

# Self-regulation and music learning: A systematic review

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## Abstract

Recent research into how individuals achieve their musical goals has been enriched by studies investigating music practice through the lens of self-regulation, or the goal-orientated planning, cyclical adaptation, and reflection of an individual's thoughts, feelings and actions. The article aims to review the available empirical evidence in order to identify the relationship between processes contained within Zimmerman's (2000) model of self-regulation and specific music learning variables. It also attempts to discover how self-regulatory behavior relates to both general music instruction and interventions designed to enhance self-regulation. Findings indicate weak, positive relationships with the variables of interest, but suggest self-regulation instruction is the most strongly related variable. The discussion proposes that future research may benefit from investigations of self-regulation within a broader spectrum of musicians and an exploration of participant-driven understandings of self-regulation theory.

## Keywords

*instrumental learning and teaching, metacognition, practice, self-regulation, teaching*

Although the practice habits of musicians have long provided a fertile source of discussion (Zhukov, 2009), missing from this conversation is an underlying educational theory that speaks to the myriad factors implicated in musical learning. Since the publication of a series of studies beginning in the late 1990s by McPherson and his colleagues, attention has increasingly been paid to the educational construct known as self-regulation. Often associated with Zimmerman's model (2000), self-regulation provides a framework through which to comprehend the various possible trajectories of individual musical development.

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Musical educational research tends not to refer to theoretical frameworks but where it does, psychology, music education, and general education are typically the preferred go-to fields of academic knowledge (Miksza & Johnson, 2012). Research on practice nevertheless forms an important backdrop to musical self-regulation research. The general practice literature has stressed the importance of effort and time investment regardless of 'talent' (e.g. Ericsson, Krampe, & Tesch-Römer, 1993; McPherson & Renwick, 2011; Sloboda, Davidson, Howe, & Moore, 1996) and the need for clear practice session goals, effortful monitoring, feedback, repetition, and error correction as found in 'deliberate' practice (Ericsson, 1997; Hyllegard & Bories, 2008; Krampe & Ericsson, 1996; Meinz & Hambrick, 2010) – a type of practice that for some is not always synonymous with 'fun' (Hyllegard & Bories, 2009). Practice researchers have also documented the numerous practice strategies of expert musicians (e.g. Chaffin, Imreh, & Crawford, 2002; Miklaszewski, 1989) and the idiosyncratic application of these strategies (Hallam, 1995). They have observed qualitative differences from early stages (Barry, 1992; Hallam, 1997; Sloboda, 1996), with higher-achieving novices displaying not only greater intrinsic interest (Davidson, Howe, & Sloboda, 1997) but also incorporating informal/creative activities into their regular practice routines (Sloboda & Davidson, 1996). Research has also demonstrated the critical role parents play in young musicians' development (Davidson et al., 1997) as well as the different influence teachers have on the acquisition of practice strategies among classically-trained musicians (Davidson & Jordan, 2007) and their non-classical counterparts (de Bézenac & Swindells, 2009).

Since music research papers cite psychology theories three times more than general education theories, the input from general education is to be both expected and welcomed (Miksza & Johnson, 2012). Zimmerman's (2000) model of self-regulation theory is, however, of particular interest. It matches general advice teachers give about the need to plan, execute and evaluate one's practice (Jørgensen, 2004). It also resembles Hallam's (1997) review-based (but empirically untested model) of presage, process, and product. More importantly, self-regulation is supported by extensive research in general education (Wolters, Benzion, & Arroyo-Giner, 2011). Meta-analytic research, for instance, has demonstrated that self-regulation instruction improves students' academic performance, use of self-regulatory strategies and overall motivation (Dignath, Büttner, & Langfeldt, 2008). Self-regulation can be fostered regardless of age or academic domain (Dignath-van Ewijk, 2011; Wang, Lo, Xu, Wang, & Porfeli, 2007) and has been corroborated across cultural groups (McInerney, 2011). It has inspired the development of technological tools designed to improve how students learn (Azevedo, Johnson, Chauncey, & Graesser, 2011) and such tools have led to significant improvement in the writing skills of elementary school students (Meyer, Abrami, Wade, Aslan, & Deault, 2010; Abrami, Venkatesh, Meyer, & Wade, 2013). Moreover, social-cognitive models of self-regulation and in particular that of Zimmerman, are the most commonly referred to in the literature, according to a recent comprehensive review of self-regulation studies (Alexander, Dinsmore, Parkinson, & Winters, 2011).

A central tenet of self-regulation theory maintains that for goals to be reached autonomously, individuals must be able to control their behavior, environment and cognitive/affective states (Zimmerman, 1990, 2000). Self-regulation represents the culmination of a maturational process involving the observation and emulation of self-regulating exemplars as well as periods of scaffolded support (Zimmerman, 1998, 2000, 2011). Moreover, it is not a trait but a context-specific process and the fully autonomous learner is believed to exercise self-regulation before, during and after any learning activity (Zimmerman, 2000). In the first phase (forethought), effective learners engage in preliminary task analysis (goal setting and strategic planning) and possess desirable self-motivation beliefs (self-efficacy; outcome expectations; intrinsic

interest/value; goal orientation). During the performance phase, they exercise self-control (self-instruction; imagery; attention focusing; task strategies) and engage in self-observation (self-recording; self-experimentation). The final phase of self-reflection involves self-judgment (self-evaluation; causal attribution) and self-reaction (self-satisfaction/affect; adaptive/defensive responses) – thoughts, feelings and behaviors that determine the next steps an individual takes in the learning process. Zimmerman has furthermore proposed a conceptual framework of six psychological dimensions that determine how well individuals self-regulate: motive, method, time, behavior, physical environment, and social factors (Zimmerman, 1998).

