Creativity Over the Lifespan in Classical Composers: Reexamining the Equal-Odds Rule

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Abstract

This investigation extends Simonton's (1977) seminal study of lifespan creativity to eighteen eminent classical composers' total output. Major and minor work production was positively correlated over the lifespan, consistent with Simonton's chance-configuration theory of creativity. However, contrary to Simonton's (1977) null finding, here strong, positive, linear and weaker, negative, quadratic age trends were consistently found in predicting hit ratio (proportion of masterpiece-level music to total music composed per age period). This uniformly replicated in several analyses examining alternative explanations for this pattern. Most individual composers' hit ratios increased with age; none declined. The results indicate that composers' perspicacity in evaluating ideas mostly increases with age, suggesting greater importance for evaluation and elaborative problem solving processes in creative productivity than implied by a chance-configuration account.

Introduction

How does creativity change over the lifespan? Do eminent creators learn to be more creative and to reliably intuit which ideas are worth elaborating? Or is creative productivity primarily driven by chance and by individual differences that are largely impervious to learning or to external influences? Dean Keith Simonton's (1977) seminal study of ten eminent classical composers was one of the first to address these questions in a comprehensive, methodologically sophisticated way. His results strongly argue for the second alternative: illustrious composers apparently do not learn to write a larger proportion of great music as their careers progress, and productivity is remarkably immune to external perturbations like wars or civil unrest. Simonton's (1977) analysis has become a cornerstone of his "chance-configuration" theory of lifespan creative productivity (Simonton, 1984a, 1988, 1997, 1999), the most comprehensive, elaborated, and parsimonious psychological theory of this complex phenomenon.

However, is it really the case that creativity, or at least perspicacity, does not improve, even in distinguished composers? Classical music aficionados may think of Beethoven, Haydn, or Verdi, and be hard pressed to think of any late, major works by these composers that are not critically acclaimed, even when compared to their earlier efforts. In contrast, thinking of comparably lauded early works by these composers is probably much harder (Hayes, 1989; Weisberg, 1999). Nevertheless, Simonton's (1977) quantitative analysis implies that these instances are illusory.

Understanding lifespan learning and creativity clearly has important theoretical and practical implications, and multiple approaches may prove fruitful. For instance, alternative definitions of "great" music might be used to examine how well Simonton's (1977) results generalize. Also, his nomothetic analysis did not investigate individual differences in career trajectory. Varied trends can cancel each other, accounting for the null finding. Of particular interest are two types of trajectories: 1) a completely flat agewise function, consistent with the "equal-odds rule" and a chance-configuration account, and 2) an agewise increase in hit ratio, consistent with an expertise acquisition or problem solving framework. (Of course, trajectories can also decline or exhibit curvilinear functions.)

Simonton's own Darwinian chance-configuration model is the most thoroughly researched theory of lifespan creativity (see Simonton, 1988, 1997). Its basis is the blind generation and selective retention of ideas (Campbell, 1960). Creative ideation follows a constant probability of success, or the "equal-odds" rule. Simonton (1999, pp. 188-197) has further argued that this ratio cannot be increased by any means; a creator's hit ratio stays constant with age.

This theory has profound psychological implications. First, it suggests there is little learning or improvement in perspicacity. Creators lack the ability to judge their ideas or works reliably, either as final products or works-in-progress. At a social level, it suggests that creators have little control over the ultimate fate of their products. Thus, mass-production is the best strategy for those who seek eminence. The chance-configuration theory counterintuitively predicts that the high point of a creator's career will simultaneously result in the most masterpieces and the most ephemera: writing one masterwork does not guarantee further success.

Numerous studies support this theory. High correlations (typically $r = .50$ to $.75$) are often found between the production of major and minor works over the lifespan (see Simonton, 1997). Comprehensive studies of the output of ten great composers (Simonton, 1977) and ten eminent psychologists (Simonton, 1985) also found no agewise hit ratio changes. However, Kozbelt (in press) found a very strong agewise increase (r (age, annual hit ratio) $= .91$, $p < .0001$) in Mozart, a composer in Simonton's (1977) sample.

