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Relationships Among Impulsivity, Achievement Goal Motivation, and the Music Practice of High School Wind Players

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ABSTRACT

The primary purpose of this study was to investigate relationships among impulsivity, achievement goal motivation, and the performance achievement of high school wind players (N = 60). An additional purpose was to examine how impulsivity and achievement goal motivation were related to observed practice behaviors. Subjects practiced in three, 25-minute sessions and completed the Eysenck Impulsiveness[7] Questionnaire (Eysenck, Pearson, Easting, & Allsop, 1985) as well as a researcher-adaptation of the Elliot and McGregor (2001) 2 X 2 Achievement Goal Questionnaire. Reliability for the impulsivity and achievement goal sub-scales, performance ratings, and observed behaviors ranged from adequate to excellent. Results showed significant (p < .01) curvilinear growth in performance achievement with rapid gains made across day one, a peak in the rate of improvement at day two, and a plateau at day three. Impulsiveness, venturesomeness, and mastery-approach motivation were significant predictors of performance achievement. Multi-level model analyses indicated that including venturesomeness and mastery-approach as simultaneous predictors explained 19% of the variance among subjects' initial performance achievement scores. Small correlations were detected between impulsiveness and the behaviors whole-part-whole and slowing and between mastery-goal motivation and skipping directly to or just before the critical musical sections of the etude.

INTRODUCTION

Recently proposed theoretical models of music learning have cited the need to investigate psychosocial individual difference variables such as motivation orientations, personality, self-regulation, self-efficacy, etc. in the context of music practicing. For example, Hallam (1997) conceives practice as embedded within three broader-defined stages of music learning: (a) presage, (b) process, and (c) product. In this model, individual difference variables are primarily accounted for in the presage stage while the act of practicing and the learning outcomes that result are situated in the process and product stages, respectively. Alternatively, McPherson and Zimmerman (2002) have proposed that practicing be studied with respect to a theory of self-regulated learning which includes consider-

ations for motivation, strategy use, time management, self-evaluation/monitoring, environment, and social factors. Similarly, theoretical descriptions of deliberate practice (i.e., effortful, goal-directed, structured activity) have also acknowledged that psychosocial and environmental elements may play a role in practice effectiveness (Ericsson, Krampe, & Tesch-Romer, 1993; Lehman & Ericsson, 1997). Although several theories have been proposed, more empirical evidence is necessary to determine the nature and extent of the effect of individual differences in psychosocial variables on music practice behaviors as well as practice effectiveness over time.

Individual differences in personality and cognitive style have been shown to be related to practice effectiveness. Barry (1990) investigated the relationships between the performance achievement of middle school band students participating in experimental practice conditions and the cognitive styles of field dependence/independence (FD/I) and reflection/impulsivity. The cognitive style FD/I refers to whether an individual processes perceptual information in a predominantly holistic (field dependent) or analytical (field independent) way (Witkin, Oltman, Raskin, & Karp, 1971), whereas reflection/impulsivity refers to the speed of processing or cognitive tempo an individual typically applies to problem solving (Kagan, 1965). Barry found a significant three-way interaction among practice condition (i.e., structured vs. free), sex type, and FD/I. Field dependent males were the lowest performing group in the study regardless of whether they were in the structured or free treatment conditions. The researcher decided not to analyze differences among subjects on reflection/impulsivity due to the homogeneity among the sample on the Matching Familiar Figures Test (Kagan, 1965). In contrast, other researchers have found significant relationships between individual differences in reflection/impulsivity and college music students' sight-singing achievement (Schmidt, 1984) as well as second graders' tonal discrimination (Schmidt & Sinor, 1986). In these studies, those who were more reflective had higher achievement scores than those who were more impulsive.

Miksza (2006) found a significant interaction between the personality variable impulsiveness and practice effectiveness as measured by pre- and post-test measures of performance achievement in a sample of college brass players. In that study, impulsiveness was operationally defined with the Eysenck Impulsiveness[7] Questionnaire for Adults (Eysenck et al., 1985) which measures two dimensions of impulsivity (a) impulsiveness (i.e., the tendency to engage in risky behavior without considering the consequences) and (b) venturesomeness (i.e., the tendency to take risks while being fully aware of possible consequences) (Eysenck et al., 1985). Miksza found that students who were less impulsive made significantly greater gains across the practice session than those who were more impulsive. Given the amounts of sustained focus and concentration required for effective practicing, it is important to design studies which examine the interaction of impulsivity and practicing over extended periods of time such as multiple days.