The work of McPherson and his colleagues has been pivotal in forging links between self-regulation theory and music research. Focusing exclusively on young musicians, these researchers have found that intrinsic interest and increased use of cognitive strategies are positively correlated with time spent on informal/creative activities, repertoire and technical work (McPherson & McCormick, 1999). They have demonstrated that regardless of level, self-efficacy is the strongest predictor of performance scores and that individuals who attribute expected results to causes such as luck or ability are in the minority (McPherson & McCormick, 2000). Students at higher grades, nevertheless, appear to have lower self-efficacy, which is probably due to increased awareness of their stage of development (McCormick & McPherson, 2003). Meanwhile, among very young learners, McPherson's team has observed that despite limited practicing strategies, differences in self-regulation levels are apparent very early on and that intrinsic motivation is significantly linked to faster progress (McPherson & Renwick, 2001). Their findings also indicate, however, that if novices are allowed to choose their own repertoire, they may suddenly exhibit sophisticated practicing strategies (Renwick & McPherson, 2002). Lastly, their findings suggest that child beginners with high self-reported self-efficacy, parents who encourage them to practice – at least in the initial stages – and self-determined practice slots are more likely to continue playing their instrument twelve years later (Faulkner, Davidson & McPherson, 2010). These discoveries have helped argue the case for a shift in the way music students are taught (McPherson, Nielsen, & Renwick, 2013). For instance, teachers need to pay greater attention to expanding students' practice strategies while raising awareness of their appropriate use; they should foster time-management skills while remembering to make room for informal/creative activities as these sustain motivation levels; and should possibly abdicate a degree of control in their lessons, for example by granting students greater autonomy in repertoire choices.

## Purpose

While interest in musical self-regulation has gathered pace (McPherson, Davidson, & Faulkner, 2012; McPherson & Renwick, 2011), a systematic review of this literature has not yet been undertaken. Systematic reviews provide a comprehensive representation of available research unlike the subjective gestalt found in standard narrative reviews (Peat, Mellis, Williams, & Xuan, 2002). Since systematic reviews explicitly state the procedures followed, they are also considered to be more transparent (Pittaway, 2008). Their protocols comprise a focused review question(s), extensive search of the literature, appraisal of studies' quality, extraction and synthesis of relevant data and dissemination of results (Pawson, 2006). Conventional systematic reviews target quantitative studies – ideally those containing randomized controlled trials – using effect sizes to calculate the magnitude of results (Petticrew & Roberts, 2006). Due to this methodological bias, some reviewers combine qualitative and quantitative studies, as exemplified by work of the EPPI-Centre at the University of London. Reviewers have yet to settle on a single best approach to synthesize heterogeneous studies and the practice remains a moot point

(Dixon-Woods et al., 2006). Nevertheless, in the interests of inclusivity, the following review represents the eclectic methodological mix in musical self-regulation studies.

## Methodology

### Research questions

Three research questions were created to investigate the relationship between students' self-regulatory characteristics and music learning variables of interest, general music instruction and self-regulation instruction:

What is the relationship between...

1. music students' self-regulatory characteristics and ... ?
  - a. musical attainment: (i) level of expertise and (ii) performance scores
  - b. amount of practice
  - c. persistence
  - d. practice content: (i) informal and (ii) formal
  - e. efficiency
2. general music instruction and student self-regulation?
3. musical self-regulation instruction and music learning variables?

'Self-regulatory characteristics' represent any of the sub-processes of Zimmerman's (2000) self-regulation cycle. The 'music learning variables' commonly appear in the literature on musical self-regulation and deliberate practice (e.g. Hyllegard, & Bories, 2008) and were operationalized thus:

*Musical attainment:* (i) level of expertise (beginner, intermediate or advanced – as determined by the researchers) and (ii) performance scores (scores in formal assessments of musical performance, including exams, competitions and auditions).

*Amount of practice:* the length of practice sessions.

*Persistence during practice:* perseverance despite difficulties during practice sessions and/or over time.

*Practice content:* (i) informal (self-selected; improvisation, composition) and (ii) formal (scales, technique, teacher-selected repertoire, exam or competition preparation).

*Practice efficiency:* structuring time during practice such that greater gains are achieved in less time.

The broad term 'general music instruction' describes how teachers typically teach. Finally, 'musical self-regulation instruction' refers to any intervention by teacher and/or researcher(s) specifically designed to foster self-regulatory characteristics in students.

### Information retrieval

To locate a comprehensive amount of relevant empirical studies, an iterative process of selection was adopted, as recommended by Hammerstrøm, Wade, & Jørgensen (2010). Studies were searched in bibliographic, non-bibliographic, dissertation and thesis and subject-specific databases, as well as citation indexes. This process was undertaken in the fall of 2011; consequently, studies with later publication dates were not included. Keywords for searching databases

**Table 1.** Sources of studies.

<i>Non-grey literature</i>		<i>Grey literature</i>
Academic search complete	PsycINFO	Bing
Art Full text	<i>Research Studies in Music Education</i>	Google
CBCA Education	RILM – Abstracts of Music Literature	PAIS International
Education Full Text	Science Direct	PsycEXTRA
Emerald	These Canada	Social Science Research Network
ERIC: Educational Resources Information Center	Web of Science	
Francis	Wiley Online Library	
PQDT: ProQuest Dissertations and Theses		

comprised the following: *music, musicians, musical* in addition to *self-regulation, self-regulated, self-regulatory, self-regulation, self-regulat\**. Search strategies were expanded to contain synonyms for self-regulation and its sub-processes and came from entries on self-regulation in relevant encyclopedias and available database thesauruses. Also, grey literature (unpublished but nevertheless potentially germane) was searched in alternative search engines and databases (Table 1). Finally, additional studies were handpicked by scanning the reference sections of included articles and three core texts (McPherson & Renwick, 2011; McPherson & Zimmerman, 2011; Zimmerman, 2000).

