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Video feedback and the choice of strategies of college-level guitarists during individual practice

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Abstract

Developing musicians are expected to accumulate many hours of self-regulated practice to attain expertise on a musical instrument. The ability to choose appropriate strategies based on the internal and external feedback obtained while performing in the absence of the teacher's support constitutes an important aspect of self-regulated practice. Nevertheless, performing and simultaneously monitoring the performance for feedback represents a challenge for any learner, therefore possibly affecting the resulting choice of strategies. A possible solution to this problem might be to videotape the performance and watching it afterwards to fully concentrate on each task. Studies that have used video feedback in the domain of sports suggest that there may be many similar potential benefits of self-recording for musicians' self-regulation practices. In our study, we examined how video feedback might affect the choice of strategies of intermediate–advanced musicians ($n = 16$) while practising a new piece of music. To attain this objective, we compared the number of qualitative text entries coded against an observation framework derived from observations of a group of musicians who used video feedback four times over a period of ten practice sessions with the number of coding entries of a group of musicians who did not use video feedback. Our results indicated that musicians who used video feedback practised at a slow tempo more often and that they played longer segments of the piece earlier in the learning process than the musicians who did not use video feedback.

Keywords

Music performance, music practice, video feedback, practice strategies, self-regulation

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Learning a musical instrument requires a vast amount of practice that the musician undertakes by him or herself. A musician must therefore effectively *self-regulate* her or his practice to gain new skills and sustain improvement between the weekly lessons with her or his teacher (McPherson & Renwick, 2011). Self-regulation of learning involves various cognitive processes, including a continuous cycle of planning, self-evaluation and adaptation (Zimmerman, 1998b). Researchers describe self-regulation as cyclical because feedback obtained from prior performance helps a learner to adjust the subsequent choice of strategy (McPherson & Zimmerman, 2002). For example, a musician could choose to play a segment more slowly to correct a fingering mistake that he or she identified while playing. However, there is some evidence that developing musicians (McPherson & Renwick, 2001; Miksza, Prichard, & Sorbo, 2012; Pike, 2017) and even elite performers (Mornell, Osborne, & McPherson, 2018) can experience difficulty in self-regulating their music practice efficiently. Because the effort required to concurrently perform and monitor a motor task represents a challenge for any learner (Winne, 1995), Zimmerman (1995) suggests videotaping the performance of the task and watching it afterwards to fully concentrate on each process. Furthermore, video feedback could allow musicians to assess which sections of the pieces they need to work on and to compare videos to evaluate how much they have improved since their last recording (McPherson & Zimmerman, 2002). Although many studies have addressed the pedagogical use of video feedback in athletic disciplines, a relatively small number of studies focused on its use by performing artists such as musicians. This study aims to verify how the repetitive use of video feedback could affect the choice of strategies of college-level guitarists during their individual practice.

Self-regulated music learning

It has been argued that musicians must undertake daily deliberate practice to gain (and maintain) new skills (Hallam, 2013; Miksza, 2011b). Deliberate practice is thought to be highly structured, involving monitoring of performance and implementing tasks that will support further improvements (Ericsson, Krampe, & Tesch-Römer, 1993). Jørgensen (2004) considers music practising as a self-teaching activity because instrumental students are practising without their teacher's support. This form of autonomous learning has been studied under the construct of self-regulated learning in various fields of learning such as sports (Cleary & Zimmerman, 2001; Kitsantas & Kavussanu, 2011), mathematics (De Corte, Mason, Depaepe, & Verschaffel, 2011), science learning (Sinatra & Taasoobshirazi, 2011) and general academic learning (Kuo, Walker, Schroder, & Belland, 2014; Mega, Ronconi, & De Beni, 2014; Zimmerman & Schunk, 2012).

Self-regulated learning is a concept in educational psychology and refers to 'the processes whereby learners personally activate and sustain cognitions, affects, and behaviours that are systematically oriented towards the attainment of personal goals' (Zimmerman & Schunk, 2011, p. 1). It involves various cognitive processes included in a continuous cycle of planning, self-evaluation and adaptation (Zimmerman, 1998b). A new cycle ends and begins, for example, every time musicians stop playing during practice to reflect on what they just played and start playing again. Researchers describe self-regulation as cyclical because feedback obtained from prior performance helps a learner to adjust the subsequent choice of strategy (McPherson & Zimmerman, 2002). Choosing appropriate strategies during practice may thus be understood as the consequence of the feedback obtained while performing.