Motivational constructs such as self-efficacy (e.g., McCormack & McPherson, 2003; Nielsen, 2004), intrinsic value (e.g., Hamann, Lucas, McCallister, & Teachout, 1998), attributions of success and failure (e.g., McPherson & McCormack, 2000), and

achievement goal orientations (e.g., Schmidt, 2005; Smith, 2002) have also been shown to be relevant to music practice. Schmidt (2005) found significant positive relationships between mastery and intrinsic motivational orientations and self-reports of time-spent-practicing in a sample of 7th through 12th grade band students. Significant positive relationships were also detected between mastery and intrinsic orientations and teacher's ratings of student effort and performance achievement. In addition, Smith (2002) found that mastery goal orientations were positively related to college instrumentalists' self-report of practice behaviors (e.g., mental practice, organization of practice, whole-to-part analysis), whereas performance orientations were negatively related to reports of practice behaviors (e.g., prioritization and monitoring). In the same study, Smith found several significant relationships between achievement goal orientations and the observed practice behaviors of a sub-sample of 20 college string players. Performance-approach orientations were positively related to the observed behaviors unintentional playing, repeat measure, repeat section, and vary rhythm whereas performance-avoid orientations were negatively related to the behaviors vary rhythm, plays other material, and marks part. Lastly, mastery orientations were positively related to the behaviors unintentional playing, errors, and intonation. However, the results of Smith's study are based on a small sample of college musicians. More research is necessary to investigate whether similar relationships would be found with school age musicians.

Research with goal orientations has recently focused on the development of a 2 X 2 achievement goal model, which incorporates approach and avoid dimensions into both performance and mastery goal constructs (Moller & Elliot, 2007). This work has become prominent in studies of physical education (e.g., Conroy, Kaye, & Coatsworth, 2006; Wang, Biddle, & Elliot, 2007) as well as academics (e.g., Elliot, 2005; Elliot & McGregor, 2001). Performance-approach goals can be described as a desire to demonstrate normative competence whereas performance-avoid goals are defined as those in which demonstration of normative incompetence is avoided. Mastery-approach goals include mastering a task for the sake of developing ability or making improvement, whereas mastery-avoid goals reflect a desire to avoid demonstrating self-referential incompetence (e.g., the loss of competence due to age). Although results are somewhat mixed, mastery-approach goals are hypothesized to lead to more positive educational outcomes (e.g., self-regulated learning, emphasis on personal improvement) and to facilitate achievement, whereas mastery-avoid, performance-approach, and performance-avoid goals have been shown to lead to maladaptive learning outcomes (e.g., rote memorization, avoidance of challenges) and therefore a lack of achievement (Moller & Elliot, 2007). It follows that individual differences in motivational goal orientations may predict similar outcomes in music learning. However, as of yet, no studies have examined the 2 X 2 achievement goal model in the context of music practice. In addition, those studies that have incorporated similar achievement goal constructs (i.e., mastery, performance-approach, performance-avoid) in music research have found correlations among sub-scales that suggest approach and avoid

distinctions may not be valid with musical populations (e.g., Schmidt, 2005; Schmidt, Zdzinski, & Ballard, 2006; Smith, 2002).

It is clear that more studies are needed that examine the interaction of psychosocial variables with music practice. The primary purpose of this study was to investigate relationships among impulsivity, achievement goal motivation, and the performance achievement of high school wind players across three practice sessions. A secondary purpose was to examine how individual differences in impulsivity and achievement goal motivation were related to observed practice behaviors.

METHOD

The sample consisted of volunteer, high school band students (N = 60) from six schools in Indiana and New Jersey. Only wind players (i.e., flute, oboe, bassoon, clarinet, bass clarinet, alto saxophone, tenor saxophone, F horn, trumpet, trombone, euphonium) with at least two years or more of playing experience on their current instrument participated. The sample consisted of 30 males and 30 females from grades 9 through 12 with a mean age of 16.23 years (SD = 1.13). Subjects participated in three, 25-minute practice sessions, one on each of three separate and consecutive days. Aside from warm-up and transitional time, subjects had a total of 75 minutes to devote to actual music practicing. This length was chosen after reviewing observed gains in performance achievement in previous research (Fortney, 1992; Miksza, 2005) as well as pilot study results. Each session yielded two measures of performance achievement (e.g., pre- and post-test scores) resulting in a total of six data points across the study.

The researcher escorted individual subjects to a private room during their usual band or study hall period, initiated the recorder, and allowed the subjects to perform and practice on their own. This decision was made in light of previous evidence regarding social facilitation theory which found that the mere presence of an individual may facilitate performance on simple or well learned tasks and/or impair performance on complex tasks or tasks not yet learned (Feinberg, 2003; Markus, 1978). All subjects received an unmarked copy of the etude and a pencil and were provided with these instructions: "practice the etude for the next 25 minutes in any way that you want – you may write on this etude if you want - the etude is designed to allow for both musical/expressive and technical improvement to be made across the entire study – try to make as much improvement as you can." All sessions were digitally recorded with a Sony MZ-R700 minidisc recorder and Sony ECM-MS907 microphone (signal to noise ratio 62db). A researcher-composed performance etude was designed for this study with considerations made for length, instrument range, style, tempo, key, meter, rhythmic values, accidentals, articulation markings, dynamic contrasts, and level of difficulty. The etude was pilot tested with high school students in order to assess the appropriate difficulty level. All subjects played the same etude with only minimal accommodations for specific instrument tendencies. The etude was collected at the conclusion of each session.

