Executive Function and Creative Potential in Third Grade Montessori Students

Katie Brown, Ph.D., Phil Dosmann, M.Ed., & Katie Grabowski, M.A.Ed.

National Center for Montessori in the Public Sector

BACKGROUND

The 21st century skills framework names creativity as a key capacity for success in the knowledge-based economy of the future (Lucas, Claxton, & Spencer, 2012). Developing creativity even leads to better experiences for students while they are still in school; students who view themselves as creative are more involved in school and have more positive academic beliefs (Beghetto, 2006). There is additional evidence that creative school environments promote learning (Davies et al., 2012; Lucas et al., 2012). According to Besançon, Lubart, and Barbot (2013), one aspect of creative potential is divergent thinking, which involves generating multiple ideas from a single stimulus. This ability to think divergently has clear implications for success in science, business, technology, and other fields that depend on innovation and complex problem-solving (Cardarello, 2014; Florida, 2004). Although creativity is traditionally associated with artistic endeavors, this research suggests that schools have a responsibility to help students develop their creative potential across academic domains.

RESEARCH QUESTION

How do student demographic characteristics and executive function predict creative potential for third grade students in public Montessori schools?

LITERATURE REVIEW

Although many people think of creativity as an innate quality or talent, research suggests that the capacity for creativity is actually quite malleable and can be influenced by the learning environment (Cardarello, 2014; Csikszentmihalyi, 1996; Davies et al., 2012). Economically disadvantaged students especially stand to gain from creativity in the classroom (Runco, 1993); unfortunately, these are the very students who are least likely to be exposed to creative teaching strategies (Schacter, Thum, & Zifkin, 2006). Learning environments that promote creativity are typically characterized by:

- Flexible use of space and time;
- Respectful relationships between children and adults;
- A culture of intrinsic motivation;
- A balance of independent work and opportunities to collaborate;
- Acceptance of non-conformity; and
- A balance of freedom and structure (Davies et al., 2012; Runco, 1993; West, 2002).

Montessori environments meet all of these criteria (Lillard, 2005). Montessori has also been shown to foster executive functions (Diamond & Lee, 2011; Lillard, 2012; Lillard & Else-Quest, 2006), which have been linked to the development of creativity (Carlson, 2010; Diamond & Lee, 2011). Thus, the Montessori Method holds significant promise as a model of education for creativity in the 21st-century, knowledge-based economy.

CONTACT

To contact the authors, and to learn more about NCMPS, please visit www.public-montessori.org.

METHODS

This study was conducted to examine creativity in public school Montessori environments. This work is part of a larger international study of creativity and critical thinking being conducted in 11 different countries by the Organization for Economic Cooperation and Development (OECD). Data were collected during the spring 2017 semester. Student demographic characteristics, including gender, SPED status, FRL status, ELL status, and race, were provided by the school district. SPED status, FRL status, and race were coded as binary variables.

The sample consisted of 74 third grade students across 14 classrooms in seven well-established public Montessori schools in a large, urban district in the Midwest. Most students in these schools enter the Montessori program at age three; thus, it is highly likely that these students have received the full cycle of Montessori primary and elementary. The sample was predominantly White and about one-third African American; Asian, Hispanic, and Native American students comprised the remainder of the sample (Figure 1). For the purposes of this analysis, students were classified as White or non-White. Approximately one-quarter of students (24%) qualified for free or reduced-price lunch (FRL), while about one-tenth (11%) of the students receive special education services. The sample was approximately evenly split between male (46%) and female students (54%). None of the students were classified as English language learners (ELLs).

Executive function was assessed using the Minnesota Executive Function Scale (MEFS), an iPad-based app normed for use with children ages two to thirteen. MEFS scores are reported as z-scores, with a score of zero representing the mean.

