the brain networks (e.g., prefrontostriatal loops) and related neurocognitive abilities (e.g., executive dysfunction) that support creative thinking. Results of this pilot study showed that better global neuropsychological functioning was associated with the ability of PWH to generate more original, elaborative, and flexible responses to both verbal and visual prompts. The relationship between neuropsychological functioning and creativity in PWH was accompanied by a large effect size and was not confounded by premorbid IQ, sociodemographics, psychiatric symptoms, or medical factors. Similarly, these findings support a recent study in older PWH that reported an association between openness (i.e., the disposition for trying new things and being creative) and global neurocognitive functioning (Fazeli et al. 2021). It is plausible that more open and creative PWH are more likely to seek out new and stimulating experiences and activities that

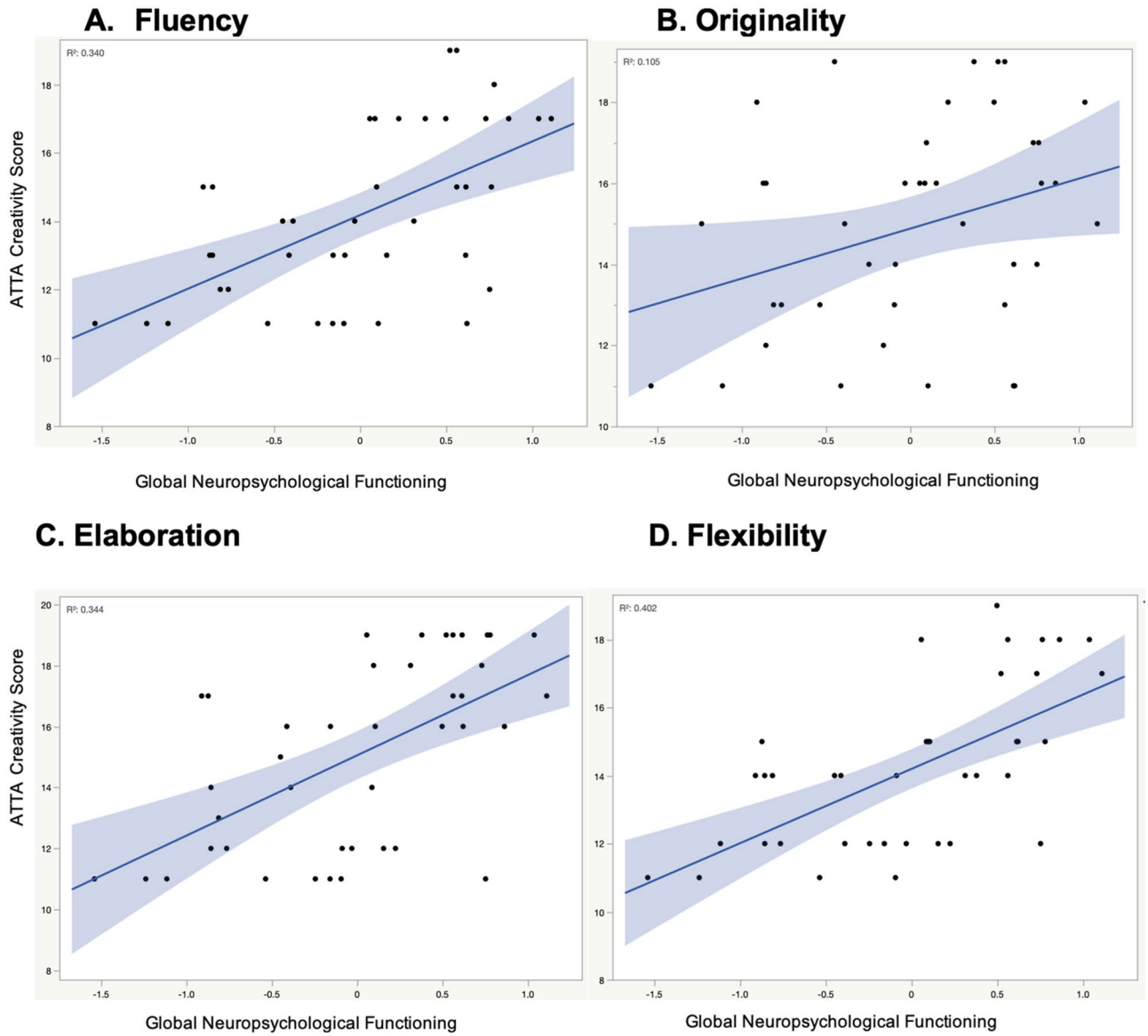

Fig. 3 Scatterplots of the relationship between global neuropsychological functioning (z-score) and the fluency (panel **A**), originality (panel **B**), elaboration (panel **C**), and flexibility (panel **D**) domains of creativity as measured by the Abbreviated Torrance Test for Adults (ATTA). The lower score range of the Y-axis was truncated to match the score range of the dataset