Choice of practice strategies

Musicians' practice strategy choices have been studied in the past decades in order to identify the most effective method of practising. Studies have focused on the location of start/stop playing segments in the score (Chaffin & Logan, 2006; Miklaszewski, 1989; Williamon & Valentine, 2000), with a particular focus on the start/stop on structurally significant points in the music (structural bars) (Chaffin, 2007; Chaffin & Imreh, 1997, 2002; Williamon & Valentine, 2002) and the resulting length of practice segments (Maynard, 2006; Miksza, 2011a; Williamon & Valentine, 2000). Other studies have focused on tempo and/or use of the metronome (Duke, Simmons, & Cash, 2009; Hallam, 2001b; Miksza, 2007, 2011a) or the use of repetition (Hallam, 2001b; Maynard, 2006; Miksza, 2007, 2011a).

In these studies, the strategies associated with performance achievement included slow practice (Duke et al., 2009; Hallam, 2001a; Miksza, 2007), use of metronome (Miksza, 2011a), use of structural bars in starting and stopping practice segments (Williamon & Valentine, 2002), repetition of sections (Hallam, 2001a; Miksza, 2007), especially repeating small sections (Miksza, 2011a), playing larger sections of the piece (Williamon & Valentine, 2000), progressively increasing the length of the practice segments (Williamon, Valentine, & Valentine, 2002) and attending to critical sections of the piece (Miksza, 2007).

Other studies have focused on the self-regulation of strategy choice during practice (Leon-Guerrero, 2008; Miksza, Prichard, & Sorbo, 2012; Mornell, Osborne, & McPherson, 2018; Nielsen, 1999). For example, Nielsen (1999) developed an observational scheme to analyse the practice strategies of two advanced church organ students preparing a complex piece of music at two different stages in the learning process that were three to four weeks apart. The scheme focused on the segmentation of music (number of bars played), tempo (expressed in percentage of the final concert tempo), playing with hands together or separated, and modification of the rhythmical structure of the piece. Across the two stages of the learning process both students reduced their use of a slow tempo ($<$50% of the final tempo) and increased their use of a fast tempo ($>$75% of the final tempo), yet they were surprisingly consistent in their use of time to play small segments of one-measure long or less. With a similar focus on practice strategies, but within a school context, Leon-Guerrero (2008) analysed the strategies used by 16 middle-school band instrumentalists during a 12-minute period in which they began to learn a new piece. The researchers found that the three most used strategies were *restarting a measure* (41.1% of the instances), *repeat more than one measure* (12.9%) and *repeat a measure* (10.3%). Such use of repetition among middle-school instrumentalists could be associated with the cyclical, and therefore repetitive, aspect of self-regulated learning (McPherson & Zimmerman, 2002). Repetition has similarly found to be a defining feature of practice behaviours of sixth-to-eighth grade band students, whose most frequent strategies were varying tempo, repeating fewer than four measures, repeating more than four measures, and irrelevant playing (Miksza, Prichard, & Sorbo, 2012). However, a defining feature of self-regulation seemed to be variation. In this study, the more highly self-regulated students were found to devote a greater amount of time to varied practice behaviours and spent less time in irrelevant playing. In contrast, a study of 14 elite performers revealed a lack of appropriate strategies associated with efficient self-regulated learning. Based on questionnaires and video analysis, the authors (Mornell, Osborne, & McPherson, 2018) reported that participants were unable to detect when they were improving, they often focused on more than one issue, and these issues were more general than specific. Researchers have looked at self-regulation at different phases of musical development and have reported mixed findings, although it seems to be that at any stage, musicians may need support in developing and applying efficient self-regulatory practice strategies.

