

Correlations Among Measures of Executive Function and Positive Psychological Attributes in College Students

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ABSTRACT. Executive functions are cognitive abilities that allow for more goal-oriented and autonomous behavior. The authors examined the relationship between self-rated executive functions and 3 positive personality attributes (satisfaction with life, gratitude, and forgiveness) in a nonclinical community sample. The authors used self-report scales (Executive Function Index, Heartland Forgiveness Scale “other” subscale, Satisfaction With Life Scale, and the Gratitude Questionnaire) to examine how executive functions related to the positive psychology attributes. After controlling for age, sex, and formal education, positive relationships emerged among gratitude, satisfaction, and executive function scales of motivational drive, empathy, and strategic planning. However, an inverse relationship emerged between impulse control and forgiveness, perhaps relating to cautiousness and suggesting finer distinctions between adaptive and maladaptive forms of forgiveness. These findings suggest common psychological and neurobiological substrates for executive functions and positive psychology attributes, warranting further, more direct biobehavioral research.

Key Words: executive, forgiveness, gratitude, positive psychology, satisfaction

EXECUTIVE FUNCTIONS ARE A SET OF COGNITIVE ABILITIES related to the character strengths of positive psychology, which focuses on understanding and building human strength. These characters include the following from the mission statement of the Positive Psychology Center at the University of Pennsylvania: “the capacity for love and work, courage, compassion, resilience, hope, creativity, social skills, integrity, self-knowledge, impulse control, future-mindedness, and wisdom.”

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Executive functions optimize the efficiency and effectiveness of behavior, allowing for behaviors that are more goal oriented, autonomous, and conceptually driven. Impulse control, for example, is impaired in a variety of clinical disorders, including bipolar disorder, attention deficit hyperactivity disorder, antisocial personality disorder, and borderline personality disorder (American Psychiatric Association, 2002; Chretien & Persinger, 2000; Swan, Anderson, Dougherty, & Moeller, 2001; van Heeringan, 2001). Impulsivity, instead, involves acting hastily on urges or environmental demands and favoring a short-sighted approach to situations, frequently at the expense of long-term goals. One aspect of life attainment that relates to impulsivity is education, because it involves long-term, goal-oriented behaviors and delayed outcomes such as salary, occupational opportunities, and status. Spinella and Miley (2003) found that a measure of impulsivity in college students related negatively to their course grades.

The prefrontal–subcortical systems mediating executive functions seem to be involved in social and emotional impulse control (Tekin & Cummings, 2002); orbitofrontal lesions in these areas tend to produce emotional and behavioral disinhibition (Malloy, Bihrlé, Duffy, & Cimino, 1993). Strokes in prefrontal systems are associated with emotional changes such as depression, emotional lability, and loss of anger regulation (Kim, Choi, & Kwon, 2002; Kim & Choi-Kwon, 2000; Paradiso, Chemerinski, & Yazici, 1999). Functional neuroimaging studies have corroborated a role for prefrontal systems in emotional regulation (Phan, Wager, Taylor, & Liberzon, 2002). Voluntary suppression of sadness activates right dorsolateral and right orbitofrontal cortex (Levesque, et al., 2003). Ochsner, Bunge, Gross, and Gabrieli (2002) showed that mood regulation through cognitive reappraisal activates lateral and medial prefrontal regions, with decreased activation of the amygdala and medial orbitofrontal cortex. Measures of executive function with demonstrated sensitivity to prefrontal dysfunction have shown relationships with substance abuse and disinhibition of eating behavior (Spinella, 2003; Spinella & Lyke, 2004). These studies suggest there is a neurological substrate for the inhibition of inappropriate emotions, cognitions, and behavior. These neurological substrates for effective executive functions may be the basis for successful task accomplishment and lead to what Seligman (2002) calls “authentic happiness.” Examples of positive psychological attributes derived from authentic happiness are satisfaction with life, gratitude, and forgiveness (Seligman).

In this study, we attempted to show how a measure of executive functions correlates with a measure of positive psychological attributes in college students. We used self-report scales (Executive Function Index and Positive Psychology Scales) to look at how motivational drive, empathy, strategic planning, and impulse control related to the positive psychology attributes of satisfaction with life, gratitude, and forgiveness.

Method

Participants

Participants were 154 adults (54 male, 100 female) aged from 17 to 76 years ($M = 32.9$, $SD = 14.8$) who had completed between 9 and 20 years of formal education ($M = 14.1$, $SD = 2.2$). Research assistants recruited participants via word-of-mouth from a college campus and the local community. We instructed research assistants to find only noninstitutionalized, community-dwelling adults. We received institutional review board approval, and all participants signed consent forms in accordance with the ethical principles of the American Psychological Association and the Declaration of Helsinki. To maintain anonymity and encourage honest responses, we asked participants to seal their completed questionnaires in an envelope before returning them to the research assistant. No financial compensation was given for participation.