ultimately facilitate learning throughout the lifespan that build cognitive reserve (e.g., Ziegler et al. 2015). Taken together, our preliminary findings align studies showing a positive association between cognition and creativity in healthy adults (e.g., De Dreu et al. 2012). Moreover, these pilot data add to a small literature showing that neuropsychological ability (e.g., verbal fluency, flexibility, and verbal learning) shows large correlations with some aspects of creativity in samples with central nervous system involvement, including frontotemporal dementia (de Souza et al. 2010) and traumatic brain injury (Rigon et al. 2020). Studies with both healthy adults and persons with HAND are needed to determine whether the presence of cognitive impairment in PWH: (1) adversely affects different dimensions of creativity or (2) amplifies, dampens, or changes the pattern of associations between creativity and neuropsychological functioning.

At the level of neuropsychological domains, all four of the cognitive ability areas measured showed significant associations with creativity in PWH. These preliminary results suggest that aspects of executive functions (e.g., fluency), simple and complex motor skills, and visuoconstructional ability all contribute to creativity in PWH. The strongest association was observed for cognitive fluency, which was comprised of tests measuring the rule-guided generation of verbs and visual designs. Importantly, this association held steady at a large effect size when we removed the ATTA fluency subscale from the total score post hoc ($r = .61$),

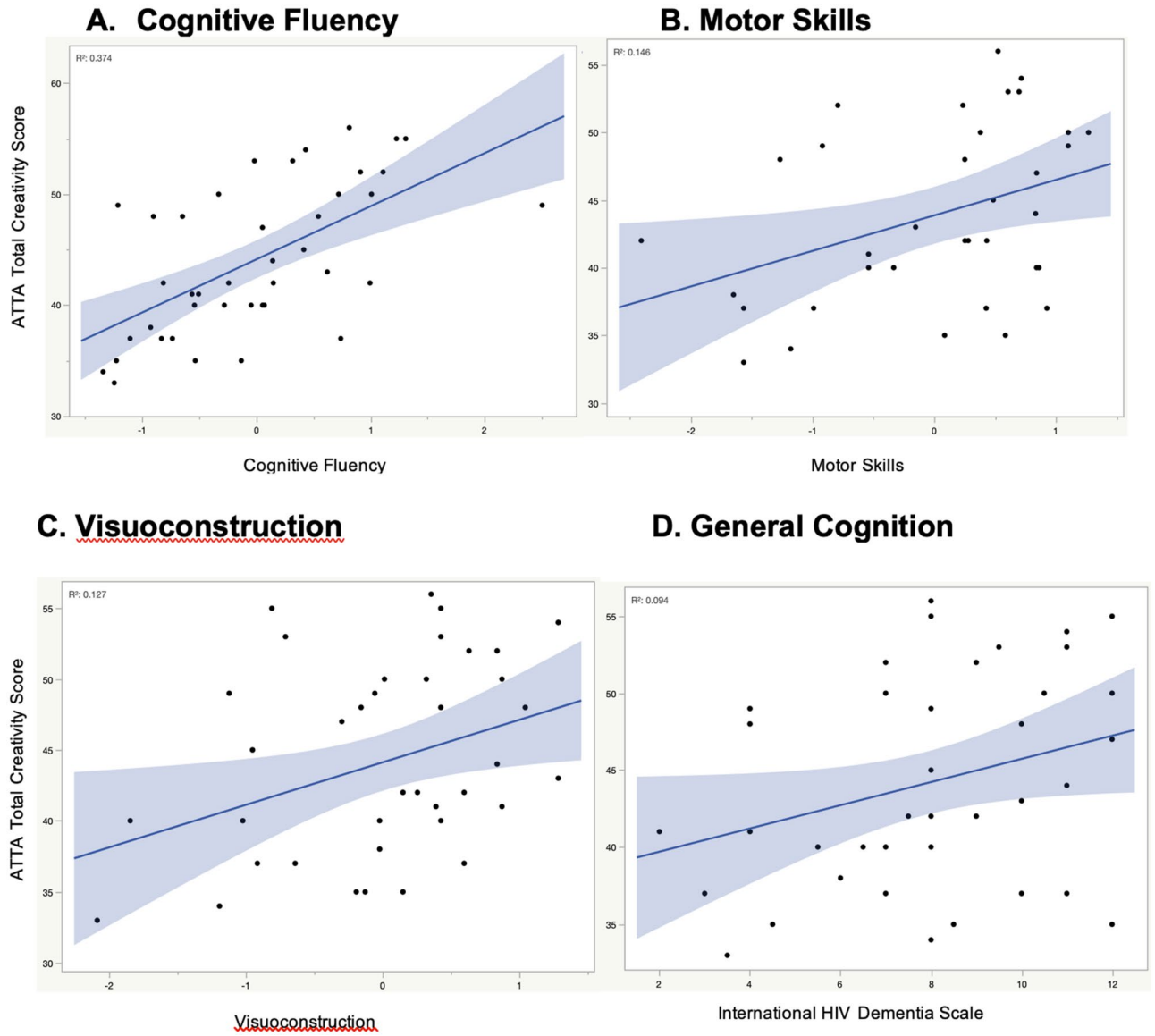

Fig. 4 Scatterplots of the relationship between different domains of neuropsychological functioning (z-scores) and creativity as measured by the Abbreviated Torrance Test for Adults (ATTA). The lower score range of the Y-axis was truncated to match the score range of the dataset

