JOURNAL OF
Creative Behavior
Publication of the Creative Education Foundation

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Creative Activities Among Older Adults and People With Cognitive Impairment

ABSTRACT

Little is known about creativity in old age. The aim of this study was to investigate to what extent the intensity of engaging in creative activities differs between older and younger people as well as older people with and without cognitive impairment. Moreover, we evaluated associations of creative activities with specific cognitive abilities. For this cross-sectional study, groups of younger people (n = 24), older cognitively healthy people (n = 24), and older cognitively impaired people (n = 23) were recruited via convenience sampling. Creative activities were assessed via the creative behavior inventory (CBI). Cognitive abilities were assessed via trail making test (TMT), standard progressive matrices (SPM), creative reasoning task (CRT), test of creative thinking-drawing production (TCT-DP), and alternate uses task (AUT). The intensity of engaging in creative activities was higher among younger people but was not significantly associated with being cognitively impaired. Only two cognitive abilities, the creative thinking scores CRT-Components and TCT-DP-Original, predicted creative activities. Both did not differ significantly between cognitively healthy and cognitively impaired older adults. The findings suggest that cognitively impaired older people still engage in creative activities, which might be due to their relatively sound creative thinking. Further studies should investigate whether engaging in creative activities can mitigate cognitive decline.

Keywords: aging, creativity, cognitive abilities, leisure activities, dementia, lifestyle.

A number of people engage in creative activities in their spare time. Creative activities can be fun and are a way to unfold one's own potential (Benedek, Bruckdorfer, & Jauk, 2020). Accordingly, the motivation to carry out creative activities is based on intrinsic motivation, for one part. A study by Silvia et al. (2014) demonstrated that the participants felt significantly happier and more active when they did something creative (Silvia et al., 2014). Extrinsic factors such as praise, money, rewards, evaluation, and competition can also motive creativity (Luria & Kaufman, 2017), as do prosocial factors like inducing pleasure for other people, promoting empathy, generating knowledge or solving problems, and getting others to think in more complex ways (Forgeard & Mecklenburg, 2013). This can be observed in daily life when creativity is used to solve problems in everyday life and at work, in new scientific findings, art movements, or new inventions (Sternberg & Lubart, 1996). Essentially, creativity requires some sort of originality, essentially generating something novel that is also effective, ensuring that what is created is actually useful and valuable (Runco & Jaeger, 2012). How creative a person is depending on several aspects. Culture and acceptance by the social group affect creativity and so does a person's motivation and ability to deviate from the norm (Stein, 1953). These aspects have been described as the four Ps: Person, Process, Press, and Product (Rhodes, 1961). More comprehensive models such as the 8Ps (Purpose, Person, Press, Problem, Process, Product, Propulsion, and Public; Sternberg & Karami, 2022) and the 7Cs (Creators, Creating, Collaborations, Contexts, Creations, Consumption, and Curricula; Lubart, 2017) provide a more concrete perspective of causes, finals, and individuals characteristics that contribute to creativity. Accordingly, a person's potential for creativity is related to each of these elements, of which the intrinsic capacities encompass just one part (Corazza & Glăveanu, 2020). Another important aspect of creativity is creative thinking. A person's creative thinking is considered to consist of two cognitive abilities: divergent and convergent thinking. Divergent thinking is the ability to generate new ideas when criteria are vague and there is more than one correct solution, while convergent thinking is applied to find the one and only correct solution (most often but not exclusively) of a well-defined problem (Zhang, Sjoerds, & Hommel, 2020).

With aging, cognitive abilities typically decline (Verhaeghen & Salthouse, 1997). Convergent thinking and aging has been mainly studied in terms of intelligence: Fluid intelligence, for instance as measured via performance in the Raven Progressive Matrices, decreases with older age (Guttman, 1981). Similarly, performance in tests that assess fluid intelligence with a small extent of crystallized intelligence (the Rebus Learning, Logical Steps, Mystery Codes, and Memory Block Design Test) is lower with older age as well (Kaufman & Horn, 1996). However, concerning divergent thinking, research has shown that older and younger people tend to have similar levels of divergent thinking, especially if workload is not very high (Fusi, Lavolpe, Crepaldi, & Rusconi, 2021). A recent study confirmed this idea, showing significant differences between younger and older people in only 2 out of 11 creativity thinking scores (for details see Ross, Lachmann, Jaarsveld, Riedel-Heller, & Rodriguez, 2023). Divergent thinking seems to be related to resting state brain connectivity (Takeuchi et al., 2017). Even though resting state connectivity decreases with aging (Dennis & Thompson, 2014), this decline might not be substantial enough to disrupt divergent thinking skills. With dementia, however, the disruption of resting state connectivity is even stronger (Dennis & Thompson, 2014) leading to a significant reduction in divergent thinking, especially in complex tasks (Hart & Wade, 2006). Nonetheless, studies involving artists with dementia demonstrated preserved creative capacities despite dementia, even though the paintings become more schematic during the disease process (Palmiero, Di Giacomo, & Passafiume, 2012). Accordingly, we could presume that some aspects of creativity remain even after a person has developed dementia.