Thus, at least some composers' hit ratios may improve with age. This is consistent with an expertise acquisition or problem solving perspective (Newell, Shaw, & Simon, 1962; Weisberg, 1999). From this view, creating a musical composition is an open-ended problem, on which composers bring their musical skill to bear. Expertise acquisition studies (Ericsson, Krampe, & Tesch-Römer, 1993) suggest

individual differences in musical ability are largely attributable to deliberate practice rather than innate talent. Likewise, Hayes (1989) examined 76 composers and found that in almost all cases, at least ten years of intensive study were required before a composer wrote his first masterwork, defined by recording counts. This result seems inconsistent with Simonton's (1977) finding of no change in hit ratio over composers' entire careers, since clearly great composers are writing *some* great works in their maturity. Thus, despite potentially important structural differences between expert performance and creative performance (Simonton, 2000), agewise improvement may be a possibility, particularly if skilled performance is a central component of creativity.

As noted earlier, individual variation may overwhelm a seemingly flat aggregate agewise trajectory. Galenson (2001) has found a systematic dichotomy among painters, linking career trajectories (based on the average value of work produced at various times) with creative processes. "Finders" peak early and largely plan their work in advance, proceeding with little revision. "Seekers" peak at reliably later ages and engage in much revision as they work. A comparable dichotomy among composers was suggested by Simonton (1986). He found that the most aesthetically successful works appeared early or, better, very late in composers' careers.

The present study tests the robustness of the equal-odds rule and also examines individual composers. It adopts Simonton's (1977) basic methodology of cross-sectional time-series. However, the present investigation also seeks to vary or improve the measurement of some constructs (e.g., how "masterpieces" are defined or how works can be more sensitively weighted in the analysis). Further, it seems important to confirm that the null finding on hit ratio replicates on a larger sample of composers, since, as noted above, few studies directly and comprehensively examine this important question. Moreover, a career-long flat hit ratio seems inconsistent with the finding that composers generally write no great works in the first decade or so of their careers (Hayes, 1989; Weisberg, 1999). Unfortunately, Simonton's (1977) original data are no longer extant, due to computer technology changes (Simonton, personal communication). While catalogs of composers' works are fairly standardized, many works of questionable authenticity or dating hover at the periphery of such catalogs, so revisiting and extending this type of analysis seems worthwhile.

The four models described above permit a characterization of aggregate and individual career hit ratio trajectories. The chance-configuration theory predicts no change in hit ratio with age, a positive correlation between major-minor work production over the lifespan, and is fairly agnostic on work quality. The problem solving perspective predicts a likely increase in hit ratio and masterpiece quality over time and is fairly agnostic on major-minor work production correlations.

Method

Composers Composers were selected from three sources: one list based on eminence (Farnsworth, 1969, p. 228), one based on performance frequency (Moles, 1958/66, p. 28), and one list of aesthetic significance ratings of composers' masterpieces (Halsey, 1976). The top ten composers in the first two lists were automatically sampled. Other composers who had numerous masterworks listed by Halsey (1976) were also included. The 18 composers examined were J.S. Bach, Bartók, Beethoven, Brahms, Chopin, Debussy, Dvořák, Handel, Haydn, Mendelssohn, Mozart, Schubert, Schumann, Richard Strauss, Stravinsky, Tchaikovsky, Verdi, and Wagner. Collectively, their lives span three centuries and their works account for 54% of all classical music performed (Moles, 1958/1966, p. 28).

Works Chwiałkowski's (1996) comprehensive catalog provided lists and dates of all known works of the 18 composers (6,560 compositions total). Arrangements, revisions, and lost works were excluded from most analyses.

Age at Composition Age at composition for each work was also determined (using Chwiałkowski, 1996). When composition spanned multiple years, the median (rounded up if necessary) was used. For aggregate analyses, works were grouped into consecutive five-year age periods for each composer (cf. Simonton, 1977): 5 – 9, 10 – 14, etc. Thus, each composer contributed data only during his active composing career. Ages were put into mean-deviation form based on the entire sample of composers, yielding an *age linear* variable. Age linear scores were also squared, yielding an *age quadratic* variable to test for curvilinear effects.

Works were also pooled into one-year age windows for finer-grained analyses. A total of 714 age periods were tallied across the 18 composers. *Age linear* and *age quadratic* measures were calculated in the same way for one-year windows as for five-year windows.

Weighting Performance times were used to weight each work. Times were taken from recordings (74% of works), estimates based on scores or listings in composers' work catalogs (14%), averages based on comparable works by the same composer (8%), and estimates using Simonton's (1977) genre-based system when no other information was available (4%).