Feedback while practising

In self-regulated learning, effective *task-intrinsic* feedback is the consequence of careful self-monitoring, which involves 'observing and tracking one's own performance and outcomes' (Zimmerman, 1998a, p. 78). Self-monitoring is critical in all types of self-regulated learning, in order to identify information required for the evaluation of a performance (Butler & Winne, 1995). Accordingly, the choice of strategy following the identification of a problem would be an essential aspect of effective musical instrument practising. Nielsen (2001, 2015) studied the self-regulation processes of two advanced organ students (2001) and two advanced jazz students (2015) as they were practising. In both studies, she found that the students monitored their progress and revised their use of strategies when they evaluated their progress as unsuccessful. This effective handling of errors was also associated with effective practice in a study by Duke et al. (2009) who analysed the practice habits of 17 graduate and undergraduate pianists while practising a difficult Shostakovich segment. The researchers reported that the three top-ranked pianists among the participants had a higher percentage of correct complete or incomplete practice trials while practising. The authors suggested that it may have been the effective handling of error correction, rather than the absence of mistakes in their playing, that explained this observation. Typically, the top-ranked pianists identified the precise location and source of each error, then rehearsed and corrected it; they varied the tempo of each performance trial; and they repeated the passage until it was corrected. The ability to 'self-teach' could be an important aspect of the practice behaviour of advanced or professional musicians, who may rely more on personal resources such as metacognitive skills (Hallam, 2001b) rather than external resources such as teachers, peers or materials (Araújo, 2016).

Interventions to foster self-regulation skills among developing musicians

After many studies involving the observation of self-regulation processes in the practice of musicians of various levels, a few studies began to focus on specific habits associated with efficient self-regulated learning. For example, music students have been found to facilitate their concentration, self-awareness and use of appropriate strategies by planning their practice at a detailed level (Hatfield, Halvari, & Lemyre, 2017). Additionally, it has been reported that music students develop their musical knowledge and stylistic awareness by listening to recordings from other musicians, which would represent an important part of self-regulated learning activities (Volioti & Williamon, 2017).

Other studies have focused on direct pedagogical interventions designed to foster self-regulation processes among developing musicians. In a meta-analysis of 25 studies focusing on self-regulation in musical instrument learning, Varela, Abrami and Upitis (2016) found that self-regulation instruction, which the authors define as 'any intervention by teacher and/or researcher(s) specifically designed to foster self-regulatory characteristics in students' (p. 58), was more strongly related to the presence of self-regulation processes in the musicians' practice behaviour than general music instruction that the authors define as 'how teachers typically teach' (p. 58). However, the researchers did not define what was conceptualised as 'typical' teaching. Among pedagogical interventions that were studied empirically, Cremaschi (2012) found a practice checklist to be effective in fostering self-regulation behaviours in the practice of beginning pianists. Mieder and Bugos (2017) designed a two-week self-regulated learning practice strategy course intended to foster self-regulated behaviour among high-school instrumentalists and found that it enhanced self-efficacy. On the other hand, no differences in practice strategy usage or performance achievement were observed. Finally, Miksza

(2015) compared two types of instruction, effective strategies and self-regulation principles, on the practice behaviour, performance achievement and self-efficacy of 28 collegiate music students. He reported that the participants who received self-regulation instruction made significantly greater gains in performance achievement than the participants who were instructed on effective strategies. Also, they chose nuanced music objectives such as dynamics, articulation or interpretation more frequently than basic musical objectives like notes or rhythms during practice.

Video feedback in athletic disciplines

Winne (1995) argues that self-monitoring the performing of a task could be detrimental to the learning effort when it hinders the mental charge already required for the performance itself. Self-monitoring performance thus represents a challenge for any learner. To allow the learner to fully concentrate on each task, Zimmerman (1995) suggests that the performing and the self-monitoring could be separated by videotaping the performance and watching it afterwards.

Results from studies that addressed the pedagogical use of video feedback in athletic disciplines indicated that video feedback could help a learner evaluate certain aspects of a motor task that she or he cannot be aware of during execution of the task (Rikli & Smith, 1980; Selder & Del Rolan, 1979). There is some evidence that time may also be a factor, with the positive effect of video analysis on performance results having been shown to appear after a minimum of two weeks (Guadagnoli, Holcomb, & Davis, 2002; Selder & Del Rolan, 1979). The positive effect of video analysis on performance results would thus require time to reveal itself. Nevertheless, video feedback could support a learner's reflection before observable changes in performance results. For example, Hebert, Landin and Menickelli (1998) identified four stages of thought process in the think-aloud verbalisations of four advanced tennis players as they were watching videos of their own performances of a particular type of tennis hit. These stages were: (a) getting used to seeing themselves, (b) detecting errors, (c) making connections and identifying tendencies and, finally, (d) correcting errors and reaching closure. More information would be required to verify how these tennis players applied the information gathered during the viewings in the context of their practice, but we could speculate that the fourth and final stage would require an adaptation of the choice of strategies. The four-stage model also highlights that the process of reflecting upon videos may benefit in terms of enhancing critical self-evaluation, even before enhanced performance results may be evident.