### *Selection procedure*

Inclusion/exclusion criteria were set in order to judge whether or not to download articles into an initial database. As can be observed from Table 2, a notable exclusion criterion was if a study related to practice but not SRL theory. Arguably, this sidelines the findings of a rich body of literature that not only provides the context *for* but is also closely intertwined *with* musical self-regulation research. While the introduction to this article goes some way towards underlining the importance of the practice literature in this regard, it should be noted that the decision to focus primarily on SRL studies was based chiefly on theoretical considerations. Firstly, although reviews of the practice literature have already been published (e.g. Hallam, 1997; Upitis, Varela, & Abrami, 2013; Zhukov, 2009), a review exclusive to musical self-regulation has not. Furthermore, amalgamating evidence from both bodies of knowledge could potentially render obscure any unique contributions from the growing musical self-regulation literature. Secondly, although including non-SRL studies would undeniably yield further evidence with which to reinforce findings for this review, it would probably require a larger team of researchers but more importantly, would be premature at present. Synthesizing findings from diverse paradigmatic perspectives is a contentious issue which would only be compounded by adding more studies to the mix. Therefore, it was deemed preferable to limit the analysis and in so doing perhaps allow room for discussion as to whether and how a more ambitiously comprehensive review might be conducted in future.

Studies were coded according to source of location, availability, duplication, and primary inclusion/exclusion status (see Supplementary Appendix A). Having downloaded articles satisfying the primary inclusion criteria (DB1), duplicates were removed and full-text versions read. Articles meeting all secondary inclusion criteria were retained in a second database (DB2). The

**Table 2.** Inclusion and exclusion criteria.

Include	Exclude
<i>Language:</i> English	Not in English
<i>Population:</i> All	Not empirical
<i>Musical genre:</i> All	Related to practice but not SRL theory
<i>Levels of expertise:</i> All	Not primarily related to music learning or performance
<i>Setting:</i> School, university, conservatory, music studio	Pre-service music teachers
<i>Study type and design:</i> Empirical – qualitative, quantitative or mixed methodology	Duplicated in another database or source
<i>Relevance:</i> Possibly related to one or more of the research questions	
<i>Date:</i> Any	

final inclusion criteria required affirmative answers to the following: (a) Does the study deal with musical self-regulation as defined by any of the three core texts? and (b) Does it provide answers to one or more of the research questions of this review? From 31,129 hits, 90 abstracts were targeted, of which 56 full-texts were retrieved and the final 25 studies selected.

To appraise the quality of the selected studies as recommended in numerous systematic literature review guides (e.g. Huff, 2009; Petticrew & Roberts, 2006; Ramey & Rao, 2011), studies were evaluated using appraisal checklists appropriate to their design (Supplementary Appendix B). These covered a range of features including soundness of methodology, study type/design, diversity of perspective, richness of data and relevance to the research questions. Appraisal scores for each study were then classified as either 'low,' 'medium,' or 'high' depending on where they had placed on the scoring band, with most selected studies ranking 'high.'

### Study features

The set comprised 25 studies dating from 1999 to 2011 (Supplementary Appendix D). While over half were conducted in the USA and Australia, other locations included Norway, Canada, Brazil, Slovenia and South Korea. Although not always stated explicitly, the studies appear to focus on classically-trained musicians with only three studies targeting non-classical musicians. Sample sizes ranged from 1 to 463 participants, with an equal proportion of smaller (i.e., 16 individuals or less) and larger (i.e., 130 individuals or more) sample sizes. Participants' ages were diverse and extended from 7 to 45 years. However, more studies focused on and/or included non-advanced individuals. As Table 3 shows, there was a relatively equal amount of quantitative and qualitative studies, with a handful using mixed methodologies. Researchers collected actual practice session data in over half of the studies and the length of observations varied from individual practice sessions to one semester.

### Data analysis

Each study was combed for instances of associations between variables identified in the research questions and self-regulatory processes as operationalized in McPherson and Zimmerman (2011), McPherson and Renwick (2011) and Zimmerman (2000).<sup>1</sup> This involved

**Table 3.** Research designs of the selected studies.

Qualitative ( <i>n</i> = 12)	Quantitative ( <i>n</i> = 10)	Mixed ( <i>n</i> = 3)
<b>Case studies</b>	<b>Survey/questionnaire</b>	<b>Questionnaire with narrative analysis</b>
Nielsen (1999)	McPherson & McCormick (1999)	
Nielsen (2001)	McPherson & McCormick (2000)	Austin & Berg (2006)
McPherson & Renwick (2001)	McCormick & McPherson (2003)	
Renwick & McPherson (2002)	Nielsen (2004)	<b>Case study with multidimensional scaling</b>
Oare (2007)	Miksza (2006)	
Kim (2008)	Martin (2008)	
Leon-Guerrero (2008)	Fritz & Peklaj (2011)	Dos Santos & Gerling (2011)
Bartolome (2009)	Miksza (2012)	
Upitis et al. (2010)		<b>Case study with questionnaire</b>
Dos Santos & Hentschke (2011)	<b>Survey with observational analysis</b>	
Brook et al. (2011)		Chung (2006)
Upitis et al. (2011)	Smith (2002)	
	<b>Quasi-experimental</b>	
	Hewitt (2010)	

entering examples of self-regulatory behavior into a database, from which a list of musical self-regulatory behavior was built (Supplementary Appendix C). Also, evidence of relationships between SRL processes and the research questions' variables of interest were recorded onto Excel spreadsheets. The unit of analysis thus consisted of observed relationships, with multiple results extracted from each study. Since both qualitative and quantitative studies were included, effect sizes were not calculated. Instead, a categorization system (Table 4) was created that required the strength of each association, ranging from  $-2$  to  $+2$ , to be charted.