Masterpiece definitions Four criteria were used to define masterpieces. Two used Halsey's (1976) list of musical masterpieces: 1) all works listed by Halsey, 2) only works given one of the two highest ratings (scores of 1 or 2) by Halsey ('stringent Halsey'). Two used recording counts from 1) the *RED Classical Catalog* (Ford, 2003), or 2) *The Penguin guide to compact discs* (March, Greenfield, & Layton, 2001). Each composer's works were rank-ordered from most to least recorded, and cumulative performance durations were computed from the top down until the total approached 50%. Top works were designated masterpieces for each measure.

Concurrent productivity Two variables were related to overall output. One, *years in interval*, logged how many years per period involved actual composition. This ranged from 1 to 5 (periods when no music was written were not analyzed). The other, *output*, tallied the total amount of music (in minutes) each composer wrote in each five- or one-year period. To minimize overall productivity differences, individual z-scores for output were computed for each composer separately.

Results

Because each composer's works were exhaustively tabulated, not sampled from a larger population, inferential statistical tests are arguably inappropriate (cf. Simonton, 2000). Therefore, effect sizes and parameter estimates accompany inferential results, whose hypothetical p-values can be used as a heuristic for discussion.

Lifespan productivity

Lifespan productivity generally increases quickly early in a creator's career, peaks, and then declines more gradually (Simonton, 1977, 1997). When age is expressed in mean-deviation form, output usually correlates positively with *age linear* and negatively with *age quadratic*. When these effects are combined, they form the backwards, inverted J-curve characteristic of creative output over the lifespan.

To confirm this trend for the present set of composers, as in Simonton (1977), data from all composers were put into the same time-series for a multiple regression analysis. To minimize inter-composer productivity variance, z-scores for output across 5-year age periods were computed for each composer separately. These defined the dependent variable. *Age linear* and *age quadratic*, as well as *years in interval*, were then used to predict productivity. A total of 179 age periods were included in the analysis.

The regression was significant, $F(3, 175) = 38.74$, $p < .0001$, adjusted $R^2 = .39$. *Age quadratic* and *years in interval* were highly significant, respectively, $\beta = -.35$ and $.45$, both $p < .0001$. The amount of variance uniquely accounted for by each variable is given by the squared semi-partial correlations, here $sr_i^2 = .09$ and $.18$, respectively. The regression coefficient for *age linear* was marginally significant, $\beta = .11$, $p = .08$ ($sr_i^2 = .01$). Thus, the overall lifespan trajectory of total productivity echoes the frequently observed single-peaked function, although its present shape is closer to an inverted U than to a backwards, inverted J.

The peak age for productivity can be computed by finding the residual *output* after regressing *years in interval*, setting up a polynomial regression using *age linear* and *age quadratic* to predict residual *output*, and taking the derivative of the regression equation. When this was done, peak productivity was found to occur at 39.7 years. When untransformed productivity was analyzed, the results essentially replicated (peak = 37.1 years).

When age was statistically controlled, the results indicating an inverted U-curve replicated. In fact, peak age for productivity lies almost exactly in the middle of standardized career lengths ($z = +0.04$).

Major-minor work correlations

Recall that the chance-configuration theory predicts a positive correlation between major and minor work production over the lifespan. Here, major works were defined by inclusion in Halsey (1976). Major and minor works were positively correlated, $r(177) = .36$, $p < .0001$ ($r^2 = .13$), supporting the chance-configuration theory. However, only two individuals showed statistically reliable correlations: Strauss, $r = -.50$, $p = .05$, and Bach, $r = .93$, $p < .0001$. Among individual composers, the median $r^2 = .16$.

Hit ratio over the lifespan

This is the main analysis of interest. Recall that Simonton (1977) found that hit ratio was essentially flat over the entire durations of ten great composers' careers, showing no systematic change with age. However, this finding seems inconsistent with Hayes's (1989) finding that composers write no masterworks in the first decade or so of their careers. To investigate this issue with the present sample of 18 composers, a hit ratio was computed for each composer in each age period using each of the four measures (basic Halsey, stringent Halsey, *RED*, and *Penguin*).

Composers vary considerably in their overall lifetime hit ratios. When defined by all works included in Halsey (1976), these range from .18 (Handel) to .70 (Wagner). The M (SD) hit ratio among the composers was .44 (.17). Thus, to minimize variance due to inter-composer hit ratio differences, z-scores for hit ratios were computed separately for each composer on each measure.

