Examining Multiple Aspects of Working Memory to Predict Musicality

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Abstract

Need to expand the understanding of the relationships between working memory abilities and musicality

Current research used three different types of complex span tasks, as well as a measure of general fluid intelligence to assess relationships with musicality, as measured by the objective and subjective components of the Goldsmiths Musical Sophistication Index (Müllensiefen ref here).

Findings indicated…

Importance of broad measurement of the working memory construct is important for generalizing to other cognitive abilities.

Examining Multiple Aspects of Working Memory to Predict Musicality

Working memory is important in the service of many daily activities.

Interest in music and cognition (Talamini, Altoè, Carretti, & Grassi, 2017; Slevc, Davey, Buschkuehl, & Jaeggi, 2016; Swaminathan, Schellenberg, & Khalil, 2017).

(e.g., Cowan, 2005) Working memory capacity and general fluid intelligence (Shipstead, Harrison, & Engle, 2016).

**Current Approach**

Operation span and Symmetry span (Unsworth, Heitz, Schrock, & Engle, 2005). tonal or non-tonal versions of the n-back task to assess working memory (e.g., Oechslin, Van De Ville, Lazeyras, Hauert, & James, 2013; Slevc et al., 2016), Operation span (e.g., Franklin et al., 2008; Lee, Lu, & Ko, 2007),

We used Raven’s Advanced Progressive Matrices (Raven, Raven, & Court, 1998) (e.g., Shelton et al., 2010; Swaminathan et al., 2017). Additionally, we used the Goldsmiths Musical Sophistication Index (Gold-MSI; Müllensiefen et al., 2014)

external validity with other musical self-report and auditory skill tests, such as the Musical Ear Test (Wallentin et al., 2010).

**Methods**

**Participants**

\*\*\* enrolled at Louisiana State University completed the study. We recruited students, mainly in the Department of Psychology and the School of Music. \*\*\* participants met the criteria for inclusion. The eligible participants were between the ages of 17 and \*\* (*M* = \*\*, *SD* = \*\*; males; person did not identify gender). Participants volunteered, received course credit, or were paid $15. The study was approved by the LSU Institutional Review Board.

**Procedure**

Participants completed \*\* tasks, lasting a total of approximately 90-120 min. The tasks were the Gold-MSI self-report inventory, Tonal span, Symmetry span, Operation span, Gold-MSI beat perception test, Gold-MSI melodic memory test, Gold-MSI sound similarity test, and the Raven’s Advanced Progressive Matrices \*\*\*number series, STOMP. Sounds were presented at a comfortable listening level for tasks that required headphones. \*\*\* were not included in the current set of analyses.

**Measures**

**Goldsmith’s Musical Sophistication Index (Gold-MSI** (see Müllensiefen et al*.,* 2014).

**Complex Span Measures** A memory task with an interspersed processing task (Unsworth et al., 2005)

**Symmetry span (SSPAN).**

**Operation span (OSPAN).**

**Tonal Span (TSPAN)**

**Gold-MSI Beat Perception Test.** (Müllensiefen et al., 2014).

**Gold-MSI Melodic Memory Test.**  (Müllensiefen et al., 2014).

**Raven’s Advanced Progressive Matrices** (**RAPM).** (Raven et al., 1998).

**Results**

The recall scores in the three complex span tasks correlated negatively with the reported number of errors in each task (Unsworth, Redick, Heitz, Broadway, & Engle, 2009; see Appendix), suggesting that rehearsal processes were effectively limited by the processing tasks (Unsworth et al., 2009). Further analyses with the processing error scores were not included.

*Working Memory Capacity*

**General Discussion**

(e.g., Schellenberg, 2004; Silvia et al., 2016

(Lee et al., 2007; Talamini et al., 2017),

(Slevc et al., 2016), (see Miyake et al., 2000), (Shelton et al., 2009) (Redick & Lindsey, 2013);

Swaminathan et al. (2017)

**Conclusions**

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**Appendix**

*Means, standard deviations, and correlations with confidence intervals*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 |
|  |  |  |  |  |  |  |  |
| 1. OspanScore | 55.49 | 16.78 |  |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 2. OspanError | 5.87 | 3.63 | -.30\*\* |  |  |  |  |
|  |  |  | [-.38, -.21] |  |  |  |  |
|  |  |  |  |  |  |  |  |
| 3. SspanScore | 28.24 | 8.34 | .63\*\* | -.11\* |  |  |  |
|  |  |  | [.57, .68] | [-.20, -.02] |  |  |  |
|  |  |  |  |  |  |  |  |
| 4. SspanError | 2.95 | 2.65 | -.21\*\* | .16\*\* | -.41\*\* |  |  |
|  |  |  | [-.29, -.12] | [.07, .25] | [-.48, -.33] |  |  |
|  |  |  |  |  |  |  |  |
| 5. TspanScore | 52.39 | 13.74 | .63\*\* | -.13\*\* | .62\*\* | -.27\*\* |  |
|  |  |  | [.57, .68] | [-.22, -.04] | [.56, .67] | [-.35, -.18] |  |
|  |  |  |  |  |  |  |  |
| 6. TspanError | 5.48 | 2.93 | -.06 | .29\*\* | -.03 | .15\*\* | -.15\*\* |
|  |  |  | [-.14, .04] | [.20, .37] | [-.12, .06] | [.06, .24] | [-.24, -.06] |
|  |  |  |  |  |  |  |  |

*Note.* *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). \* indicates *p* < .05. \*\* indicates *p* < .01.