For coding purposes, these associations were categorized according to data type. Labelled A to F, they comprised the following: test of difference, correlation, regression, proportion of sample, point on a Likert scale, and qualitative statement of non-relationship. Hence, among the studies that documented relationships between self-regulatory characteristics and performance scores, McPherson and McCormick (2000) discovered a significant positive relationship between self-efficacy and performance scores, regardless of expertise level. This relationship was therefore scored  $+2$  and labelled data type B. On the other hand, the majority of Chung's (2006) participants expressed dissatisfaction with their evaluation scores. Consequently this association was scored  $-2$  and labelled data type D. Meanwhile, relationships with problematic data were labelled '?' and consisted of 7 categories, as illustrated in the final column of Table 4. For instance, McCormick and McPherson (2003) identify imagery use as part of a set of cognitive strategies that possibly predict performance scores. However, since data for imagery alone is not provided, the association was labelled '?' (ii).

This system allowed the inclusion of results from methodologically diverse studies and provided the metric by which findings were integrated. Relationships received a graded score, from which averages within individual and across the four level groupings (beginner, intermediate, advanced, all-level) were calculated. In the next section, overall scores for a complete set of

Table 4. Categorization of relationship types.

	-2	-1	0	+1	+2	?
A	Statistically significant negative difference		No significant difference		Statistically significant positive difference	Lack of, Insufficient or Unclear data
B	Significant negative correlation ( $r \geq -.25$ )	Non-significant negative correlation ( $r \leq -.24$ )	No correlation	Non-significant positive correlation ( $r \leq +.24$ )	Significant positive correlation ( $r \geq +.25$ )	Self-regulatory process is measured as part of a larger category
C	Negative relationship and explains a significant proportion of variance in a regression analysis ( $b \geq -.10$ )				Positive relationship and explains a significant proportion of variance in a regression analysis ( $b \geq -.10$ )	Measured but results not provided due to removal from questionnaire, analysis or selected model
D	Negative relationship observed in <b>75%</b> or more of the sample	Negative relationship observed between <b>50% and 75%</b> of the sample	No clear pattern among multiple participants in a qualitative study	Desired relationship observed between <b>50% and 75%</b> of sample	Desired relationship observed in 50% or more of sample	Can change depending on the person or situation
E	At the extreme end of a negative Likert scale (1 on 5 pt scale; 1~1.4 on 7 pt)	Below the midpoint (-) of a directional Likert scale (2 on 5 pt, 1.5 ~ 2.8 on 7 pt)	Around the midpoint of a directional (+/-) Likert scale (3 on 5pt, 2.9~4.2 on 7 pt)	Above the midpoint (+) of a directional Likert scale (4 on 5 pt, 4.3~5.6 on 7 pt)	At the extreme positive end of a Likert scale (5 on 5 pt, 5.7~7 on 7 pt)	Desired relationship observed in less than 50% of the sample
F		No relationship (in a qualitative study)				Frequency counts; percentage of time (Undesired relationship observed in less than 50% of the sample)

Note. Scores categorized according to data type: A = test of difference, B = correlation, C = regression, D = proportion of sample, E = Likert scale, F = qualitative statement. Unclear data denoted by '?' and Roman numerals.



studies that address a research question are denoted by the symbol  $\mu$  whereas  $M$  represents the average score for studies belonging to a specific level of expertise only.

## Results

### RQ1a(i) Musical attainment: *Level of expertise*

RQ1a(i) represents the largest data set with all 25 studies containing findings potentially indicating that SRL is related to expertise (Supplementary Appendix E). Classifiable relationships exist in 19 studies with each self-regulatory process related to musicians' attained level of expertise. However, the overall average score for SRL processes ( $\mu = 0.27$ ) suggests a weak, positive relationship (Supplementary Table 5). Although mostly positive, averages for individual processes are generally low. The findings reveal that level of expertise is most closely related to task strategies ( $\mu = 0.64$ ), but only weakly associated to outcome expectations and causal attributions ( $\mu = 0.08$ ) in addition to a weak but negative relationship with self-satisfaction ( $\mu = -0.04$ ).

Of the four data sets, advanced ( $M = 0.45$ ) and beginner ( $M = 0.38$ ) level studies have the highest mean SRL scores with typically low, positive scores for individual processes. Nevertheless, for advanced musicians, task strategies ( $M = 1.22$ ) are the most associated with level of expertise, whereas for beginners, the closest ties exist with intrinsic interest and self-experimentation ( $M = 1.20$ ). Dos Santos and Hentschke (2011) provide numerous instances of advanced musicians' task strategies including the harmonic reduction of pieces to better understand a piece's structure, writing in fingerings and intense repetition of motoric patterns. Meanwhile, Bartolome (2009) and Uptis et al. (2010) describe motivated beginners who incorporate improvisation and composition into their practice schedules.

Nevertheless, weak negative relationships also occur. Examples include those between beginners and attention focusing ( $M = -0.40$ ), or advanced musicians and self-satisfaction/affect ( $M = -0.44$ ). Few of the specialist school musicians studied by Chung (2006) appeared to enjoy practicing, with high achievers expressing dissatisfaction over their rank and low achievers voicing discontent about performance scores. By comparison, intermediate ( $M = 0.09$ ) and all-level ( $M = 0.05$ ) data sets have markedly lower average scores for SRL processes. For intermediate-level musicians, for example, most expertise-related processes suggest positive but weak associations. Some are also negative: goal setting ( $M = -0.50$ ) and strategic planning ( $M = -0.17$ ). The young middle-school musicians in Oare (2007), for instance, set neither proximal nor distal goals. In the all-level studies, meanwhile, only goal-setting and intrinsic value ( $M = 0.40$ ) seem in any way related to level of expertise.