Being creative is important for expressing emotions and well-being and first studies have shown that dementia patients are still creative (Li & Yan, 2021). A review on arts-based activities in dementia care giving settings has concluded that being creative might have a positive impact on cognitive abilities (Young, Camic, & Tischler, 2016). However, research is still very scarce and creative capacities of non-artist dementia patients as well as their engagement in creative activities is not well understood.

Besides potentially beneficial effects on well-being, engaging in creative activities can have protective effects. Results from previous studies indicate that the performance of certain creative activities may be associated with a reduced risk of dementia. Wang, Karp, Winblad, and Fratiglioni (2002) analyzed data from the Kungsholmen project and observed that engaging in mental (reading books/journals, writing, solving crossword puzzles, drawing, painting), physical (swimming, gymnastics, walking), social (theater and concert visits, traveling or playing cards in groups), and productive (gardening, cooking, sewing, knitting, or crocheting) leisure activities was associated with a reduced incidence of dementia (Wang et al., 2002). Therein, a high frequency of performing these leisure activities was critical. Another study by Hughes, Chang, Vander Bilt, and Ganguli (2010) analyzed data from the MoVIES project and showed that pursuing several hobbies was associated with a reduced risk for developing dementia, of which crafts seemed to have the strongest effect (Hughes et al., 2010). These findings are explained by the idea that cognitive stimulation protects cognitive abilities in old age, as several studies have demonstrated (Iizuka et al., 2019; Litwin, Schwartz, & Damri, 2017).

The aim of our study was to investigate creative activities across the lifespan, particularly among older people with and without cognitive impairment. On one hand, if engaging in creative activities serves as a protective factor against cognitive impairments or if a predisposition for cognitive impairment reduces involvement in creative activities, we should expect a higher intensity of engaging in creative activities among those without compared to those with cognitive impairment. On the other hand, cognitive abilities are lower among those with cognitive impairment, so we wanted to learn more about possible associations between poorer cognitive abilities (processing speed, fluid intelligence, creative thinking) and creative behavior. As the level of cognitive abilities might be an important driver of creative behavior, we speculated that lower cognitive abilities are associated with engaging less frequently in creative activities. Therein, creative thinking might be most relevant regarding creative behavior. Processing speed and fluid intelligence are known to decline with old age and with cognitive impairment, so these abilities might reflect a person's capacity for engaging in creative activities.

In this study, we conducted cross-sectional comparisons between three groups, a group of younger people and two groups of aged people, one with and the other without cognitive impairment. We have previously analyzed differences in creative thinking in this sample (Ross et al., 2023) and did now, in this study, analyze differences in engaging in creative activities and how this differs by cognitive ability level.

METHODS

SAMPLE & STUDY DESIGN

The sample was recruited via convenience sampling using personal contacts, mailing lists, handouts, and contacting interest groups throughout Germany in 2020–2021. Participants had to be at least 18 years old, capable of consent (i.e., not in a delirium), have sufficient vision, hearing, and motor capacity to perform the assessments. People with neurological diseases (e.g., multiple sclerosis, stroke, schizophrenia) other than age-related dementias were excluded.

A total of 71 individuals took part in the study. There were three groups. Group 1 consisted of 24 healthy adults aged between 18 and 30 years (younger group). Groups 2 and 3 each consisted of participants aged ≥65 years, one group with (cognitively healthy older group, $n = 23$), and one group without cognitive impairment (cognitively impaired older group, $n = 24$). Cognitive impairment was validated by the study team using the Montreal Cognitive Assessment and defined as performing with a score <26, a cutoff with a 100% sensitivity, 87% specificity, and 100% negative predictive value for Alzheimer's disease (Nasreddine et al., 2005). For details of the sample, see Table 1.

An appointment was arranged with each participant, which in most cases took place at the participants' home. First, participants were informed about the objectives of the study and, if there were any questions, they were answered. Then, the participants signed an informed consent. The subsequent assessment comprised questions on some personal data and everyday creative activities as well as tests of cognitive abilities (see below). Appointments lasted approximately 90 min.

The study was approved by the Ethics Committee of the University Medical Center Greifswald (No. BB 012/20), the Medical Faculty of the University of Leipzig (No. 319/19-ek), and the University of Kaiserslautern (No. mh/18/2019) and was carried out in accordance with the Declaration of Helsinki.

The same sample was used in an analysis on differences in creative thinking (Ross et al., 2023). In contrast, this study investigated differences in engaging in creative activities and whether the intensity of creative activities varies significantly by level of cognitive abilities.