Intercorrelations between hit ratios determined by the four masterpiece criteria were all highly correlated, with correlation coefficients ranging from .45 to .74. To simplify matters, an unrotated, principal components analysis was conducted and revealed two factors. Factor 1 accounted for 71.6% of the variance, with an eigenvalue of 2.87 and loadings ranging from .75 to .91. Factor 2 accounted for 16.1% of the variance, with an eigenvalue of .65 and loadings ranging from .63 to -.36. The stringent Halsey criterion, defining composers' very greatest masterworks, had the lowest loading on Factor 1 and the highest loading on Factor 2, and this pattern was exaggerated in varimax rotated and oblique analyses. This measure was thus analyzed separately. (In practice, the results reported below do not substantively differ depending on whether three or four measures are combined, or if each of the four measures is examined individually.)

Hit ratio multiple regression To test hit ratio trends over the lifespan, all composers were initially put onto the same time-series. Each composer contributed data only during his active composing career. In each age period, individual z-scores of hit ratios from the basic Halsey, *RED*, and *Penguin* measures were averaged, yielding the dependent measure (basic hit ratio). Individual z-scores for *output* in each age period, used as the dependent measure for productivity, were used here as a statistical control. *Age linear*, *age quadratic*, and *output* predicted hit ratio.

Contrary to Simonton's (1977) findings and the

predictions of the chance-configuration theory, the regression was highly significant, F (3, 175) = 40.0, $p <$ .0001, adjusted R^2 = .40. Both *age linear* and *age quadratic* (but not *output*) significantly predicted hit ratio, *age linear* ß = .65, and *age quadratic* ß = -.43, both $p <$ .0001 (sr_i^2 = .36 and .13, respectively). Since output was not significant, taking the derivative of the second-order polynomial regression equation yields the peak age for hit ratio: 52.6 years, almost 15 years after the peak for overall output. The basic hit ratio trajectory is shown in Figure 1.
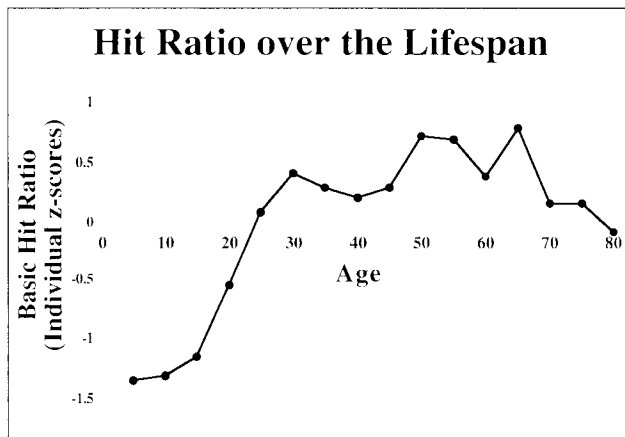

Figure 1: Average basic hit ratio over the lifespan (z-scores computed for each composer individually).

Subsample and individual analyses Why do these results differ so strikingly from Simonton's (1977)? Perhaps the additional eight composers affected the results. However, this is not the case: when his ten composers and the additional eight are analyzed separately (recalculating age z-scores for each subsample), the results essentially replicate: for Simonton's (1977) ten composers, the regression equation accounts for 37% of the variance in hit ratio, *age linear* ß = .64, $p <$ .0001, (sr_i^2 = .38) and *age quadratic* ß = -.26, $p <$ .05, (sr_i^2 = .04); for the remaining eight, the regression equation accounts for 41% of the variance in hit ratio, *age linear* ß = .63, age quadratic ß = -.52, both $p <$ .0001 (sr_i^2 = .33 and .19, respectively) .

Each composer was also individually analyzed. In these analyses, one-year age windows were used and age z-scores were recomputed. The hit ratio of almost every individual composer was impacted by age (median adjusted-R^2 = .34). In particular, thirteen composers showed reliable ($p <$ .05) positive *age linear* effects (median individual sr_i^2 = .22). Five showed reliable negative *age quadratic* effects (median individual sr_i^2 = .02). Only Bach and Strauss showed no age-related trends. The linear increase seems quite robust; the mid-career quadratic boost is consistently weaker.