Clear patterns across levels are hard to discern due to fluctuations in global SRL mean scores and data points per level-type. However, in processes for which scores exist across levels, scores typically dip among intermediate level musicians, particularly with self-satisfaction.

### RQ1a(ii) Musical attainment: *Performance scores*

RQ1a(ii) comprises a smaller set of studies ( $N = 5$ ) (Supplementary Appendix F). From the three studies with classifiable data points, six processes appear to be related to performance scores. Since these relationships are mostly found in a single study of advanced musicians (Chung, 2006) they constitute an undeniably fainter trail of evidence. Correlational findings from this study suggest every SRL sub-category except for self-judgment is strongly related to higher performance scores. However, while these findings contribute to the study's global score for this variable, it is impossible to identify the strength of individual processes situated within

sub-categories. The set's resulting mean global score ( $\mu = 0.20$ ) is therefore problematic. The analysis suggests that (learning) goal orientation and self-satisfaction have weak, negative relationships ( $\mu = -0.40$ ) with performance scores and Chung indeed reported high-scoring participants with ego approaches to musical learning (Supplementary Table 6). However, the lack of data from studies focusing on beginner or intermediate studies precludes the identification of trends across levels. Nevertheless, the high mean score for self-efficacy ( $M = 2.00$ ) in the all-level studies highlights the importance of this self-motivational belief, irrespective of level, and explains the set's somewhat strong average relationship between performance scores and self-efficacy ( $\mu = 1.20$ ).

### *RQ1b Amount of practice*

Although seven studies produce data germane to RQ1b, only three elicit clear relationships (Supplementary Appendix G). The findings suggest two processes are associated to amount of practice: self-efficacy ( $\mu = 0.57$ ) and, to a lesser extent, task strategies ( $\mu = 0.14$ ) (Supplementary Table 7). The mean global score ( $\mu = 0.04$ ), consequently, implies an especially weak positive relationship between SRL and how much music students practice. Since intermediate level studies ( $\mu = 0.04$ ) constitute the only homogenous sub-set in terms of level, trends are speculative. Nevertheless, data from all-level studies ( $M = 0.06$ ) underscores the association with self-efficacy ( $M = 0.67$ ). McCormick and McPherson (2003), like Miksza (2006), observed significant positive relationships between perceived efficiency and amount of practice. Meanwhile, McPherson and McCormick (1999) found that technical work significantly predicts amount of weekly practice. Whether task strategies in general are strongly related to how much musicians practice remains to be seen however.

### *RQ1c Persistence*

Data regarding the relationship between SRL and persistence appears in five studies (Supplementary Appendix H). While six processes, distributed among four of the studies, display positive associations, the resulting mean score ( $\mu = 0.20$ ) suggests a weak positive relationship with persistence (Supplementary Table 8). Five of the relevant processes are somewhat weakly related ( $\mu = 0.40$ ) but intrinsic interest ( $\mu = 1.20$ ) has the most salient association.

Among beginners, persistence is moderately linked ( $M = 1.00$ ) with just two processes: intrinsic interest and self-recording. Renwick and McPherson's (2002) beginner practiced each note for an average of 9.83 seconds when working on self-selected repertoire compared with only 0.79 if repertoire was chosen by her teacher. Meanwhile, Uptis et al.'s (2010) novice participant repeated difficult passages more frequently in order to upload her best performances onto an online portfolio.

Although greater persistence may not be associated with self-recording among higher-level musicians, it is related to slightly more processes, including a particularly strong positive relationship with intrinsic interest ( $M = 2.00$ ). The advanced violinists in Kim's (2008) study, for example, remained intrinsically motivated while persevering through challenges, whether technical, musical or cognitive. Martin's (2008) larger-scale study of advanced level young musicians, meanwhile, found a significant positive correlation between intrinsic interest and persistence. Consequently, the global mean SRL score for advanced musicians ( $M = 0.38$ ) is almost three times higher than for beginners ( $M = 0.13$ ), implying an increase in the importance of SRL for persistence, and especially intrinsic interest, as musicians grow in expertise.

### RQ1d(i) Practice content: *Informal*

Five studies contain data relevant to SRL and informal/formal practice (Supplementary Appendix I) with classifiable relationships present in four studies. Informal practice yields slightly more relationships and across a larger number of processes (Supplementary Table 9). Although eight processes are associated with informal practice, their global mean SRL score ( $\mu = 0.15$ ) indicates only a weak positive relationship. Relationships with individual process are uniformly weak ( $\mu = 0.40$ ), with goal orientation unique in its negative association.

Despite the similar strength of relationships at the full-sample level, inter-level fluctuations reveal that self-regulatory processes may be more related to informal practice among beginners ( $M = 0.63$ ), than musicians of either diverse ( $M = 0.19$ ) or intermediate levels ( $M = -0.13$ ). When observing their beginner practice a jazzy piece, Renwick and McPherson (2002) noticed conscious efforts to recall the teacher's demonstrations as well as a richer than usual palette of task strategies. However, the intermediate and all-level studies show fewer related processes, and these are of moderate strength. Among intermediate musicians, goal orientation and adaptive/defensive behavior have a moderately negative relationship ( $M = -1.00$ ) with informal practice. For instance, Miksza (2006) found significant negative correlations between informal practice and mastery orientation items among junior high band students. Meanwhile, the all-level studies indicate moderately positive relationships ( $M = 1.00$ ) with intrinsic interest, self-efficacy and adaptive/defensive behavior.