TABLE 1. Characteristics of the Groups

Characteristics	**Younger group** % (*n*)	**Cognitively healthy older group** % (*n*)	**Cognitively impaired older group** % (*n*)	**df**	**χ (*p*)**[a]
Gender					
Male	33.3 (8)	41.7 (10)	34.8 (8)	2	0.409 (.815)
Female	66.7 (16)	58.3 (14)	65.2 (15)		
Age group					
18–30 years	100% (24)	-	-	8	83.518 (<.001)
65–70 years	-	41.7% (10)	8.7% (2)		
71–80 years	-	41.7% (10)	47.8% (11)		
81–90 years	-	16.7% (4)	39.1% (9)		
91–100 years	-	-	4.4% (1)		
Education					
≤12 years	8.3% (2)	4.2% (1)	8.7% (2)	2	0.460 (.794)
≥13 years	91.7% (22)	95.8% (23)	91.3% (21)		
Marital status					
Single	66.7% (16)	25.0% (6)	30.4% (7)	2	10.148 (.006)
In a partnership	33.3% (8)	75.0% (18)	69.6% (16)		
Chronic diseases					
None	87.5% (21)	54.2% (13)	47.8% (11)	4	14.996 (.005)
One	12.5% (3)	20.8% (5)	43.5% (10)		
Two or more	-	25.0% (6)	8.7% (2)		

Note. df = degrees of freedom; n = number of participants; p = level of significance; χ = chi square. [a]Significance levels of comparisons in which cells have an expected $n < 5$ are not reliable.

PERSONAL DATA

In our interview, structured questions on age, gender, occupational category, highest educational qualifications, marital status, and diagnoses received by a doctor were asked.

CREATIVE ACTIVITIES

The 28-item version of the Creative Behavior Inventory (CBI) was used for indication of creative activities carried out in the last 10 years in the visual, literary, and performing arts and crafts (Dollinger, 2003). Participants indicated how often they had performed the activity (never, one to two times, three to five times, more than five times). The overall score of the CBI is the sum of the answers. This inventory has a high internal consistency (Silvia, Wigert, Reiter-Palmon, & Kaufman, 2012) and correlates with other indicators of creativity (Dollinger, Clancy Dollinger, & Centeno, 2005; Silvia & Kimbrel, 2010). The English-language inventory was translated into German. In this process, we have twice merged two questions into one (first, Q1: drawing a picture for aesthetic reasons and Q2: drawing a picture; second, Q1: receiving an award for crafts and Q2: receiving an award for artistic accomplishments). The range of the CBI sum score was 26–76. Internal consistency was $\alpha = .82$.

COGNITIVE ABILITIES

Trail-making test (TMT)

We used the TMT by Oswald and Roth (1987), in which participants connect the numbers from 1 to 90 as quickly and accurately as possible in ascending order (Oswald & Roth, 1987). This TMT measures mainly processing speed and could also be considered an indicator of fluid intelligence (Salthouse, 2011).

Standard progressive matrices (SPM)

The SPM is a non-verbal intelligence test that is an indicator of fluid intelligence (Staff, Hogan, & Whalley, 2014) and also measures convergent thinking (Raven, 2003). There are 60 test items in the SPM with either a continuous pattern 1×1 matrix, 2×2 matrix, or 3×3 matrix, each with one empty cell. Participants are requested to select from response alternatives the figure, which would fill the empty cell and correctly complete the pattern of the matrix. Test administration was not timed.

Creative reasoning task (CRT)

The CRT measures creative thinking by asking participants, after having solved SPM items, to create their own Raven matrix that should be as original as possible (Jaarsveld & Lachmann, 2017). The CRT and its scoring method was developed systematically over a process of several studies published in the past 15 years by Jaarsveld and colleagues to assess divergent as well as convergent creative thinking with only one simple test. The test was selected for the purposes of this study because it shares the same underlying concept as the SPM and thus the test measures both divergent thinking (CRT-Components score) and convergent thinking (CRT-Relations score) in an open problem space within the same knowledge domain whereas the SPM measures thinking in a closed problem space. Therefore, reasoning operations in closed (SPM) and open (CRT) problem spaces can be directly compared without confounding by different knowledge domains, which is not possible with other creativity tests. Jaarsveld, Lachmann, and van Leeuwen (2012) demonstrated correlations between the CRT-Components score and the TCT–DP as well as between the CRT-Relations score and the SPM (Jaarsveld et al., 2012). The CRT-Components score is determined by the number of components in the matrix and their distribution across the matrix (e.g., place and repetition). Additional points are awarded for new components compared to repeated ones (see Jaarsveld et al., 2012 for details). The CRT-Relations score consists of the relationships between components within rows and columns (e.g., Continuation, Combination, Increase, etc.). Scoring details can be found in (Jaarsveld et al., 2012). The authors also demonstrated that the thinking processes involved in creating a CRT matrix activate the acknowledged psychophysiological correlates of creative thinking, as evidenced in EEG studies (Jaarsveld et al., 2015).

Test of creative thinking-drawing production (TCT-DP)

TCT-DP was developed to assess a person's creativity (Urban & Jellen, 1996) and captures divergent thinking together with creativity-relevant components such as composition, content, unconventionality, elaboration, or humor (Urban, 2005). Participants complete an incomplete drawing that consists of five simple components within a frame and a sixth component outside the frame (TCT-DP, Form A). The

TCT-DP-Impression score is the mean of the first impression of the participants' drawing by three independent evaluators (instruction, "Rate the first impression of the rating on a scale from 0 = not creative at all to 7 = extraordinarily creative") (Amabile, 1982). The interrater reliability in our team was $\alpha = 0.90$. The TCT-DP-Original is derived of 13 categories (e.g., continuation, new elements, connections, perspective, unconventionality) which result in total score ranging from 0 to 66. For scoring detail, see Urban, 2005 (Urban, 2005). The interrater correlation in our team was $\alpha = 0.97$.