The objective performance measure (OPM) used in this study was an adaptation of the Watkins-Farnum Performance Scale (WFPS) (Watkins & Farnum, 1954). For the purposes of this study, the number of errors in notes, rhythms, articulations, and dynamics were measured by counting the number of beats performed incorrectly on either dimension. This resulted in a modification of the WFPS' scoring system to include each beat rather than each measure. The subjective performance measure (SPM) used in this study, an adaptation of Zdzinski's (1993) Performance Rating Scale Supplement (PRSS), was comprised of 39 five-point Likert-type items that addressed the categories: (a) etude specific criteria (e.g., the decrescendo in measure eight reaches a true piano); (b) interpretation/musical effect (e.g., performer plays mechanically); (c) tone/intonation (e.g., the quality of the tone was rich); and (d) technique/articulation (e.g., attacks and releases were clean). Internal consistency of the SPS across all time points was excellent (α = .96 to .98). Interjudge reliability results for the OPS and SPS scores with three independent raters scoring 50% of the performances ranged from α = .86 to .97 across each time point. Strong correlations were detected between OPS and SPS scores at all time points (r = .72 to .83). As a result, a composite performance achievement score (Comp) based on equally weighted OPS and SPS T-scores was used for all further analyses.

Subjects' practice sessions were analyzed for frequencies of the following behaviors: repeat measure, repeat section, whole-part-whole, chaining, repeat etude, slowing, varying pitch, varying articulation, varying rhythm, non-etude-related playing, singing/whistling, use of metronome, and marks part (see Table 1). The number of times a subject began playing directly on or just before five researcher-selected critical musical sections was counted as well. The critical musical sections selected were those that presented the most difficulty to participants in a pilot study. Section one contains a passage of eighth and sixteenth note figures, section two contains a large octave leap and complex scalar passages, section three contains an abrupt change to triplet figures, section four contains a sixteenth note passage in the upper range, and section five contains a large octave leap, scalar motion, and complex articulation patterns. Durational recording of time spent playing was measured with a stop watch. Practice behaviors were identified through continuous observational recording across the subjects' practice sessions (e.g., rather than interval recording). Several of the behaviors were operationally defined by the researcher based on informal observation, pilot study results, and teaching experience, while others were drawn from scales by Gruson (1988) and Smith (2002) for pianists and strings, respectively.

Interjudge reliability for the practice behaviors with two independent observers was acceptable with percentage agreements ranging from 68% to 100%. The reliability of the measurement of duration of time spent playing for each day was assessed with Spearman correlations and resulted in coefficients ranging from r = .83 to .91. For the purposes of this study, only behaviors exhibited by more than 50% of the sample at each day were examined with correlational analyses (see Table 1). In addition, moderate to strong relationships were found among the behaviors across each day, suggesting that those who

were more likely to use a particular behavior on day one were also more likely to exhibit that same behavior on days two and three. As a result, composite variables summing the frequencies of observed behaviors across days were used for all further analyses.

Table 1
Operational definitions and descriptive statistics for composite, observed practice behaviors

Practice Behaviors – Operational Definitions	%	*M*	*SD*
Repeat Measure: Repeats a measure, or part of a measure, in which an error may or may not have occurred with or without correction	100	238.00	114.94
Repeat Section: Repeats a section of a piece longer than a measure in which an error may or may not have occurred with or without correction	100	56.63	32.64
Whole-Part-Whole: Strategically isolates a phrase or unit of any kind, breaks it down into smaller parts and then recombines	80.0	4.25	4.50
Chaining: Playing a segment of music and systematically adding segments that appear either before or after	< 50	NA	NA
Repeat Etude: Repeats the whole piece from the beginning after completing previous practice of the entire piece	< 50	NA	NA
Slowing: Isolates a section or unit of any kind and slows the tempo down beyond that which is marked	95.0	8.97	7.01
Varying Musical Element:: Isolates material and plays on a pitch, articulation, or rhythm other than that is printed	< 50	NA	NA
Non-etude-related playing: Plays melodic or rhythmic music not associated with the etude used in the study, e.g. another work, improvised material, etc.	< 50	NA	NA
Singing/Whistling/Buzzing: Sings, whistles or buzzes on a mouthpiece a passage either melodically or rhythmically for any length of time	< 50	NA	NA
Use of Metronome: Uses an audible metronome device to aid playing	< 50	NA	NA
Section 1: Number of times subject skips to playing directly on or just before ms. 14-16	98.3	2.87	2.35

Section 2: Number of times subject skips to playing directly on or just before ms. 26-29	98.3	3.77	3.46
Section 3: Number of times subject skips to playing directly on or just before ms. 32-33	< 50	NA	NA
Section 4: Number of times subject skips to playing directly on or just before ms. 43	< 50	NA	NA
Section 5: Number of times subject skips to playing directly on or just before ms. 46-49	91.7	3.47	3.11
Marks Part: Pencil/pen marks left by the subject on the etude	85.0	NA	NA
Duration of playing in minutes: Time spent emitting sound from the instrument	100.0	53.06	7.75

NOTE: Statistics calculated from observed behaviors summed across three practice sessions.