Measures

Executive Function Index. The Executive Function Index (EFI) is a self-rating measure of executive functions developed in a nonclinical community sample. We generated the items based on comprehensive literature reviews of executive functions mediated by prefrontal–subcortical systems. We reduced the initial pool of 41 items to 27 items according to factor loadings on five factors derived by principal components analysis, and named these factors Empathy (EM), Strategic Planning (SP), Organization (ORG), Impulse Control (IC), and Motivational Drive (MD; Table A1). Items are rated on a Likert-type scale of 1 to 5, and the scores from negatively valenced items are inverted so that higher scores on the subscales and the total score reflect improving executive functioning and to help control for response pattern bias or response set. The IC scales were all inverted to keep the wording more symmetrical with the other scales. Cronbach's alpha for the scales ranged from .70 to .82. A second-order factor analysis indicated three higher order factors consistent with executive functions associated with dorsolateral (SP, ORG), orbitofrontal (IC, EM) and medial prefrontal (MD) regions. Although the EFI continues to undergo psychometric evaluation and is preliminary in nature, validity was demonstrated by strong correlations with subscales of the Frontal Systems Behavior Scale, Barratt Impulsiveness Scale, and Interpersonal Reactivity Index (see Table A1). Spinella (2005) reviewed related measures that have been validated using clinical populations, objective measures of behavior, and neuroimaging studies.

Positive Psychology Scales. We selected three scales to measure aspects of positive psychology. We measured forgiveness by the "other" subscale of the Heartland Forgiveness Scale, which is a six-item scale that assesses interpersonal forgiveness (Thompson, 2003). We measured satisfaction with the Satisfaction

With Life Scale (Diener, Emmons, Larson, & Griffin, 1985), and gratitude with the Gratitude Questionnaire six item form (see Table A2 in the Appendix; McCullough, Emmons, & Tsang, 2002).

Results

Controlling for age, gender, and education, with partial correlations, significant correlations occurred between several positive psychology scales and several EFI scales ($df = 148$; see Table 1). Motivational Drive, Empathy, and Strategic Planning correlated positively with Gratitude $r_s = .28, .25, .31$ respectively; $p < .001, p < .01, p < .001$. Motivational Drive and Strategic Planning correlated positively with Satisfaction ($r = .21, r = .38$; $p_s < .05; p < .001$). Impulse control related inversely to Forgiveness ($r = -.32, p < .001$).

We observed intercorrelations among positive psychology scales: Forgiveness correlated with Gratitude ($r = .24, p < .01$), Satisfaction correlated with Gratitude ($r = .52, p < .001$), and Satisfaction correlated with Forgiveness ($r = .23, p < .01$).

Discussion

This study showed positive relationships between self-ratings of executive function, gratitude, and satisfaction with life, even after controlling for age, sex, and formal education. One speculation drawn from these data might be that effective executive functions support positive psychological attributes. Further research may clarify the underlying neurological mechanisms. Prefrontal systems play a critical role in mediating higher order cognitive, social, and emotional

TABLE 1. Partial Correlations Between Scales of the Executive Function Index (EFI) and Positive Psychology Scales ($N = 154$)

EFI Scale	GRA	FOR	SAT
Motivational Drive	.28***	.15	.21*
Impulse Control	-.08	-.32***	-.12
Empathy	.25**	.15	.14
Organization	-.10	-.16	-.12
Strategic Planning	.31***	.13	.38***
Total	.28***	-.02	.22**
FOR	.24**		
SAT	.52***	.23**	

Note. Correlations are controlling for age, sex, and education ($df = 128$). GRA = Gratitude Questionnaire; FOR = Heartland Forgiveness Scale; SAT = Satisfaction With Life Scale.
* $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$ (two-tailed tests).

functioning, as evidenced by prior studies using clinical populations and functional neuroimaging. However, the small samples used in functional neuroimaging studies and the afflicted individuals used in clinical studies are not necessarily representative of the larger population. By using validated self-rating methods in larger nonclinical, community samples, this study suggests commonalities in executive functions, positive psychological attributes and speculative common neurological substrates that await further corroborating research in the general population.