Alternate uses task (AUT)

The AUT measures verbal divergent thinking (Kaufman, Plucker, & Baer, 2008) and asks participants to name uncommon, original uses of a can, a paperclip, and a brick. Fluency and creativity scores were aggregated into a total score for the AUT. This total AUT score was calculated by counting the number of responses (fluency scores) as well as the scores for the creativity of each response given by our three independent evaluators on a 5-point Likert scale ranging from 1 (not at all creative) to 5 (very creative) (creativity score). The reason for aggregating these fluency and creativity score of the AUT was that each score by its own had only a very small range, especially among our older participant group, which would have made statistical testing more difficult. The exact process for deriving the AUT score was the following: First, the average of the creativity scores by the three independent raters (can: $\alpha = 0.88$, paperclip: $\alpha = 0.82$, and brick: $\alpha = 0.75$) was calculated for each response. Second, these averaged creativity scores were added up for each response that a participant gave, for each item (can, paperclip, brick) separately. Third, we calculated the average of the can score, paperclip score, and brick score.

STATISTICAL ANALYSIS

The data analysis was carried out using Stata version 16 and a significance level of $p = .05$.

Participants with missing data (CBI $n = 2$, TCT-DP $n = 1$, AUT = 2, CRT $n = 8$; 85% of missings in Older group with cognitive impairment) were excluded in a case-wise manner for each analysis separately (n reported with each result, see Tables 2 and 3). Scores of participants that were three standard deviations (SD) above the mean were considered outliers and set to missing to avoid biased results (e.g., skewed distribution, large error variance, inflated estimates). This occurred only for $n = 2$ in the TMT. Furthermore, to achieve the criteria of homoscedasticity and equal variances for the analyses, $n = 1$ with a TMT score below 50 s had to be excluded from the analyses.

To test for significant differences in the characteristics of the three groups in our sample, we used chi square tests. To test for significant differences in CBI as well as cognitive abilities between the three groups, we used the Kruskal–Wallis test because most of the variables on cognitive abilities were not normally distributed. Assumption of equal variances was assessed via Levene's test and Bartlett test. To meet this criteria, TMT and SPM were Box–Cox power transformed TMT and SPM scores. We additionally ran Tukey's pairwise comparisons (Tukey–Kramer test if the group size was unequal) of each group with each of the other groups.

To test for significant associations between the CBI and cognitive abilities, we used correlation as well as —to adjust for the effect of age—linear regression analysis. Assumptions of normal distribution of errors and homoscedasticity were tested via Q–Q plot and Shapiro–Wilk test as well as Breusch–Pagan and Cook–Weisberg test, respectively. The TMT, SPM, CRT-relations, TCT-DP-impression, and AUT score had to be Box–Cox power transformed to meet these criteria. Linear regression was adjusted for age because cognitive abilities have shown to decline with aging (Salthouse, 2009). Significant associations were further adjusted for gender (Proust-Lima et al., 2008), education (Alley, Suthers, & Crimmins, 2007), family status (van Gelder et al., 2006), and number of chronic diseases (Yaffe et al., 2004) because these factors tend to be associated with cognitive functioning and might influence the investigated effect. As SPM ($r = -.718$, $p < .001$), CRT-Components ($r = -.547$, $p < .001$), CRT-relations ($r = -.581$, $p < .001$), and TCT-DP-Original ($r = -.438$, $p < .001$) correlated significantly with age, age was used as a categorical variable (<30 years, 61–70 years, 71–80 years, >80 years) in the analysis. As most cognitive abilities correlate with each other, the association of creative thinking and the intensity of creative activities together on cognitive performance in the TMT and SPM was analyzed using structural equation modeling, but only to investigate the relevance of the predictors. The models comprised CRT-Components, CRT-Relations, TCT-DP-Original, TCT-DP-Impression, and AUT in a latent score of creative thinking and were adjusted for age.

To test if the results are influenced by demographic differences that affect the intensity of creative activities or cognitive impairment, we matched cases (cognitively impaired older participants) and controls

TABLE 2. Cognitive Abilities by Group

Cognitive abilities test	Means: Younger group (Y) M (SD)	Means: Cognitively healthy older group (O−) M (SD)	Means: Cognitively impaired older group (O+) M (SD)	Kruskal–Wallis test: All groups[a] χ (p)	Tukey pairwise comparison: O−:Y[b] Contrast (p)	Tukey pairwise comparison: O+:Y[b] Contrast (p)	Tukey pairwise comparison: O−:O+[b] Contrast (p)
TMT[c] (n = 63)	152.16 (103.47)	154.21 (77.28)	245.81 (137.55)	11.05 (.004)	0.00 (.990)	0.03 (.023)	0.03 (.020)
SPM[c] (n = 71)	43.58 (6.89)	33.38 (7.88)	20.52 (12.76)	37.81 (<.001)	−211.76 (<.001)	−387.41 (<.001)	−175.65 (.001)
CRT-Components (n = 63)	20.33 (9.43)	11.22 (9.51)	8.25 (9.18)	13.687 (.001)	−9.12 (.004)	−12.08 (.001)	−2.97 (.599)
CRT-Relations (n = 63)	28.63 (14.68)	13.83 (11.38)	10.13 (10.73)	15.98 (<.001)	−14.79 (<.001)	−18.50 (<.001)	−3.70 (.641)
TCT-DP-Original (n = 70)	21.58 (8.19)	17.21 (6.55)	12.14 (6.57)	18.86 (<.001)	−4.38 (.094)	−9.45 (<.001)	−5.07 (.050)
TCT-DP-Impression (n = 70)	2.88 (1.50)	2.89 (1.31)	2.24 (1.24)	3.91 (.142)	0.01 (.999)	−0.63 (.262)	−0.65 (.248)
AUT (n = 69)	14.53 (6.94)	16.00 (4.75)	8.86 (4.49)	19.44 (<.001)	1.48 (.628)	−5.66 (.003)	−7.14 (<.001)