Stricter hit ratio criterion The stricter Halsey criterion (reversed ratings of 4 or 5) was also tested. Hit ratios and individual hit ratio z-scores were recalculated, and the same three-predictor regression was performed. This demanding criterion reduces power, as happens whenever hit ratios approach 0 or 1. Despite this, the regression remained

highly significant, F (3, 175) = 15.05, $p <$ .0001, adjusted R^2 = .19, *age linear* ß = .49, $p <$ .0001, (sr_i^2 = .20) and *age quadratic* ß = -.19, $p <$ .05, (sr_i^2 = .02). *Total output* was not significant. Individual analyses, using one-year age windows, revealed ten composers with reliable ($p <$ .05) positive *age linear* trends (median individual sr_i^2 = .12). *Age quadratic* was a weaker predictor (median individual sr_i^2 = .03). Three composers showed reliable quadratic trends, one (Wagner), negative, and two (Bartók and Schubert), positive, indicating a late surge in great masterwork production. Taking the derivative of the polynomial regression equation (after accounting for *output*) yields a peak age was 65.1 years for stringent hit ratio, notably later than that for productivity (late thirties) or the basic hit ratio measure (early to mid-fifties).

Mature works Perhaps these results, particularly the repeatedly observed *age linear* effect, are an artifact of composers' unacclaimed early works (recall Hayes's (1989) ten-year rule), which dampen hit ratio at career outset. To test this, the first two age periods of each composer (plus the third periods of Bartók and Dvořák, when both hit ratios were 0) were dropped from the analysis. Age z-scores were recalculated. The average of the basic Halsey, *RED*, and *Penguin* hit ratios defined hit ratio. The three-predictor regression remained significant, F (3, 140) = 7.79, $p <$ .0001, adjusted R^2 = .13. *Age linear* positively predicted hit ratio, ß = .29, p = .001 (sr_i^2 = .07). *Age quadratic* and *output* each negatively predicted hit ratio, respectively, ß = -.30, p = .001 (sr_i^2 = .08), and ß = -.15, p = .09 (sr_i^2 = .02). The agewise effects are attenuated during compositional maturity, but the effects remain reliable.

Arrangements and revisions Not incorporated into any previous analyses were arrangements and revisions that were included (albeit minimally weighted) in Simonton's (1977) analysis. As a final test of the work measure, arrangements, revisions, and datable lost works were included in the analysis. Simonton's (1977) weighting system was employed. Hit ratios were recalculated using inclusion in Halsey (1976) as masterpiece criterion. A total of 8,057 data points were included. The number of age periods also increased, to 186. Untransformed hit ratios in each age period were used as the dependent measure, and *years in interval* was used as a control, echoing Simonton (1977). The results replicated and are comparable in strength to most previous analyses. The three-predictor regression remained significant, F (3, 182) = 31.85, $p <$ .0001, adjusted R^2 = .33. *Age linear* positively predicted hit ratio, β = .57, $p <$ .0001 (sr_i^2 = .27). *Age quadratic* negatively predicted hit ratio, β = -.30, $p <$ .0001 (sr_i^2 = .06). *Output* was a marginally significant predictor, β = .13, p = .05 (sr_i^2 = .01). Eight composers showed significant positive *age linear* trends, and three showed significant *age quadratic* trends (two negative, one positive).

Thematic measure A final analysis used a measure based on musical themes or melodies rather than entire works (cf.

Simonton, 1977). Hit ratio in each age period was defined by the number of melodies included by Barlow and Morgenstern (1948, 1950) in all works listed by Halsey (1976) divided by the total number of anthologized melodies from that age period. Fewer age periods (141) were represented by this measure than the work measure, since not all periods contained anthologized themes. Age z-scores for the sample were recalculated. Here, *total themes* per period was used as a control. The three-predictor regression predicting hit ratio remained significant, contrary to Simonton's (1977) report: $F (3, 137) = 9.64$, $p < .0001$, adjusted $R^2 = .16$. *Age linear* positively predicted hit ratio, $\beta = .37$, $p < .0001$, $(sr_i^2 = .12)$ and *age quadratic* negatively predicted hit ratio, $\beta = -.26$, $p = .002$, $(sr_i^2 = .06)$. *Total themes* was marginally significant, $\beta = .15$, $p = .06$, $(sr_i^2 = .02)$.