Table 1

*Means, standard deviations, and correlations with confidence intervals*

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 1. General | 82.78 | 20.85 |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 2. Active | 42.41 | 9.71 | .74\*\* |  |  |  |  |  |  |  |  |
|  |  |  | [.70, .78] |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 3. Perceptual | 49.70 | 7.59 | .78\*\* | .55\*\* |  |  |  |  |  |  |  |
|  |  |  | [.74, .81] | [.49, .61] |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 4. Musical | 26.84 | 12.14 | .87\*\* | .56\*\* | .63\*\* |  |  |  |  |  |  |
|  |  |  | [.84, .89] | [.49, .62] | [.58, .69] |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 5. Singing | 31.99 | 7.78 | .82\*\* | .50\*\* | .65\*\* | .57\*\* |  |  |  |  |  |
|  |  |  | [.79, .85] | [.43, .56] | [.59, .70] | [.51, .63] |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 6. Emotions | 34.78 | 4.61 | .64\*\* | .68\*\* | .57\*\* | .48\*\* | .44\*\* |  |  |  |  |
|  |  |  | [.58, .69] | [.63, .72] | [.51, .63] | [.40, .54] | [.36, .51] |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 7. RavenTotal | 24.22 | 4.76 | .27\*\* | .19\*\* | .29\*\* | .31\*\* | .14\*\* | .19\*\* |  |  |  |
|  |  |  | [.18, .35] | [.10, .28] | [.20, .37] | [.23, .39] | [.05, .22] | [.11, .28] |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 8. Ospan | 55.49 | 16.78 | .17\*\* | .17\*\* | .14\*\* | .19\*\* | .10\* | .08 | .31\*\* |  |  |
|  |  |  | [.08, .26] | [.08, .25] | [.05, .23] | [.10, .27] | [.01, .19] | [-.01, .17] | [.22, .39] |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 9. Sspan | 28.24 | 8.34 | .22\*\* | .16\*\* | .18\*\* | .25\*\* | .13\*\* | .11\* | .43\*\* | .63\*\* |  |
|  |  |  | [.13, .31] | [.07, .24] | [.09, .26] | [.17, .34] | [.04, .22] | [.02, .20] | [.35, .50] | [.57, .68] |  |
|  |  |  |  |  |  |  |  |  |  |  |  |
| 10. Tspan | 52.39 | 13.74 | .41\*\* | .30\*\* | .30\*\* | .44\*\* | .29\*\* | .22\*\* | .42\*\* | .63\*\* | .62\*\* |
|  |  |  | [.33, .49] | [.21, .38] | [.22, .38] | [.36, .51] | [.20, .37] | [.13, .31] | [.34, .49] | [.57, .68] | [.56, .67] |
|  |  |  |  |  |  |  |  |  |  |  |  |

*Note.* *M* and *SD* are used to represent mean and standard deviation, respectively. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). \* indicates *p* < .05. \*\* indicates *p* < .01.

Table 3

*Regression results using GENERAL as the criterion*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Predictor | *b* | *b*  95% CI  [LL, UL] | *beta* | *beta*  95% CI  [LL, UL] | *sr2* | *sr2*  95% CI  [LL, UL] | *r* | Fit | Difference |
| (Intercept) | 52.76\*\* | [45.53, 59.98] |  |  |  |  |  |  |  |
| OspanScore | -0.19\* | [-0.33, -0.04] | -0.15 | [-0.26, -0.03] | .01 | [-.01, .03] | .17\*\* |  |  |
| SspanScore | 0.00 | [-0.28, 0.29] | 0.00 | [-0.11, 0.11] | .00 | [-.00, .00] | .22\*\* |  |  |
| TspanScore | 0.77\*\* | [0.59, 0.94] | 0.51 | [0.39, 0.62] | .13 | [.08, .19] | .41\*\* |  |  |
|  |  |  |  |  |  |  |  | *R2*  = .184\*\* |  |
|  |  |  |  |  |  |  |  | 95% CI[.12,.24] |  |
|  |  |  |  |  |  |  |  |  |  |
| (Intercept) | 44.26\*\* | [34.75, 53.77] |  |  |  |  |  |  |  |
| OspanScore | -0.18\* | [-0.32, -0.04] | -0.14 | [-0.26, -0.03] | .01 | [-.01, .03] | .17\*\* |  |  |
| SspanScore | -0.09 | [-0.38, 0.20] | -0.04 | [-0.15, 0.08] | .00 | [-.00, .00] | .22\*\* |  |  |
| TspanScore | 0.72\*\* | [0.54, 0.89] | 0.47 | [0.36, 0.59] | .11 | [.06, .16] | .41\*\* |  |  |
| RavenTotal | 0.55\*\* | [0.15, 0.96] | 0.13 | [0.03, 0.22] | .01 | [-.01, .03] | .27\*\* |  |  |
|  |  |  |  |  |  |  |  | *R2*  = .196\*\* | Δ*R2*  = .012\*\* |
|  |  |  |  |  |  |  |  | 95% CI[.13,.25] | 95% CI[-.01, .03] |
|  |  |  |  |  |  |  |  |  |  |

*Note.* A significant *b*-weight indicates the beta-weight and semi-partial correlation are also significant. *b* represents unstandardized regression weights. *beta* indicates the standardized regression weights. *sr2* represents the semi-partial correlation squared. *r* represents the zero-order correlation. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively.  
\* indicates *p* < .05. \*\* indicates *p* < .01.