Note. AUT = Alternative Uses Test; CRT = Creative Reasoning Task; M = mean; n = number of participants; O− = Cognitively healthy older group; O+ = Cognitively impaired older group; p = level of significance; SD = standard deviation; SPM = Standard Progressive Matrices; TCT-DP = Test of creative Thinking-Drawing Production; TMT = trail making test; χ = chi square. [a]Kruskal–Wallis test. [b]Tukey's pairwise comparison (SPM, TCT, AUT) or Tukey–Kramer test (TMT, CRT) due to unequal group size. [c]Box–Cox power transformed for testing to meet the criteria of equal variance between the groups.

TABLE 3. Association between Intensity of Creative Activities (CBI) and Cognitive Abilities

Cognitive abilities test	Correlation with CBI		Regression on CBI[a,b]	
	***r* (*p*)**	**95% CI**	***b* (*p*)**	**95% CI**
TMT[c] (n = 61)	−.106 (.411)	−0.347 to 0.147	−0.0001 (.768)	−0.0011 to 0.0008
SPM[c] (n = 69)	.374 (.002)	0.151–0.561	2.15 (.212)	−1.26 to 5.56
CRT-Components (n = 61)	.442 (<.001)	0.214–0.625	0.28 (.012)	0.06–0.50
CRT-Relations[c] (n = 61)	.375 (.003)	0.136–0.572	0.04 (.077)	−0.00 to 0.08
TCT-DP-Original (n = 68)	.485 (<.001)	0.278–0.648	0.25 (.002)	0.09–0.41
TCT-DP-Impression[c] (n = 68)	.190 (.120)	−0.050 to 0.410	0.01 (.241)	−0.01 to 0.03
AUT[c] (n = 67)	.281 (.021)	0.044–0.488	0.03 (.133)	−0.01 to 0.07

Note. 95% CI = confidence interval of 95%; AUT = Alternative Uses Test; b = regression coefficient; CBI = creative behavior inventory; CRT = Creative Reasoning Task; n = number of participants; p = level of significance; r = correlation coefficient; SPM = Standard Progressive Matrices; TCT-DP = Test of creative Thinking-Drawing Production; TMT = trail making test. [a]Adjusted for age. [b]Unstandardized. [c]Box–Cox power transformed to meet the criteria for testing.

(cognitively healthy older participants) by age, gender, and education. A total of 16 pairs could be matched and were used as a predictor in a conditional regression model focused on the association between CBI and cognitive impairment.

RESULTS

The average CBI score, which gives an indication of the creative activities carried out in the last 10 years, was 45.78 (SD 11.58, n = 69). There were statistically significant differences between the groups (younger group mean = 50.88, SD 10.78, cognitive healthy older group mean = 44.35, SD 9.99, cognitively impaired older group mean = 41.73, SD 12.40, Kruskal–Wallis test χ^2 = 6.78, p = .034). Tukey's pairwise comparison indicated that, on average, young participants engaged statistically significantly more often in creative activities than cognitively impaired older participants (contrast −9.15, p = .018) with the other comparisons being non-significant (younger group: cognitively healthy older group contrast −6.53, p = .115; cognitively healthy older group: cognitively impaired older group contrast −2.62, p = .708).

Figure 1 shows the percentage of participants per group engaging in each creative activity. Cognitively impaired older participants most often engaged in assembling flowers (65.2%), making decorations (65.2%), and working with wood (39.1%). Statistically, they were significantly more likely to engage in making decorations (Pearson χ^2 = 22.423, p = .001) and less likely to engage in drawing pictures (Pearson χ^2 = 22.989, p = .001), writing poems (Pearson χ^2 = 17.421, p = .008), keeping a sketchbook (Pearson χ^2 = 16.885, p = .010), drawing comics (Pearson χ^2 = 25.996, p < .001), or receiving an award (Pearson χ^2 = 12.835, p = .012) than the other groups. Engagement in the remaining creative activities was comparable (see Figure 1).

Concerning cognitive abilities, results from Kruskal–Wallis test with Tukey pairwise comparison (Tukey–Kramer for the TMT and CRT because of unequal group size) indicate that cognitively impaired older participants performed statistically significantly worse in the TMT, SPM, and the AUT; the performance in the other creative thinking tests were comparable to the other groups (results shown in Table 2).