Alternative analyses In addition to the analyses reported here, additional analyses ruled out further candidate alternative explanations for the inconsistency of the present results with those of Simonton (1977). Among the analyses performed were those using the raw average hit ratio for the basic *Halsey*, *RED*, and *Penguin* criteria, rather than individually z-transformed hit ratios; using an aggregate one-year age window rather than a five-year age window; computing age based on years of musical study (career age) rather than chronological age; analyzing only mature works using a one-year window dating from the onset of musical study or of musical composition; and performing all of these analyses on each two subsamples of composers: Simonton's (1977) ten and the additional eight. The same pattern of a significant, positive *age linear* trend coupled with a significant (but weaker), negative *age quadratic* trend was found in each analysis.

Discussion

Without exception, the present results contradict Simonton's (1977) null finding on agewise changes in classical composers' hit ratios. *Age linear* increases were uniformly found in analyses using two sets of masterpiece criteria, two measures of overall output (works and themes), two weighting systems, statistically controlling for individual differences in lifetime hit ratio, analyzing only composers' mature works, including arrangements and revisions and lost works, and separately examining two subsamples of the composers. Individual analyses generally showed reliable $(p \leq .05)$ *age linear* increases in at least half of the sample, and no change in hit ratio in the rest. A weaker, negative *age quadratic* trend was also frequently evident, suggesting a mid-career boost in hit ratio. These findings support the problem solving and peak age perspectives and seem largely inconsistent with the chance-configuration theory. An increase in the quality of masterpieces, also significant in about half of individual composers, further supports the problem solving and peak age perspectives. The chance-configuration theory was supported, however, by a somewhat lower (though still reliable) positive correlation between the production of major and minor works.

It remains unclear why these results differ so dramatically from those reported by Simonton (1977). Numerous alternative explanations (e.g., including arrangements and revisions, using various masterpiece criteria) were tested and ruled out. More detailed comparisons are difficult to make, since Simonton (1977) reported few descriptive statistics about the analyzed compositions, and sometimes the reported statistics contradict the present data (e.g., in the number of age periods analyzed). Unfortunately, because of computer technology advances, his original data are no longer retrievable (Simonton, personal communication).

Aspects of the observed agewise changes are compatible with both the problem solving and chance-configuration perspectives. For instance, much of the improvement in hit ratio occurs in the early part of composers' careers, consistent with expectations about skill and expertise acquisition as a precondition for outstanding creative achievement (Hayes, 1989; Weisberg, 1999). However, age trends during compositional maturity accounted for only one-third to one-half as much variance as those spanning composers' entire careers, which is at least *somewhat* more consistent with the chance-configuration theory.

The slight hit ratio decline late in life is inconsistent with both theories. The problem solving perspective does not posit a mechanism to explain a drop in perspicacity late in life. The hit ratio decline among elderly composers also violates the equal-odds rule applying until the end of creators' lives. However, this decrement should be interpreted cautiously, due to a low N and high variability in hit ratios of composers in their seventies and beyond.

The pattern of peak ages is more difficult to reconcile with the chance-configuration theory. Overall productivity peaks first, in composers' late thirties, consistent with previous work (see Simonton, 1997). Hit ratio defined by the three less stringent masterpiece criteria peaks around age 53. The more stringently defined hit ratio peaks even later, at 65 years. Note also that these data are not minor statistical aberrations, as they represent parameters for the career landmarks of these 18 composers.

These results dissociate two predictions of the chance-configuration theory. Many studies, including this one, show positive major-minor work correlations. However, such correlations do not preclude an agewise improvement in hit ratio and cannot by themselves rule out alternative theoretical models. Comprehensive analyses of agewise hit ratio trends, as performed here, are also necessary.

The consistent *age linear* increase and late peaks for hit ratio and masterpiece quality suggest that at least some creators boost creativity as their careers progress. While certainly quantity of ideation provides the raw material for creative productivity, the present results suggest that some creators are perspicacious and able to consolidate gains as they elaborate ideas. Thus, goal-directed problem solving and evaluation processes, as well as accumulated expertise (Hayes, 1989; Simonton, 2000; Weisberg, 1999), play substantial roles in creative productivity. Naturally, creators' instincts are not perfect, but many composers'

intuitions about the value of their ideas appear to have been sound, and they seem to have improved these intuitions substantially with age.