An inverse correlation between executive functioning between impulse control and forgiveness was an unanticipated finding in this study. That is, individuals who report more impulse control also report less forgiveness. Forgiveness is regarded as a positive characteristic because it ultimately results in less emotional burden to the person who grants forgiveness. While emotional reactions such as anger or depression may be a normal reaction to harm done to the individual, forgiveness may reduce those negative emotions in the long term and lead to more adaptive emotional functioning. However, indiscriminate forgiveness would likely be a very maladaptive characteristic. While forgiveness is adaptive, it is not implied that individuals should continue to allow themselves to be harmed, which would more likely bring further emotional distress. Thus, adaptive forgiveness may be a careful balance between possessing caution and forgiveness, which may not be captured entirely in the items used here. Further work is required in this area to more clearly differentiate relationships between executive function and aspects of forgiveness.

While the self-rating methodology of this study cannot provide neuroanatomical specificity, the close relationship between executive functions and prefrontal systems suggests further work on their relationships. If research in this area supports this relationship, then the anatomy and physiology of prefrontal development will hold greater significance for cognitive, emotional, and behavioral processes considered by positive psychology. For example, functional neuroimaging research by Baird and colleagues (1999) has shown that prefrontal brain functions may not be fully developed until early adulthood. Indeed, other changes in prefrontal development, such as myelination, can persist into the 5th decade of life (Bartzokis et al., 2001; Sowell et al., 2003). Normal variations among individuals in prefrontal development, likely a combined result of genetic variations and environmental experiences, could also account for such characteristics. In any case, further biobehavioral research is warranted to develop a more complete understanding of the processes examined by positive psychology.

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APPENDIX

TABLE A1. Partial Correlations Between Scales of the Executive Function Index (EFI) and Positive Psychology Scales (N = 154)

#	Subscale	Item
1.	MD	I have a lot of enthusiasm to do things.
2.	ORG*	When doing several things in a row, I mix up the sequence.
3.	SP	I try to plan for the future.
4.	MD*	I can sit and do nothing for hours.
5.	IC*	I take risks, sometimes for fun.
6.	ORG*	I have trouble when doing two things at once, multi-tasking.
7.	MD	I'm interested in doing new things.
8.	EM	I have a lot of concern for the well-being of other people.
9.	SP	I'm an organized person.
10.	SP	I save money on a regular basis.
11.	IC*	I do or say things that others find embarrassing.
12.	EM*	People who are foolish enough to be taken advantage of deserve it.
13.	SP	I only have to make a mistake once in order to learn from it.
14.	MD	I tend to be an energetic person.
15.	IC*	I make inappropriate sexual advances or flirtatious comments.
16.	EM	When someone is in trouble, I feel the need to help them.
17.	ORG*	I sometimes lose track of what I'm doing.
18.	EM	I feel protective towards a friend who is being treated badly.
19.	SP	I think about the consequences of an action before I do it.
20.	IC*	I lose my temper when I get upset.
21.	EM	I take other people's feelings into account when I do something.
22.	ORG*	I have trouble summing up information in order to make a decision with it.
23.	ORG*	I start things, but then lose interest and do something else.
24.	IC*	I swear/use obscenities.
25.	EM	I don't like it if my actions or words hurt someone else.
26.	SP	I use strategies to remember things.
27.	SP	I monitor myself so that I can catch any mistakes.

Note. MD = motivational drive; ORG = organization; SP = strategic planning; IC = impulse control; EM = empathy; * = inverted item.

TABLE A2. Positive Psychology Scales

#	Subscale	Item
1.	GRA	I have so much in life to be thankful for.
2.	GRA	If I had to list everything that I felt grateful for, it would be a very long list.
3.	GRA*	When I look at the world, I don't see much to be grateful for.
4.	GRA	I am grateful to a wide variety of people.
5.	GRA	As I get older I find myself more able to appreciate the people, events, and situations that have been part of my life.
6.	GRA*	Long amounts of time can go by before I feel grateful to something or someone.
7.	FOR*	I continue to punish a person who has done something I think is wrong.
8.	FOR	With time I am understanding of others for the mistakes they've made.
9.	FOR*	I continue to be hard on others who have hurt me.
10.	FOR	Although others have hurt me in the past, I have eventually been able to see them as good people.
11.	FOR*	If others mistreat me, I continue to think badly of them.
12.	FOR	When someone disappoints me, I can eventually move past it.
13.	SAT	In most ways my life is close to my ideal.
14.	SAT	The conditions of my life are excellent.
15.	SAT	I am satisfied with life.
16.	SAT	So far I have gotten the important things I want in life.
17.	SAT	If I could live my life over, I would change almost nothing.

Note. GRA = gratitude; FOR = forgiveness; SAT = satisfaction; * = inverted item.

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