Impulsivity was measured with the Eysenck Impulsiveness[7] Questionnaire for Adults (Eysenck et al., 1985). The scale consists of 35 yes/no items that yield separate sub-scores for impulsiveness (19 items) and venturesomeness (16 items). Impulsiveness items are intended to measure an individual's tendency to act 'on the spur of the moment' without considering consequences (e.g., Do you generally do and say things without stopping to think?). Venturesome items are intended to measure an individual's tendency to act 'on the spur of the moment' even though they may be fully aware of the consequences (e.g., Do you welcome new and exciting experiences and sensations even if they are a little frightening and unconventional?). Internal consistency results for both the impulsiveness (r = .74) and venturesomeness (r = .77) sub-scales were adequate.

A researcher-adaptation of the Elliot and McGregor (2001) 2 X 2 Achievement Goal Questionnaire was used to measure subjects' motivational orientation towards achievement. Elliot and McGregor's original achievement goal questionnaire consisted of 12 items measuring four sub-scales: mastery-approach, mastery-avoid, performance-approach, and performance-avoid goal. Performance-approach goals refer to a desire to demonstrate normative competence (e.g., It is important for me to do better than other students.) whereas performance-avoid goals refer to avoiding demonstrating normative incompetence (e.g., My goal in this class is to avoid performing poorly.). Mastery-approach goals entail mastering a task for the sake of improvement (e.g., I want to learn as much as possibly from this class.), whereas mastery-avoid goals reflect a desire to avoid demonstrating self-referential incompetence (e.g., I worry that I might not learn all that I possibly could in this class.) (Elliot, 1999). For the purposes of this study, the items from the Elliot and McGregor scale were reworded to reflect band class rather than general education. For example, the item 'I just want to avoid doing poorly in this class' was reworded to read 'I just want to avoid doing poorly in band class.' Items

on the researcher-adapted achievement goal questionnaire were also drawn from scales designed for use with college-age and high school-age musicians by Smith (2002) and Schmidt (2005), respectively. The researcher-adapted achievement goal measure for the current study consisted of 40 items, 10 items each for mastery-approach, mastery-avoid, performance-approach, and performance-avoid subscales. Subjects responded to all motivation items using a likert-type scale ranging from *1-not at all true of me* to *7-very true of me*. Reliability results were excellent for each subscale (α = .83 to α = .92).

RESULTS

The impulsiveness and venturesomeness measures yielded scores with possible ranges of 0 to 19 and 0 to 16, respectively, whereas each achievement goal sub-scale had a possible range of 7 to 70. The mean impulsiveness score for the sample (M = 7.20) was lower than that reported by Eysenck et al. (1985) who found a mean of 9.78 for subjects 16 to 19 years of age (Table 2). This suggests that the sample in the current study may be less impulsive than the general population. In contrast, the mean venturesomeness score for this sample (M = 10.68) was very similar to that reported by Eysenck et al. (1985) who found a mean of 10.52 for subjects 16 to 19 years of age. The descriptive analyses of the achievement goal sub-scales revealed that the sample had the greatest tendency toward mastery-approach orientations (M = 56.02), followed in descending order by performance-approach (M = 49.07), performance-avoid (M = 44.65), and mastery-avoid (M = 43.55) orientations. A repeated measures analysis of variance with follow-up contrasts revealed that the mastery-approach mean was significantly ($p < .001$) higher than all other motivation sub-scale means.

Table 2
Descriptive statistics for personality, motivation, and composite performance achievement

	M	SD	Sk	Kurt
Impulsiveness	7.20	3.63	.86	.54
Venturesomeness	10.68	3.17	-.58	-.17
Mastery Approach	56.02	10.46	-.88	.30
Mastery Avoid	43.55	10.82	.30	-.25
Performance Approach	49.07	13.08	-.64	-.08
Performance Avoid	44.65	13.43	-.25	-.18
Composite Performance Achievement 1-1	50.00	9.43	-.25	.40
Composite Performance Achievement 1-2	54.99	10.58	-.04	-.22
Composite Performance Achievement 2-1	55.06	10.13	.16	-.11
Composite Performance Achievement 2-2	56.77	10.61	-.07	.07
Composite Performance Achievement 3-1	57.29	10.12	-.01	-.46
Composite Performance Achievement 3-2	58.04	11.27	-.54	.97