The evaluative and elaborative processes that might permit an increase in hit ratio and masterpiece quality remain ill defined, but these results suggest that both cognitive and motivational variables play key roles. Average hit ratio does not increase linearly but is a more curvilinear, single-peaked function. Later in their lives, composers write less music than in midcareer, but a progressively higher proportion is masterpiece-level, and the masterpieces themselves are of higher quality. What older composers lack in energy, they appear to make up for in wisdom.

The underlying psychological processes may also be informed by further ideographic analyses. Here, over half of the 18 composers showed systematic agewise increases in hit ratios and masterpiece quality, and the rest showed few agewise changes. Further research linking career trajectory with characteristic creative processes of composers (cf. Galenson, 2001) may inform the conditions under which improvement in hit ratio or masterpiece quality may be realized.

The present data must be interpreted with caution. They represent a single (but robust) violation of the equal-odds rule. However, they clearly show that the equal-odds rule does not universally characterize creative productivity. In addition to ideographic analyses, comprehensive studies like this one are necessary to determine the extent of equal-odds rule application (or violations) in other domains. At a minimum, the results suggest that there can be important roles for elaborative and evaluative problem solving processes, as well as for learning, in creative productivity.

Acknowledgments

References

Barlow, H., & Morgenstern, S. (1948). *A dictionary of musical themes*. New York: Crown.

Barlow, H., & Morgenstern, S. (1950). *A dictionary of opera and song themes*. New York: Crown

Campbell, D. T. (1960). Blind generation and selective retention in creative thought as in other thought processes. *Psychological Review, 67*, 380-400.

Chwialkowski, J. (1996). *The Da Capo catalog of classical music compositions*. New York: Da Capo.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in acquisition of expert performance. *Psychological Review, 100*, 363-406.

Farnsworth, P. R. (1966). *The social psychology of music* (2nd ed.) Ames, IA: Iowa State University Press.

Ford, G. (Ed.) (2003). *The RED classical catalog*. London: RED Publishing.

Galenson, D. W. (2001). *Painting outside the lines: Patterns of creativity in modern art*. Cambridge, MA: Harvard University Press.

Halsey, R. S. (1976). *Classical music recordings for home and library*. Chicago: American Library Association.

Hayes, J. R. (1989). *The complete problem solver* (2nd ed.). Hillsdale, NJ: Erlbaum.

Kozbelt, A. (in press). Factors affecting aesthetic success and improvement in creativity: A case study of the musical genres of Mozart. *Psychology of Music*.

March, I., Greenfield, E., & Layton, R. (2001). *The Penguin guide to compact discs: The guide to excellence in recorded classical music*. New York: Penguin Books.

Moles, A. (1966). *Information theory and esthetic perception* (J.E. Cohen, Trans.). Urbana, IL: University of Illinois Press. (Original work published 1958)

Newell, A., Shaw, J. C., & Simon, H. A. (1962). The processes of creative thinking. In H. E. Gruber, G. Terrell, & M. Wertheimer (Eds.), *Contemporary approaches to creative thinking* (pp. 63-119). New York: Atherton Press.

Simonton, D. K. (1977). Creative productivity, age, and stress: A biographical time-series analysis of 10 classical composers. *Journal of Personality and Social Psychology, 35*, 791-804.

Simonton, D. K. (1985). Quality, quantity, and age: The careers of 10 distinguished psychologists. *International Journal of Aging and Human Development, 21*, 241-254.

Simonton, D. K. (1986). Aesthetic success in classical music: A computer analysis of 1,935 compositions. *Empirical Studies of the Arts, 4*, 1-17.

Simonton, D. K. (1988). *Scientific genius: A psychology of science*. Cambridge: Cambridge University Press.

Simonton, D. K. (1997). Creative productivity: A predictive and explanatory model of career landmarks and trajectories. *Psychological Review, 104*, 66-89.

Simonton, D. K. (1999). *Origins of genius: Darwinian perspectives on creativity*. New York: Oxford University Press.

Simonton, D. K. (2000). Creative development as acquired expertise: Theoretical issues and an empirical test. *Developmental Review, 20*, 283-318.

Weisberg, R. W. (1999). Creativity and knowledge: A challenge to theories. In R.J. Sternberg (Ed.), *Handbook of creativity* (pp. 226-250). New York: Cambridge University Press.