### RQ1d(ii) Practice content: *Formal*

Aggregate scores for RQ1d(ii) indicate five processes are linked with formal practice, producing a similarly weak if slightly lower global mean ( $\mu = 0.10$ ) than RQ1d(i). As illustrated in Supplementary Table 10, goal orientation, self-efficacy, and task strategies have weak positive relationships ( $\mu = 0.40$ ) with formal practice, whereas intrinsic interest ( $\mu = 0.80$ ) approaches moderate strength. Attention focusing, however, displays a weak negative association ( $\mu = -0.40$ ) with formal practice.

While beginners have a nil global SRL score, musicians in the intermediate and all-level set have identical weak positive scores ( $M = 0.13$ ). Renwick and McPherson (2002) observe strong relationships with formal practice in their beginner musician but these effectively cancel each other out due to diametrically opposed scores: intrinsic interest and task strategies ( $M = 2.00$ ) versus attention focusing and adaptive behavior ( $M = -2.00$ ). In contrast, mostly moderately positive relationships are found in the intermediate and all-level sets. For example, Miksza (2006), McPherson and McCormick (1999), and McCormick and McPherson (2003) identify associations with goal orientation, intrinsic value, and self-efficacy, respectively. Although these results lend support to the relationship between self-motivation processes and formal practice across levels, it is not otherwise possible to discern inter-level patterns.

### RQ1e Efficiency

While the five studies in RQ1e generate a considerable number of potentially relevant data points, only two studies – both of intermediate-level instrumentalists – demonstrate classifiable relationships (Supplementary Appendix K). This evidence is limited to three data points, each linked to a different process, constituting only a small portion of the data (Supplementary Table 11). The particularly weak positive relationship between SRL processes and practice efficiency ( $\mu = 0.08$ ) is therefore perhaps not particularly surprising. Nonetheless, goal orientation,

self-efficacy and adaptive behavior all exhibit moderate positive relationships ( $M = 1.00$ ), at least among intermediate level musicians. Miksza (2006), for instance, found perceived efficiency was significantly correlated with both a commitment to improve and respondents' perceived ability to concentrate when practicing. Miksza (2012) also observed a significant positive correlation with self-efficacy items such as confidence in one's ability to achieve one's musical goals.

### **RQ2 General music instruction and SRL behavior**

Eleven studies bear data points describing the relationship between SRL and general music instruction (see Supplementary Appendix L), with findings indicating a particularly weak positive relationship ( $\mu = 0.02$ ). As Supplementary Table 12 demonstrates, relationships exist for six processes, but these are mixed. Cross-level comparisons reveal slightly higher average SRL scores for beginner ( $M = 0.06$ ) and intermediate ( $M = 0.05$ ) musicians. In contrast, there is a weak negative relationship between instruction and self-regulation among advanced musicians ( $M = -0.03$ ).

While beginners have the highest global mean, due to a moderately high score for adaptive behavior ( $M = 1.00$ ), only two processes appear to be related to instruction among intermediate musicians: attention focusing ( $M = 0.40$ ) and task strategies ( $M = 0.40$ ). Teachers who accommodate a student's musical interests might reasonably expect some adaptive behavior in return. For example, in Renwick and McPherson's (2002) study, a demonstration of a 'jazzy' version of a piece inspired a beginner to request that the teacher notate the piece for her. Oare (2007), meanwhile, found a high incidence of attention focusing among intermediate band students being tested as well as the common use of warm-up exercises, even if other strategies were conspicuously absent. In Hewitt's (2010) quasi-experimental study of middle school band musicians, however, instruction in self-evaluation had minimal impact on self-evaluation accuracy.

More relationships are observable among advanced musicians but several of these are negative: adaptive behavior, intrinsic interest ( $M = -0.25$ ) and notably self-satisfaction ( $M = -1.00$ ). University-level musicians expressed negative affect in response to competitive structures within orchestras (Smith, 2002), felt unsupported, confused or held back by teachers (Dos Santos & Hentschke, 2011) and dissatisfied with their ranking at an institutional setting (Chung, 2006). However, general instruction among advanced musicians also seems to be positively related to strategic planning ( $M = 0.50$ ) and, in particular, task strategies ( $M = 0.75$ ), with Dos Santos and Hentschke (2011) observing that all members in their study employed 'approaching' and 'deepening' phases when practicing, attributing this to the norms of western classical music instruction.

### **RQ3 Self-regulation instruction**

Findings for RQ3 are drawn from comparatively few participants, producing a positive average for individual processes of 0.72 (Supplementary Table 13). While qualitatively weak, this score suggests the strongest relationship in this review. Each self-regulatory process is positively related to self-instruction, with an unusually high number of moderately positive relationships ( $\mu = 1.00$ ) for goal setting, strategic planning, imagery, self-evaluation and adaptive behavior. Moreover, the score for intrinsic interest ( $\mu = 1.50$ ) represents the only strong positive relationship for any individual process with a variable of interest in this review. Other processes, for instance self-experimentation ( $\mu = 0.25$ ), seem only weakly related to SRL instruction.