NOTE: 1-1 = day 1 pre-test, 1-2 = day 1 post-test, 2-1 = day 2 pre-test, etc

Pearson correlations were determined among the personality and motivation sub-scales (Table 3). The significant positive correlation found between the impulsiveness and venturesomeness sub-scales ($r = .39, p < .001$) is somewhat larger than that reported by Eysenck et al. (1985) who found coefficients ranging from $r = .11$ to .24 for similar age groups. No significant relationships ($p > .05$) were detected between the impulsiveness and venturesomeness sub-scales and any of the motivation sub-scales. Moderately strong significant ($p < .001$) relationships were found between the performance-approach and performance-avoid orientations ($r = .75$) and the mastery-approach and mastery-avoid orientations ($r = .59$). These correlations indicated that the sample tended to respond to all mastery and all performance orientation items in a somewhat similar manner regardless of whether they were intended to measure approach or avoid dimensions. A significant ($p < .001$) relationship was also found between the mastery-avoid and performance-avoid orientations ($r = .60$) indicating that subjects who reported a greater tendency toward mastery-avoid orientations also reported a greater tendency toward performance-avoid orientations. The smallest correlations were detected between mastery-approach and performance-approach ($r = .34, p < .01$) and mastery-approach and performance-avoid ($r = .37, p < .01$). However, all correlations among the motivation sub-scales are stronger than those reported by Elliot and McGregor (2001).

Table 3
Pearson correlations among impulsivity, motivation, and composite performance achievement

	1. Imp	2. Vent	3. Ma-Ap	4. Ma-Av	5. Perf-Ap	6. Perf-Av	7. Comp 1-1	8. Comp 1-2	9. Comp 2-1	10. Comp 2-2	11. Comp 3-1	12. Comp 3-2
1.	1.00	.39**	-.04	.14	.00	.07	-.20	-.26*	-.28*	-.24	-.25	-.26*
2.			-.03	-.01	-.15	-.11	-.37**	-.33*	-.30*	-.31*	-.33*	-.32*
3.				.59***	.34**	.37**	.28*	.17	.35*	.27*	.30*	.20
4.					.46***	.60***	-.08	-.16	-.06	-.10	-.05	-.10
5.						.75***	.07	-.04	.06	.02	.09	-.01
6.							.00	-.07	.02	.00	.03	-.05
7.								.89***	.89***	.89***	.89***	.85***
8.									.92***	.91***	.90***	.89***
9.										.94***	.94***	.89***
10.											.93***	.93***
11.												.90***

NOTE: Imp = impulsiveness, Vent = venturesomeness, Ma-Ap = mastery approach, Ma-Av = mastery avoid, Perf-Ap = performance approach, Perf-Av = performance avoid, Comp = composite performance achievement
NOTE: 1-1 = day 1 pre-test, 1-2 = day 1 post-test, 2-1 = day 2 pre-test, etc
*$p < .05$, **$p < .01$, ***$p < .001$

A multivariate analysis of variance was conducted to examine whether mean differences existed on the personality and motivation sub-scales as a function of sex, whether or not the subject had taken private lessons, or whether the subject played a brass or woodwind instrument. Cell sizes for the between-subjects effects were: (a) 30 male, 30 female; (b) 38 woodwind, 22 brass; and (c) 47 private lessons, 13 no private lessons. Interaction effects were suppressed due to inadequate cell sizes. No significant differences ($p > .05$) were detected for any of the main effects.

Descriptive analyses of the composite performance achievement scores revealed mean increases from day one ($M = 50.00$) through three ($M = 58.04$) (Table 2). Standard deviations showed that the scores were least varied at day one pre-test ($SD = 9.43$) and most varied at day three post-test ($SD = 11.27$). Pearson correlations determined between composite performance achievement scores at each time point were found to be very strong ($r = .85$ to $.94$, $p < .001$), indicating that those with high performance achievement scores at one time point tended to have high performance achievement scores at all other time points as well (Table 3). In other words, the relative positions of individuals

within the sample in regards to performance achievement remained somewhat constant across the duration of the study.

A mixed-design analysis of variance was conducted to examine whether mean differences existed on the composite performance achievement measures as a function of the between-subjects factors sex, whether or not the subject had taken private lessons, or whether the subject played a brass or woodwind instrument. The interaction effects of each between-subjects variable and time were included in the model. Although significant mean differences in performance achievement ($p < .001$) were detected across time, no significant interactions ($p > .05$) were detected between any of the between-subjects factors and performance achievement scores. The effect sizes for change in performance achievement at days one, two and three were $d = .53$, $d = .17$, and $d = .07$, respectively. The effect size calculated for the mean difference between day one pre-test and day three post-test was $d = .85$.

Significant relationships ($p < .05$) were detected between impulsiveness and composite performance achievement scores at day one post-test ($r = -.26$), day two pre-test ($r = -.28$), and day three post-test ($r = -.26$), suggesting that those who were more impulsive had somewhat lower performance scores at these respective time points (Table 3). Significant negative relationships ($p < .05$) were detected between venturesomeness and all composite performance achievement measures ($r = -.30$ to $-.37$), suggesting that subjects who were more venturesome tended to also have lower performance achievement scores. Lastly, mastery-approach sub-scale scores were significantly correlated ($p < .05$) with performance achievement at day one pre-test ($r = .28$), day two pre- ($r = .35$) and post-test ($r = .27$), and day three pre-test ($r = .30$), indicating that those with mastery-approach motivation orientations had higher performance achievement scores at each time point.