Results on associations between CBI and cognitive abilities are shown in Table 3. There was a statistically significant correlation between more intense engagement in creative activities (CBI score) and a better performance in the SPM, CRT-Components, CRT-Relations, TCT-DP-Original, and AUT (see Table 3). However, in linear regression analyses, after adjusting for age, only CRT-Components and TCT-DP-Original remained significant (see Table 3). Adjusting further for gender, education, family status, and number of chronic diseases did not change that (CRT-Component: CBI b = 0.31, p = .011, n = 61; TCT-DP-Original b = 0.23, p = .011, n = 68). To illustrate these associations, we show the intensity of engaging in creative activities for those scoring high (upper 50%) and low (lower 50%) in the CRT-Components and TCT-DP-Original in Figure 2, for each of our groups separately.

To test if the results are influenced by demographic differences that affect the intensity of creative activities or cognitive impairment, we ran a case–control analysis (16 matched pairs). Results confirmed

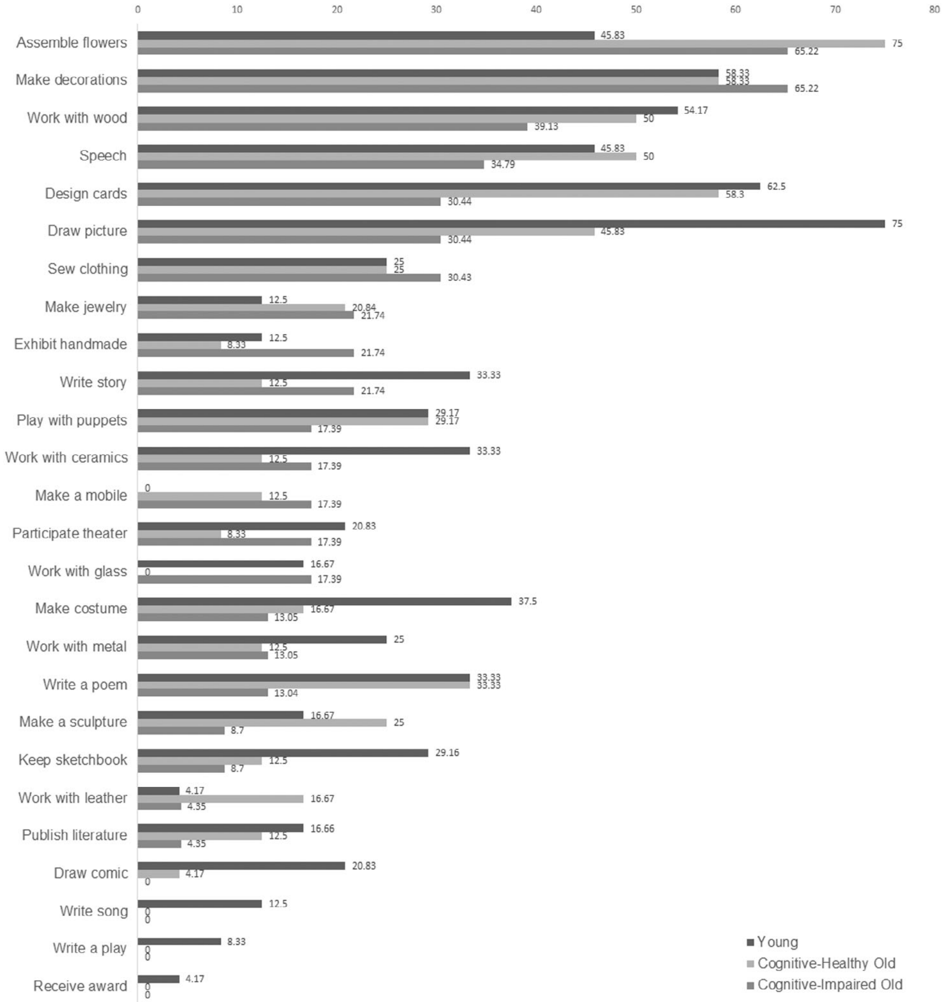

FIGURE 1. Percentage of participants per group engaging in the respective creative activity.

statistically non-significant differences for the CBI score between cognitively healthy and cognitively impaired participants ($b = -0.02$, $p = .578$).

Further, to identify the most relevant associations between creativity (creative activities, creative thinking) and processing speed as well as fluid intelligence, we ran age-adjusted structural equation modeling. The CBI score was statistically significantly associated with creative thinking (latent score of the CRT-Components, CRT-Relations, TCT-DP-Original, TCT-DP-Impression, AUT) and the SPM but not the TMT (see Table 4). Creative thinking was statistically significantly associated with the SPM and the TMT; however, there was no path from the CBI through creative thinking on the SPM or the TMT (see Table 4).