While both beginners ( $M = 1.00$ ) and advanced musicians ( $M = 1.75$ ) have positive relationships with self-regulation instruction, the association is stronger with the latter. The beginner in Uptis et al.'s (2010) study used her online portfolio to set goals she had never attempted before and engaged in new discussions about practice strategies. Meanwhile, the conservatory-level participants in Kim's (2008) study reported that keeping a daily self-regulation journal over several weeks enhanced their concentration, boosted confidence about practicing independently, helped them structure their practice better and actively encouraged them to evaluate their practice more thoughtfully while considering more effective ways to practice. As closer inspection suggests, however, inclusion of findings from a study containing musicians of all levels results in a dramatic decrease in the strength of this relationship ( $M = 0.06$ ) since only one association exists within the all-level data set (intrinsic interest,  $M = 1.00$ ) (Supplementary Appendix M).

However, considerable caution should be exercised when interpreting RQ3's findings. The results for beginner level musicians are taken from a study of a single individual and those for advanced musicians pertain to just four individuals. Also where relationships are identified in these studies, they are almost exclusively strong positive relationships ( $M = 2.00$ ). Thus the fact that among beginners, nine processes appear to bear no relationship with self-regulation instruction, whereas for advanced musicians, all except self-experimentation, self-recording ( $M = 1.00$ ) and self-satisfaction ( $M = 0.00$ ) are strongly related, may not be true of the general population.

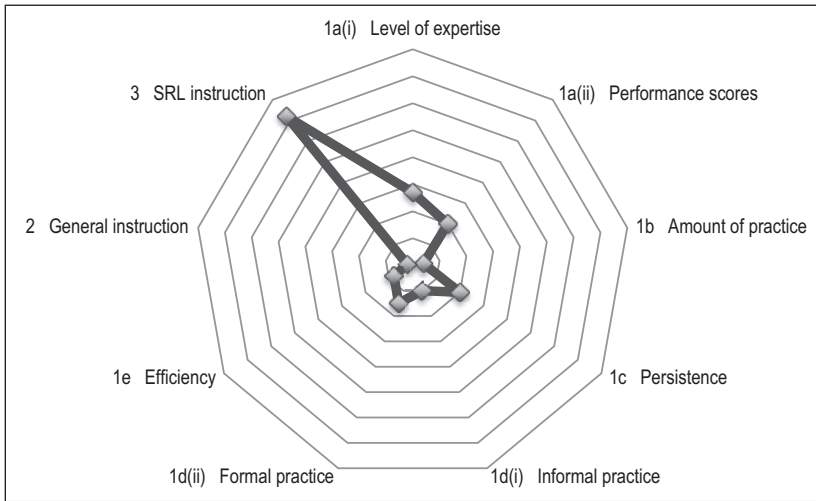
### General summary

Although most of the valid data points are positive (Supplementary Table 14), the findings reveal a weak positive relationship ( $\mu = 0.20$ ) between self-regulatory behavior and the combined variables of interest. SRL appears most closely associated with self-regulation instruction (RQ3,  $\mu = 0.72$ ). The relationship is three times that of the next most important association (RQ1a(i): level of expertise,  $\mu = 0.27$ ) and substantially dwarfs the association with general music instruction (RQ2,  $\mu = 0.02$ ). While the latter is SRL's least closely related variable, amount of practice (RQ1b,  $\mu = 0.04$ ) is also rather weakly related, however.

### Discussion

It may be premature to extrapolate from these findings. First, the scores have been left unweighted in order not to undervalue findings from studies with smaller sample sizes – a double-edged sword since it also inflates their importance. Second, there is considerable variety in the amount of data found per research question: while the relationship between expertise and self-regulation (RQ1a(i)) can be observed in data points scattered across 25 studies, other questions rely on 11 studies at most ( $M = 5.88$ ), with RQ3 being addressed by only four. Similarly, the presence of studies from different level groupings also varies depending on the research question. For example, apart from RQs1a(i) and 1e, where all level groupings are represented, data points for research questions are missing from one level in each instance. Meanwhile, advanced level studies are particularly visible in RQ1a ( $n = 9$ ) but do not contribute to findings for questions 1e and 1b. In contrast, beginner and all-level studies contain data applicable to 7 of the 8 research questions.

Caveats notwithstanding, the review suggests a positive but generally weak relationship between self-regulatory processes and the variables of interest (Figure 1). While research into the association between music teaching and self-regulated learning (RQ3) remains at an



**Figure 1.** Variables of interest and self-regulatory behavior

embryonic stage, some may welcome the possibility that self-regulation instruction has a substantially stronger relationship with SRL behavior than general music instruction (RQ2). As the results attest, however, there is also considerable evidence of self-regulation even when it is not being explicitly taught. More research in this area is therefore essential.

Regardless of their apparently weak relationships, it is perhaps not surprising that the two level of attainment variables (RQ1a) and perseverance (RQ1b) enjoy the next strongest associations with self-regulation: ties with level of expertise are supported by SRL theory and it is axiomatic that self-regulating musicians persist when confronted with challenges. The demonstrably weaker relationship with amount of practice (RQ1b) is more likely to raise eyebrows however, given the oft-cited importance of the many hours musicians should practice to attain the highest levels of expertise. Conceivably not all types of practice require intense levels of self-regulation and the demands of highly self-regulated practice may restrict how long one can practice in this way. Nevertheless, if self-regulated practice somehow militates against lengthy practice sessions, one would expect a relatively strong association with practice efficiency (RQ1e), which does not appear to be the case. It may still be early days to wager whether self-regulation is more related to informal or formal practice, although the data suggest the former has the stronger association. Perhaps when students take autonomous steps to engage in informal practice, they are more intrinsically motivated and therefore more likely to self-regulate to begin with.