The change in performance achievement over time and whether the selected individual difference variables interacted with performance achievement over time were examined in more detail by fitting several multi-level models to the data (Figure 1). Individual plots of the subjects' composite performance achievement suggested that examining the fit of both linear and quadratic models to the data would be appropriate. The relationships found between mastery-approach, impulsiveness, venturesomeness, and performance achievement suggested that these variables should be examined in the model as predictors. All multi-level analyses were conducted with the *HLM 6.04* computer program (Raudenbush, Bryk, & Congdon, 2007). Given the moderate sample size, restricted maximum likelihood parameter estimation was employed to generate results. There were no cases with missing data. All coefficients presented are non-standardized. Time was re-scaled by subtracting one from each time point (i.e., time points 1 to 6 became time points 0 to 5) so that coefficients for the fixed-effect initial status would reflect the predicted performance achievement at the beginning of the study rather than some arbitrary time point. Quadratic models were estimated by squaring the re-scaled time point values (e.g., time points zero, one, two, three, four, and five became zero, one, four, nine, sixteen, and twenty five, respectively).

Multi-level Model Taxonomy

	Level-1 model	***Level-2 model***
A	$Y_{ij} = \pi_{0i} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \xi_{0i}$
B	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \xi_{0i}$ $\pi_{1i} = \gamma_{10} + \xi_{1i}$
C	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \xi_{0i}$ $\pi_{1i} = \gamma_{10} + \xi_{1i}$ $\pi_{2i} = \gamma_{20} + \xi_{2i}$
D	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$
E	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \gamma_{01}Mastery\text{-}approach_i + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$
F	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \gamma_{01}Impulsiveness_i + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$
G	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \gamma_{01}Venturesomeness_i + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$
H	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \gamma_{01}Impulsiveness_i + \gamma_{02}Venturesomeness_i + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$
I	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \gamma_{01}Mastery\text{-}approach_i + \gamma_{02}Venturesomeness_i + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$
J	$Y_{ij} = \pi_{0i} + \pi_{1i}TIME_{ij} + \pi_{2i}TIME^2_{ij} + \varepsilon_{ij}$	$\pi_{0i} = \gamma_{00} + \gamma_{01}Mastery\text{-}approach_i + \gamma_{02}Venturesomeness_i + \gamma_{03}Mastery\text{-}approach_i\ X\ Venturesomeness_i + \xi_{0i}$ $\pi_{1i} = \gamma_{10}$ $\pi_{2i} = \gamma_{20}$

Figure 1
Hierarchical taxonomy of multi-level models with composite performance achievement as the outcome variable

The first model fit to the data was an unconditional means model (Model A). This was comprised of only a fixed effect which represented the mean initial status of composite performance achievement at the beginning of the study (π_{0i}) and a variance component representing individual deviations from the fixed effect. Model B included an additional level-1 fixed effect which represented the rate of change in performance achievement across the six time points included in this study ($\pi_{1i}TIME_{ij}$) as well as an additional variance component describing individual deviations from this effect. Essentially, Model B describes the change in performance achievement as being linear over time. The third model (Model C) included a quadratic term as an additional level-1 fixed effect ($\pi_{2i}TIME^2_{ij}$) as well as individual deviations from the quadratic term. The inclusion of the quadratic term alters the interpretation of the linear, level-1 fixed effect from rate of change to instantaneous rate of change after time point zero. Subsequently, the quadratic term can then be interpreted as an indicator of whether this instantaneous change persists or varies in direction and/or rate. Taken together, the linear and quadratic level-2 fixed effects included in Model C examine whether the change in performance achievement over time was at all curvilinear. Model D is similar to Model C except the individual deviations from the linear and quadratic terms were removed. Mastery-approach goal motivation, impulsiveness, and venturesomeness were included as level-2 predictors in Models E, F, and G, respectively. These models estimated what effect each respective level-2 predictor had on the sample's predicted initial performance achievement. Model H examined the effect of simultaneously including impulsiveness and venturesomeness as level-2 predictors whereas Model I examined the effect of simultaneously including mastery-approach motivation and venturesomeness as level-2 predictors. Lastly, Model J included an additional level-2 predictor representing the interaction between mastery-approach and venturesomeness.

Of all the models examined, it seems that Model I had the best overall fit (Figure 2; Table 4). The largest decrease in the between-person variability present in initial performance achievement scores was observed when venturesomeness and mastery-approach were simultaneously included in the model. When comparing models G to H it seems that most of the variance that could be explained among the initial performance achievement scores by including impulsiveness overlapped with that which could be explained with venturesomeness. In addition, Model J indicated that the interaction of mastery-approach and venturesomeness was non-significant. The coefficients for initial status calculated with Model I suggested a predicted initial performance achievement mean of 47.90 ($p < .001$), with those who had stronger mastery-approach motivation orientations and who were less venturesome beginning with higher scores. As in the previous models, the coefficients for the linear and quadratic growth terms indicated an instantaneous rise in performance achievement after time point zero with a peak between time points four and five. In summary, performance achievement increased in a curvilinear fashion and those who were less venturesome and had stronger mastery-approach orientations were

more likely to begin the study with somewhat higher performance achievement ratings that were maintained across time.