DISCUSSION

The primary aim of our study was to investigate creative activities among older people with and without cognitive impairment. Moreover, we evaluated whether the intensity of engaging in creative activities is associated with specific cognitive abilities. Our findings indicate that the intensity of engaging in creative activities is statistically significantly lower with older age. However, there was no statistically significant difference

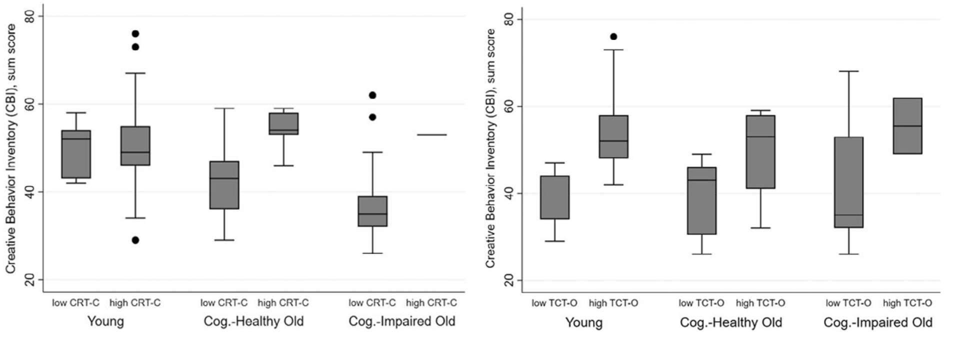

FIGURE 2. Intensity of engaging in creative activities for those scoring high (upper 50%) and low (lower 50%) in creative thinking (performance in the CRT, TCT-DP), over the three groups of participants (younger, cognitively healthy older, cognitively impaired older).

TABLE 4. Association of Creative Thinking and the Intensity of Creative Activities (CBI) Together on Cognitive Performance in the Trail Making Test (TMT) and the Standard Progressive Matrices (SPM)

Predictors	**TMT[a,b] (*n* = 52)**		**SPM[a,b] (*n* = 58)**	
	***b* (*p*)**	**95% CI**	***b* (*p*)**	**95% CI**
Latent score: Creative thinking				
CRT-Components	1.00	Constrained	1.00	Constrained
CRT-Relations[c]	1.04 (<.001)	0.99–1.09	2.41 (<.001)	2.22–2.59
TCT-DP-Original	3.58 (<.001)	3.25–3.91	3.80 (<.001)	1.67–5.94
TCT-DP-Impression[c]	0.11 (<.001)	0.08–0.15	−0.03 (.816)	−0.26 to 0.20
AUT[c]	0.24 (.431)	−0.36-0.84	0.27 (.319)	−0.26-0.79
Direct effects				
Creative Thinking > TMT/SPM	−5.22 (<.001)	−6.86 to 3.58	0.00 (<.001)	0.00–0.00
CBI > TMT/SPM	−60.13 (.123)	−136.65-16.38	0.02 (.001)	0.01–0.04
CBI > Creative Thinking	0.08 (.020)	0.01–0.14	0.02 (.010)	0.01–0.04
Indirect effects				
CBI > TME/SPM (thru Creative Thinking)	No path		No path	

Note. 95% CI = confidence interval of 95%; AUT = Alternative Uses Test; *b* = coefficient; CBI = creative behavior inventory; CRT = Creative Reasoning Task; *n* = number of participants; *p* = level of significance; SPM = Standard Progressive Matrices; TCT-DP = Test of creative Thinking-Drawing Production; TMT = trail making test. [a]Adjusted for age. [b]Standardized. [c]Box–Cox power transformed to meet the criteria for testing.

between cognitively healthy and cognitively impaired older adults. Cognitively impaired older people engaged often in assembling flowers and making decorations, while they participate less often in activities like writing poems, maintaining a sketchbook, or drawing comics compared to cognitively healthy older or younger people. In the literature, this observation is confirmed by studies that reported that artists with dementia remain creatively active even in the later stages of the disease (Drago et al., 2006; Fornazzari, 2005). Despite a loss in accuracy, for example, of the content that is being drawn (Harrison et al., 2019), there are some indications that being creative is beneficial for reducing stress-related behaviors in dementia (Mimica & Kalinić, 2011). In Singapore, an intervention program with art appreciation, art making, singing, and dance movements has shown to come with improvements in well-being among dementia patients (Tan et al., 2022). A study with individuals with mild cognitive impairment (MCI, an intermediate state between normal aging and dementia; Petersen et al., 2014) demonstrated that viewing art pieces and producing visual arts improved learning and memory (Mahendran et al., 2018). Furthermore, a study with retired older adults reported enhanced default network connectivity in brain after a 10-week visual arts production intervention (Bolwerk, Mack-Andrick, Lang, Dörfler, & Maihöfner, 2014). Several studies suggest that arts can lead to sustained attention and this can enhance other cognitive abilities (Posner, Rothbart, Sheese, & Kieras, 2008). However, there is a lack of research evaluating the effectiveness of engaging in non-verbal creative activities (other than dancing or music) among people with dementia. Researchers suggest that art therapy for dementia should take place in a comfortable environment allowing freedom of expression (Chancellor, Duncan, & Chatterjee, 2014). Combining artistic engagement with music or specific lighting can be helpful (Chancellor et al., 2014). The University of Central Florida tested the use of an artistic toolkit (poetry, music, dancing, painting, making collages) by caregivers. Their results indicate that caregivers enjoyed the interaction, but also experienced problems with acquiring the material supplies (Golden, Gammonley, Powell, & Wan, 2017).