The average strength of relationships between the variables of interest and individual self-regulatory processes ranges from very positively weak (self-satisfaction/affect,  $\mu = 0.02$ ) to moderately positively weak (goal setting and self-evaluation,  $\mu = 0.68$ ). The relative importance of the latter speaks to the goal-driven yet iterative nature of self-regulation. Somewhat unsettling is the low relationship score for self-satisfaction, however. As mentioned, this is primarily due to dissatisfaction reported in studies of advanced musicians. Some claim traditional music education systems that restrict autonomy and value deliberate practice over 'playing for fun' or 'pleasure' (de Bézenac & Swindells, 2009) are to blame. However, it is possible that at higher levels, where competition is more intense and standards correspondingly higher, classically-trained musicians are simply harder to please. Presumably, they are sufficiently able to evaluate

the results of their own practice efforts, and any instruction that does not successfully address individual learning needs is likely to lead to disappointment. Similarly, while performance scores are typically an integral part of a traditional music education, the review suggests higher scores are not associated with positive self-reactions. Indeed, despite the motivational benefits of progressing through a well-structured curriculum, exams and competitions can be perceived as threats to individuals' musical identities (McPherson, Davidson, & Faulkner, 2012).

It is self-efficacy that boasts the most frequent association with each variable of interest. This stands to reason: without the will to practice and the belief in one's ability, why would anyone self-regulate? Other specific relationships are also worth mentioning, however. One is the strong association between intrinsic interest and self-regulation instruction. Another is the apparent lack of association between self-instruction and longer practice sessions (RQ1b). Perhaps cognitive demands during practice hamper efforts to self-verbalize, causing self-instruction to occur only in exceptional circumstances, for example when focusing on a single musical parameter. Alternatively, perhaps musicians are constantly self-instructing but at a subconscious level that is difficult to observe and/or measure.

The association between higher self-regulation and self-selected repertoire is another relationship of interest. Studies show that letting students follow their own interests can have a positive effect on students' engagement and sense of agency (Azevedo, 2006). Therefore, choosing one's own repertoire presupposes the presence of a musical goal and the intrinsic motivation necessary for its attainment.

Finally, the possibility that self-recording can increase perseverance among novice musicians is worth highlighting. If novices are so overwhelmed by the demands of learning a new instrument that they cannot self-monitor effectively (Zimmerman, 2000), retroactive monitoring via recordings may prove important and also provide a source of mastery evidence needed to bolster self-efficacy beliefs. Modern technology indeed allows musicians to archive and track their progress in an art form whose products are both intangible and ephemeral, and in so doing may provide the motivation needed to persevere long term.

### *Limitations*

While care was taken to ensure the search for literature was comprehensive, English-language articles were targeted – excluding research from non-Anglophone scholars. Given the time needed to conduct a systematic review, the very latest research could not be included, although this is rarely possible with reviews of this type. Also, in order to pinpoint relationships with specific self-regulatory processes, unmeasurable data points were by necessity excluded. Typically, these were relationships comprising clusters of processes, as a result of factor analysis, for instance.

### *Implications for further research*

These findings suggest self-regulation researchers need to continue accumulating cross-sectional data among musicians of all levels and genres. As most studies currently rely on self-reported data and limited numbers and/or lengths of practice sessions, longitudinal data of observed practice sessions and performances triangulated with teacher and/or parent perspectives are also in order. Further development of measures may also help capture processes such as self-instruction or causal attribution, which are currently underrepresented. Similarly, quasi-experimental studies will serve to clarify the impact of musical self-regulation on variables of interest. Self-efficacy, in particular, looms large in many studies' discussion sections with

as-of-yet unanswered questions regarding its origins (McCormick & McPherson, 2003), its relationship to technical work (McPherson & McCormick, 1999) and its interaction with performance outcome attributions and ability (McPherson & McCormick, 2000). Non-musical research suggests perceived mastery experiences contribute most significantly to self-efficacy (Pajares, Johnson, & Usher, 2007), but as to which factors account for their presence in musical contexts and how these are effectively sustained remains uncharted territory.

There is clearly scope for exploratory research into the relationship between teachers and the development of self-regulatory behavior. Similarly, little is known about the impact of modern technology on musical self-regulation or the link between social support and self-regulation. Perhaps the work of researchers like Hadwin and Oshige (2011) can lead to interesting new discoveries. These researchers describe co-regulated learning and socially shared regulation as forms of self-regulated learning that emphasize collective interactions and collaboration. Moreover, they argue that observations focusing on the frequency and content of interactions are important, and that discourse and content analyses can reveal the interplay among individual, parent, teacher, and cultural influences.

### *Implications for educators*

While music educators are unlikely to challenge the need for self-regulation, what is required is a discussion of how self-regulation instruction can be respectfully integrated into teaching practices. Given the limited evidence, teachers' contributions in future research are crucial. Moreover, what role will technology play as it continues to impact pedagogical norms? Abrami, Bernard, Bures, Borokhovski, and Tamim (2011) argue learning tasks should be novel, complex and perceived as important, otherwise students become frustrated by technologically-assisted attempts to scaffold self-regulation. How can teachers meet such criteria as well as tap into the power of technology in a way that is simultaneously effective and efficient? Perhaps by disseminating findings from this review at music conservatories and conferences, and providing guidance to teachers via professional development days or online support, answers to some of these questions will unfold.

### *Conclusion*

The preponderance of the classical genre and the difficulties in operationalizing an essentially non-linear process, among others, limit our ability to validate a universal theory of musical self-regulation. Nonetheless, this approach also offers exciting new possibilities for observing and articulating ways that music is learned. Years from now, we expect that a more nuanced and complex theory of self-regulation in music learning will be derived, colored by thoughtful studies illustrating examples of co-regulated learning, along with work that involves participants more actively in the generation of theories and models of their own learning.

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### **Note**

1. For dichotomous self-regulatory processes, relationships with the desirable option were charted (e.g. 'adaptive' behavior).



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