Creative potential was assessed using the Evaluation of Creative Potential (EPoC), Artistic-Graphic edition. For this measure, children are presented with various stimuli and prompted to use those stimuli to create drawings. The results reported here focus on the abstract divergent subtest of the EPoC Artistic-Graphic. This subtest uses an abstract shape as a stimulus. Students are prompted to create as many drawings as possible using the given shape, to demonstrate their capacity for divergent thinking. The score reflects the number of qualifying drawings the student was able to generate within the allotted time.

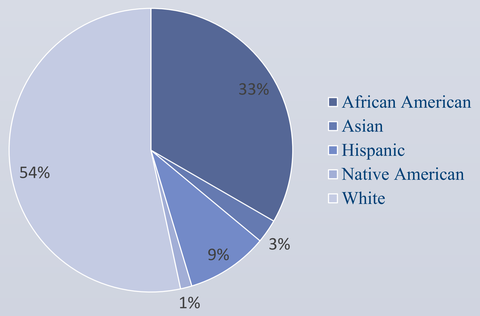

Figure 1. Race/ethnicity composition of sample (n=74).

RESULTS

A multiple regression was performed using SPSS between EPoC Graphic Abstract Divergent as the dependent variable and gender, SPED status, FRL status, race, and EFs as the independent variables. Table 1 displays the descriptive statistics and correlations of the variables. There was a significant prediction of EPoC Graphic Abstract Divergent by EFs, gender, SPED status, FRL status, and race, $F(5, 68) = 3.059$, $p = .015$, $R2 = .184$, adjusted $R2 = .124$.

Table 1
Mean, Standard Deviation, and Intercorrelations for EPoC Graphic Abstract Divergent and Predictor Variables

Variable	M	SD	1	2	3	4	5
EPoC Graphic Abstract Divergent Score	4.88	3.523	-.224*	-.241*	-.025	.314**	.261**
Predictor Variables							
1. Gender (1=Male; 0=Female)	.46	.502		.046	.028	.033	-.050
2. FRL Status (1=Yes; 0=No)	.24	.432			.107	-.246*	-.535**
3. SPED Status (1=Yes; 0=No)	.11	.313				-.094	-.106
4. MEFS Score	.15	.739					.312**
5. Race (1=White; 0=Nonwhite)	.53	.503					

Note. *$p<.05$; **$p<.0$

Table 2 presents the unstandardized regression coefficients, (B), their standard errors (SEB), their confidence intervals, standardized regression coefficients (β), and the squared semipartial correlations (sr^2). Only one of the independent variables contributed significantly to prediction of EPoC Graphic score: EFs (B=1.211, $t(68)$=2.118, p=.032, sr^2=.058). The confidence limits for EFs were .107 and 2.316, suggesting that the increase in EPoC Graphic Abstract Divergent score is somewhere between .107 and 2.316 points for each additional point in EFs while keeping the other independent variables constant. There was no significant prediction of EPoC Graphic Abstract Divergent score by gender (B=-1.506, $t(68)$= -1.954, p=.055, sr^2=.046), FRL status (B=-.898, $t(68)$= -.843, p=.402, sr^2=.008), SPED status (B=.323, $t(68)$=.259, p=.797, sr^2=.001), or race (B=.807, $t(68)$=.865, p=.390, sr^2=.009).

Table 2
Regression Analysis Summary for Predicting EPoC Graphic Abstract Divergent

Variable	B	SEB	95% CI	β	sr^2
Gender (1=Male; 0=Female)	-1.506	.771	(-3.044, .032)	-.215	.046
FRL Status (1=Yes; 0=No)	-.898	1.065	(-3.024, 1.227)	-.110	.008
SPED Status (1=Yes; 0=No)	.323	1.246	(-2.164, 2.810)	.029	.001
MEFS Score	1.211*	.554	(.107, 2.316)	.254	.058
Race (1=White; 0=Nonwhite)	.807	.933	(-1.055, 2.669)	.115	.009