In our study, the intensity of engaging in creative activities was neither statistically significantly associated with being cognitively impaired, as indicated by the comparison between cognitively healthy and cognitively impaired older adults, nor with processing speed or fluid intelligence in our entire sample. Even a matched case–control analyses resulted in statistically non-significant effects. Having a non-significant finding does not necessarily mean that there is no true effect. Previous findings from cohort studies suggest that more intensive engagement in mental and productive activities such as writing, painting, drawing, gardening, knitting or crocheting (Wang et al., 2002) as well as hobbies or craft activities (Hughes et al., 2010) are associated with reduced dementia risk. The selection of our samples makes it difficult to establish such a temporal relationship. Our findings indicate that the creative thinking scores CRT-Components and TCT-DP-Original were associated with the frequency of engaging in creative activities. Both scores measure divergent thinking in a non-verbal two-dimensional context (Jaarsveld et al., 2012; Urban, 2004). Accordingly, an individual's capacity to generate new ideas within a context with vague criteria and situations, in which more than one correct solution is possible, could either serve as a motivation for engaging in creative activities or might be enhanced by active involvement in such activities. Both scores were higher for younger participants, suggesting that the age-gradient in the intensity of creative engagement could be attributed to changes in divergent thinking. Literature identifies both, significant (Alpaugh & Birren, 1977) as well as non-significant (Palmiero, Di Giacomo, & Passafiume, 2014) differences in age-related divergent thinking. In our study, the creative thinking score AUT, which is a verbal measure, was not statistically significantly associated with the frequency of engaging in creative activities. A possible explanation could be that a loss in verbal abilities does not necessarily lead to a decrease in creative behaviors, or vice versa. Overall, however, the role of regular engagement in creative activities on cognitive abilities is not established so that it is difficult to make assumptions on cause–effect relationships.

Limitations must be taken into considerations. Concerning the comparison in engaging in creative activities between cognitively impaired and cognitively healthy older adults, we cannot exclude the possibility of a false negative. It is important to note that only creative activities listed in the CBI were considered and other creative activities (e.g., designing a garden, playful game with children, software-based activities) were not taken into account. Furthermore, we included only participants with dementia who were able to participate in the study independently. Accordingly, we cannot come to any conclusions regarding those in more severe stages of dementia. Concerning the association between creative activities and cognitive abilities, the effect sizes are small and the confidence intervals rule out larger effect sizes. However, our study may be underpowered, and our sample does not capture the full spectrum of dementia. This might be particularly relevant concerning analysis for which we used the structural equation modeling. One aspect is the small sample size, which might have a reduced statistical power and a higher probability of type II error. The associations under investigation might be statistically significant if a greater alpha level instead of the commonly used alpha level of $p < .05$ would have been used. Yet, since our study is the first—as far as we are aware of—to provide estimates on the association of creative activities and creative thinking in the older population, future studies can use those estimates to calculate the appropriate sample size. Moreover, we applied a convenience sampling method, which may have affected the generalizability of the findings. For instance, it is possible that mainly those people with dementia, who are interested in arts and creativity, decided to participate in our study, shifting the mean in this group toward the upper end. On the other hand, the tests on creative thinking depend on motor skills or language abilities, both decrease in older age and with dementia so that these measures might not capture the full extent of creative thinking that these people might have. New tests using alternative methods of assessing creative thinking for people with dementia should be developed. Not having been able to include people with more severe stages of dementia in the study, due to such restrictions, has led to a loss at the lower end of variance. Hence, we might have underestimated the true effect. Overall, our study cannot come to any conclusion regarding an underlying causal relationships. For this, longitudinal observation studies as well as intervention studies are necessary.

As our findings suggest that cognitively impaired older people still engage in creative activities despite their generally reduced cognitive abilities, it can be hypothesized that engaging in creative activities might be a useful therapeutic method in the early stages of dementia. Moreover, frequent engagement in creative activities might have an impact on the rate of cognitive decline, before as well as after the onset of dementia. Further research is needed to evaluate to what extent engaging in creative activities can delay the decline of cognitive abilities and enhance well-being.

FUNDING INFORMATION

The study did not receive any funding.

CONFLICT OF INTEREST STATEMENT

None of the authors have conflicts of interest.

AUTHOR CONTRIBUTIONS

FSR conceived the study design, conducted the data analysis, interpreted the data, drafted the manuscript, and approved the final version of the manuscript; SR conducted the study, interpreted the data, revised the manuscript, and approved the final version of the manuscript; JR conducted the study, ran preliminary analyses, revised the manuscript, and approved the final version of the manuscript; SJ conceived the study design, supported the interpretation of the data, revised the manuscript, and approved the final version of the manuscript; TL conceived the study design, interpreted the data, revised the manuscript, and approved the final version of the manuscript.

ETHICS STATEMENT

The study was approved by the Ethics Committee of the University Medical Center Greifswald (No. BB 012/20), the Medical Faculty of the University of Leipzig (No. 319/19-ek), and the University of Kaiserslautern (No. mh/18/2019).

PATIENT CONSENT STATEMENT

All participants signed an informed consent.

DATA AVAILABILITY STATEMENT

Due to restrictions in the informed consent and the European data protection law, we are not able to share the data with researchers outside our institutions. Exceptions have to be negotiated with our legal department.

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AUTHOR NOTE

We thank all participants for helping us realize this study.