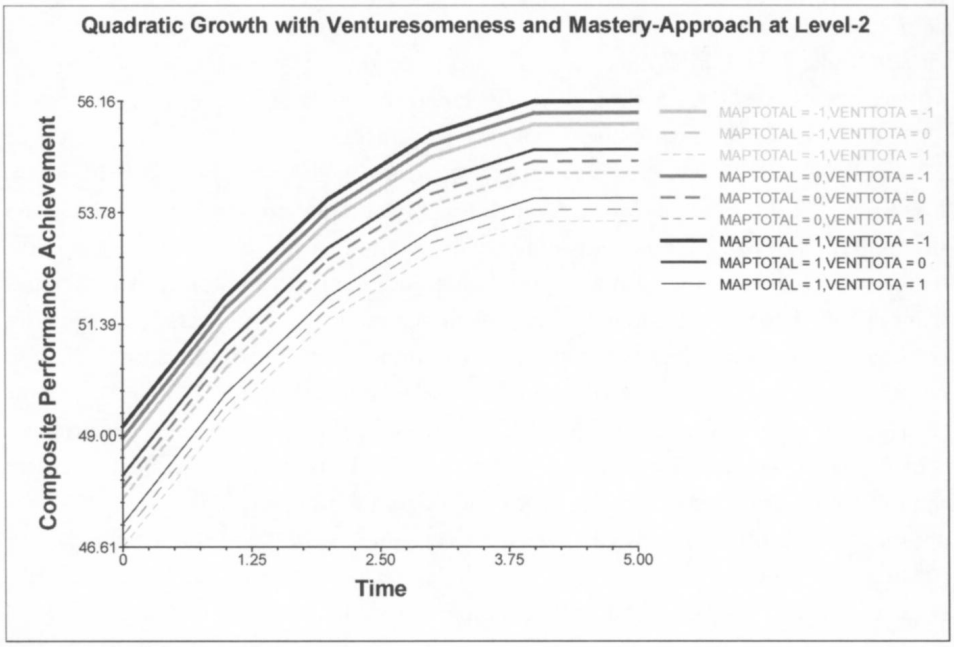

Figure 2
Quadratic model with venturesomeness and mastery-approach as level-2 predictors.

NOTE: VENTTOTAL 0 = mean venturesomeness, VENTTOTAL -1 = scores one standard deviation below the mean, VENTTOTAL 1 = scores one standard deviation above the mean, MAPTOTAL 0 = mean mastery-approach, MAPTOTAL -1 = scores one standard deviation below the mean, MAPTOTAL 1 = scores one standard deviation above the mean

Correlations between the composite behaviors exhibited by more than 50% of the sample (i.e., summed frequencies of behaviors across the three days) and the personality and motivation scales are presented in Table 5. Given the high degree of relationship between the approach and avoid dimensions of the mastery and performance scales, mastery (MAST) and performance (PERF) composite scales were created to reduce the number of correlations calculated. Impulsiveness scores were negatively related ($p < .05$) to the behaviors whole-part-whole ($r = -.32$) and slowing ($r = -.27$). These findings indicated that those who were more impulsive also tended to exhibit less whole-part-whole and slowing behaviors. Mastery-goal composite scores were significantly related ($p < .01$) to the behaviors skipping directly to or just before critical musical sections 1 ($r = .35$), 2 ($r = .37$), and 5 ($r = .37$) suggesting that those with stronger mastery motivation orientations were also more likely to focus on the critical musical sections of the etude while practicing. A significant correlation ($p < .05$) was also detected between mastery-goal composite

scores and duration of time spent playing (r = .27) indicating that those with stronger mastery motivation orientations also tended to spend more time playing during the study. It is important to note that these relationships were relatively small and therefore may only have minimal practical significance.

Table 4
Results generated with the hierarchical taxonomy of multi-level models fit to the composite performance achievement data

Parameter	*Model A*	*Model B*	*Model C*	*Model D*	*Model E*	*Model F*	*Model G*	*Model H*	*Model I*	*Model J*
Fixed Effects										
Initial Status, π_{oi}										
Intercept γ_{00}	55.36•	51.87•	50.72•	50.72•	36.30•	55.84•	62.01•	63.09•	47.90•	56.74••
Mast-Ap goal γ_{01}					.26*				.25*	.08
Imp γ_{01}						-.71*		-.41		
Vent γ_{01}							-1.06••	-.88*	-1.04••	-1.85
Mast-Ap X Vent γ_{03}										.01
Rate of Change π_{1i} π_{2i}										
Intercept γ_{10}		1.39•	3.12•	3.12•	3.12•	3.12•	3.12•	3.12•	3.12•	3.12•
Intercept γ_{20}			-.35•	-.35•	-.35•	-.35•	-.35•	-.35•	-.35•	-.35•
Variance Components										
Level 1										
Within person σ^2_e	18.93	11.08	9.83	11.30	11.30	11.30	11.30	11.30	11.30	11.30
Level 2										
Initial status σ^2_0	95.47•	86.26•	84.12•	96.74•	91.06•	91.67•	86.88•	86.48•	81.44•	82.57•
Linear Slope σ^2_1		.31••	.82							
Quadratic Slope σ^2_2			.02							
Covariance σ_{01}		.33	.42							
Covariance σ_{02}			-.31							
Covariance σ_{12}			-.09							
Deviance	2281.60	2144.15	2119.81	2131.02	2130.76	2136.91	2129.02	2125.70	2121.71	2128.46