Note. (a) R^2=.184 (n=74); (b) *$p<.05$

DISCUSSION, LIMITATIONS, & FUTURE RESEARCH

EFs were significantly predictive of EPoC scores; this finding is consistent with other studies of executive function and creativity in non-Montessori settings. Creativity outcomes in this study were not predicted by gender, SPED status, FRL status, or race. This suggests that Montessori environments may create an equal-opportunity environment for developing creative potential, regardless of socioeconomic status. It should be noted, however, that the percentage of SPED students in this sample was very small; it possible that this would have been a predictive factor, given a larger sample. Furthermore, the combination of demographic variables and EFs only accounted for about 12% of the variance in EPoC scores. Using the squared semipartial correlation coefficient to calculate effect size, f^2=.07, for a small effect size. This suggests that there are probably other important factors at play in predicting student performance on this measure of creative potential.

This study represents a snapshot of a single point in time and does not provide any insight into how children develop both EFs and creative potential over time in Montessori environments. The lack of a comparison group constitutes another limitation. Furthermore, the small size of the SPED subgroup limits the conclusions that can be drawn about this demographic.

Future studies might consider other variables that could predict performance on measures of divergent thinking. A longitudinal or repeated-measures design would shed light on how Montessori students develop this capacity over time. Divergent thinking in other domains should also be examined in Montessori environments. Comparative studies of divergent thinking in Montessori and non-Montessori students may also be fruitful.

REFERENCES

Beghetto, R. A. (2006). Creative self-efficacy: Correlates in middle and secondary students. *Creativity Research Journal*, 18, 447 – 457.

Besançon, M., Lubart, T., & Barbot, B. (2013). Creative giftedness and educational opportunities. *Educational & Child Psychology, 30*(2), 79-88.

Cardarello, R. (2014). Enhancing scientific thinking in children: Suggestions based on studies about creativity. *New Perspectives in Science Education*. Retrieved from http://conference.pixel-online.net/NPSE/files/npse/ed0003/FP/0306-SERA206-FP-NPSE3.pdf

Carson, S. M. (2010). Development of conscious control and imagination. In R. Baumeister, A. Mele, & K. Vohs (Eds.), *Free will and consciousness: How might they work?* (pp. 135-152). New York, NY: Oxford University Press.

Csikszentmihalyi, M. (1996), *Creativity: Flow and the psychology of discovery and invention.* New York, NY: Harper Collins.

Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., Howe, A. (2012). Creative learning environments in education: A systematic literature review. *Thinking Skills and Creativity*, 8, 80-91.

Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science*, *333*(6045), 959-964.

Florida, R. (2004). *The rise of the creative class: And how it's transforming work, leisure, community and everyday life.* New York, NY: Basic Books.

Lillard, A. S. (2005). *Montessori: The science behind the genius.* New York, NY: Oxford University Press.

Lillard, A. S. (2012). Preschool children's development in classic Montessori, supplemented Montessori, and conventional programs. *Journal of School Psychology, 50*(3), 379-401. doi: 10.1016/j.jsp.2012.01.001

Lillard, A. & Else-Quest, N. (2006). Evaluating Montessori education. *Science*, *313*, 1893-1894.

Lucas, B., Claxton, G., & Spencer, E. (2012). *Progression in student creativity in school: First steps towards new forms of formative assessments* (OECD Education Working Paper No. 86). Retrieved from www.oecd.org/edu/workingpapers

Runco, M. A. (1993). *Creativity as an educational objective for disadvantaged students*. Storrs, CT: National Research Center on the Gifted and Talented. Retrieved from ERIC: http://files.eric.ed.gov/fulltext/ED363074.pdf

Schacter, J., Thum, Y. M., Zifkin, D. (2006). How much does creative teaching enhance elementary school students' achievement. Journal of Creative Behavior, 40, 47-72.

West, M. A. (2002). Sparkling fountains or stagnant ponds: An integrative model of creativity and innovation implementation in work groups. *Applied Psychology: An International Review*, 51, 355–424.