which reduces concern about shared-method variance. HIV is associated with mild-to-moderate deficits in multiple aspects of fluency (Basso and Bornstein 2003; Iudicello et al. 2007), which are dependent upon frontostriatal circuits (e.g., Thames et al. 2012) and are characterized by inefficiencies in quickly and flexibly retrieving information from semantic memory stores (Woods et al. 2004). Verbal fluency deficits increase the risk of dependence in everyday functioning in HIV (Woods et al. 2006), but generativity and accuracy can be enhanced by providing structured, lexicosemantic cues (Iudicello et al. 2012). Therefore, it is possible that creative fluency may be improved in PWH by developing structured prompts to help minimize the executive demands of search, retrieval, and integration of ideas across semantic networks.

There was not a significant interaction between global neuropsychological functioning and the four domains of creativity that were measured in this pilot study of PWH. Therefore, we can be more confident that the relationship between cognition and creativity is not simply an artifact of both constructs including elements of fluency (i.e., generativity). In fact, the primary association between global neuropsychological functioning and creativity remained strong when we removed the ATTA fluency domain score as one of the within-subjects variables from the model ($p = .007$). A qualitative review of the effect sizes displayed in Table 3 shows large associations between cognition and the creativity domains of fluency, elaboration, and flexibility, whereas the correlation between cognition and originality (i.e., the number of uncommon ideas

generated) was at the level of a medium effect. Interestingly, the same pattern of correlations was evident for the association between estimated premorbid IQ and creativity, such that the lowest correlation was with originality. Perhaps the generation of low base rate responses to standard prompts depends more heavily on aspects of executive functions that were not measured in this pilot study. So future studies might examine constructs such as prepotent response inhibition, novel problem-solving, and planning, especially given that these domains are reliably affected by HIV (Walker and Brown 2018).

Creativity was not associated with everyday functioning in this pilot study. It is possible that the analyses were not adequately powered to detect the subtle association between creativity and such complex functional outcomes. Indeed, our sample was fairly small. It is also possible that the aspects of creativity assessed in this study do not map onto the particular demands of everyday functioning that were measured. Health and everyday functioning are complex constructs that future studies might measure more comprehensively and objectively, including laboratory-based measures (e.g., medication management), technology-driven assessments (e.g., internet navigation; Woods et al. 2016), and observational approaches (e.g., pharmacy refills). Likewise, although the ATTA is an objective and standardized measure of creativity, it is nevertheless only one test of a complex, multidetermined construct. Future studies might examine whether other measures of novelty seeking (e.g., Cloninger et al. 1994), associative thinking (e.g., Pringle and Sowden 2017), and convergent thinking (e.g., Mednick 1962) are related to cognition and everyday functioning in PWH.

There are a few limitations of the current pilot study that are important to consider. This was a retrospective, preliminary study with a limited battery of mostly non-verbal neuropsychological measures and did not include some domains that might be important in creativity (e.g., response inhibition). The consecutive series of patients in this sample was specifically referred for neuropsychological evaluation and thus includes persons with many "confounding" conditions (Antinori et al. 2007) that are commonly excluded from neuroAIDS studies. Thus, our findings cannot be interpreted as being specific to HIV. Of note, the primary results did not change if we restricted the sample to only those persons who were prescribed ART and had undetectable viral loads. The generalizability and power of the results is limited by the absence of a seronegative comparison group and the use of a small, clinical sample that was referred for neuropsychological evaluation. Moreover, the small sample precluded us from examining any potential non-linear relationships between cognition and creativity or mediating and moderating effects. High levels of creativity might serve as a buffer for some dimensions of health and everyday functioning; in other words, individuals with higher levels of creativity might be able to find clever or unusual ways to successfully navigate risk factors (e.g., mood, neuropsychological impairment) and avoid poor health outcomes and dependence in everyday functioning (e.g., Fazeli et al. 2020). For example, PWH with heightened psychosocial stress (e.g., Kalichman and Catz 2000) might leverage their creativity skills in adapting, adjusting, or problem-solving in novel ways to facilitate resilience (e.g., Metzl and Morrell 2008). Likewise, creativity may be a pathway (i.e., mediator) through which neurocognitive functioning exerts its supportive influence on various health behaviors (e.g., medication adherence) and dimensions of everyday functioning (e.g., compensatory strategies). For instance, creativity may increase the likelihood of developing and using compensatory strategies that can buffer against the adverse effects of neuropsychological deficits in the laboratory and in daily life (Matchanova et al. 2020).

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