NOTE: Mast-Ap goal = mastery-approach goal orientation, Imp = impulsiveness, Vent = venturesomeness
*p < .05, **p < .01, •p < .001

Table 5
Spearman correlations between practice behaviors and motivation and personality sub-scales

	Imp	Vent	MAST	PERF
Repeat Measure	-.08	.08	-.03	-.13
Repeat Section	-.24	-.23	.12	.08
Whole-Part-Whole	-.32*	-.17	.13	.04
Slowing	-.27*	-.12	.17	.00
Section 1	-.11	-.11	.35**	.14
Section 2	-.03	-.08	.37**	-.02
Section 5	-.05	-.13	.37**	.02
Marks Part	-.10	-.07	-.05	-.04
Duration Played	-.05	-.09	.27*	.17

NOTE: Imp = impulsiveness, Vent = venturesomeness, MAST = mastery composite, PERF = performance composite
*$p < .05$, **$p < .01$, ***$p < .001$

DISCUSSION

The findings of this study have many theoretical implications for psychosocial models of music learning. Consistent with the results of previous studies that compared musicians and non-musicians on similar traits, the findings suggested that musicians may be somewhat less impulsive than the general population (e.g., Barry, 1990; Kemp, 1996; Miksza, 2006). Broader studies designed to compare the impulsivity of musicians with the general population could reveal interesting results. It may be that those who are more impulsive are less likely to be successful in music and therefore more likely to drop out of school programs. This population in particular may need to be encouraged to adopt a more reflective style. Studies examining this hypothesized effect could have strong implications for practicing as well as music education in general.

This study also showed that those among the sample who were relatively impulsive may have also been less strategic in their approach towards practicing. Furthermore, those in the study who were more impulsive and venturesome tended to have lower performance achievement scores. The results suggest that encouraging a more reflective approach to practicing in the early stages of learning may help students increase their initial accuracy and efficacy. Teachers could guide students who are generally more impulsive or venturesome to focus on more strategic approaches when sight-reading or practicing new music. For instance, those students who are less likely to think things through before acting could be encouraged to practice difficult musical passages at a slower tempo or spend more time silently analyzing materials. These findings as well as those from other studies (e.g.,

Miksza, 2006; Schmidt, 1984; Schmidt & Sinor, 1986) underscore the importance of investigating constructs of impulsivity when developing models of music learning.

The curvilinear change in performance achievement identified in this study also has strong practical implications for music educators. The findings suggest that secondary-level instrumental musicians may lack the ability to critique or analyze their own performance after reaching a certain level of improvement and therefore may not be aware of what musical issues need attention when practicing a single etude for extended periods of time. Alternatively, secondary-level musicians should consider strategies to counteract the possible effects of boredom when engaged in learning. The relationships found between mastery-approach motivation orientations, performance achievement, and the observed practice behaviors suggest adopting self-referential goals such as making personal improvement may be one approach to bolstering persistence. For example, subjects in the study with stronger mastery-approach orientations began with higher performance achievement scores and tended to exhibit more strategic behaviors and longer durations of playing. More studies are needed which examine the effects of practicing over extended periods of time.

Although the findings demonstrated important theoretical links between mastery motivation orientations and music practicing, the results regarding the construct validity of the 2 X 2 achievement goal model were less convincing. The relationships detected among the hypothesized achievement goal sub-scales suggested a large degree of overlap among the constructs. These results were a dramatic contrast to those reported in previous studies with samples of non-musicians (e.g., Duda, 2005; Elliot, 2005; Elliot & McGregor, 2001). However, previous researchers examining similar goal constructs with musicians have also reported strong relationships between approach- and avoid- motivation sub-scales (e.g., Schmidt, 2005; Schmidt, Zdzinski & Ballard, 2006; Smith, 2002). The 2 X 2 achievement goal framework may not be valid when applied to high school musicians' motivation orientations and it is clear that this model must be re-examined in the context of music education research. Given the findings from this study as well as those from previous studies, particular emphases should be placed on exploring whether musicians perceive performance-approach and performance-avoid dimension as discrete orientations and whether including a mastery-avoid dimension in theoretical achievement goal models is valid.

In summary, the results from this study have strong theoretical implications for music education researchers in regards to how impulsivity and achievement goal motivation may supplement psychosocial models of learning. Several relationships were found among the selected individual difference variables, observed practice behaviors, and performance achievement that may have practical value as well. In addition, the findings suggest that more studies need to be designed that examine music practicing over extended periods of time in order to provide musicians with methods for overcoming plateaus in the learning process.

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