Video feedback in music

Some researchers have referred to the potential benefits of video feedback in the preparation of a musical performance (Hallam et al., 2012, p. 670; McPherson & Zimmerman, 2002, p. 342; Pike, 2017, p. 11; Varela et al., 2016, p. 69), but little empirical research has focused on the topic. Daniel (2001) surveyed 35 university-level musicians who had used video feedback four times over the course of one year. On each occasion, the students watched their recorded concert performance and wrote a 300-word reflection. After one year of using the video feedback, only 14% of the students remained unchanged in their opinion of their performances after watching the recordings; 49% were able to identify weaknesses in their performances more easily with video feedback, and 37% considered their performances to be better after watching them on video than it had felt while performing. This implies that 86% of the participants recognised that video feedback modified their initial evaluation of their performance.

In a study by Masaki, Hechler, Gadbois and Waddell (2011), 22 university-level piano students were filmed during a rehearsal and a public performance of a piece. Subsequently, the students compared both performances before and after watching the videos using an observation grid accompanied by a Likert-scale measuring eight different aspects of performance. The authors compared the results with an expert assessment of the same videos. The statistical results showed that the participants' assessments after performing and after watching the videos of the performances differed substantially, and that it was the participants' assessment of the recorded performance that was closer to the external expert's assessment. These results suggest that video feedback, when used by an advanced musician supported by an observation grid, could function as a useful tool in self-evaluation, allowing the performer to adopt a more distanced and objective perspective similar to that of an observer.

In a study by Deniz (2012), four pianists recorded their instrumental lessons over a four-week period, including the performances of the piece and the following discussion with their teacher. The research used semi-structured interviews to explore the students' perceptions of the process. The participants reported that they had improved the quality of their performances with the use of video feedback. Re-watching and recalling the performance and the teacher's feedback had, according to the students, motivated them to practise, helped to identify their weak and strong sides and enhanced the quality of their piano performance.

A study by Johnston (1993) explored the effectiveness of a combination of video feedback, peer assessment, instructor feedback and the use of an assessment form in the learning of conducting technique with 25 students. The participants considered the process of video feedback as useful and that the combination of videotaping, peer evaluation, self-evaluation and instructor feedback helped them identify aspects of their techniques that needed improvement.

In self-regulated learning, strategy choices are essentially based on feedback obtained while performing. But how can a musician learn to choose the best strategies during practice when the mental charge devoted to self-monitoring is affected by the mental charge devoted to playing? Hallam et al. (2012) found that the use of recordings for modelling and feedback was one of the few significant predictors of level of expertise among the participants. The studies already discussed (Daniel, 2001; Deniz, 2012; Johnston, 1993; Masaki et al., 2011) suggest that video feedback may enable musicians to gain a new perspective on their performances by separating the performance from its concurrent self-monitoring.

To our knowledge, no previous studies have been undertaken to explore how developing musicians could use the information provided by video feedback in their practice, and if this information could affect how they choose their strategies while practising. This study will verify if access to video feedback after a performance could have an effect on the choices of strategies made by classical guitar students in their subsequent practice sessions. The present article addresses this research question: How could the information provided by repeated video feedback ($n = 4$) influence college-level guitar students' choices of strategies during their subsequent practice sessions?

Method

An experimental between-group design was adopted with one experimental group and one control group. The use/non-use of video feedback was the independent variable, and practice strategy choice, as measured by observational coding entries, was the dependent variable.

Table 1. Characteristics of the participants: years of experience, grade obtained on their last performance exam, age and distribution of the participants' level in the music programme (1st or 2nd year).

	Experience		Grade		Age		Instrumental level	
Group[a]	*M*	*SD*	*M*	*SD*	*M*	*SD*	1st year	2nd year
Control	7.2	3.9	85.9%	3.6	17.9	1.4	4	4
Experimental	7.1	3.6	79.6%	10.4	19	1.3	3	5

Note. [a]$n = 8$.

Participants

The study took place in a CÉGEP in Québec, Canada. A CÉGEP (Collège d'enseignement général et professionnel) is an institution offering various specialised curricula, including music performance, that students must attend before entering university. All classical guitar students enrolled in a two-year music programme were offered the opportunity to participate. Thirteen males and three females volunteered and completed a consent form and questionnaire regarding their age, instrumental level in the programme, years of experience in individual lessons, most recent grade obtained in an instrumental evaluation, and frequency of using video or audio feedback. All the participants indicated that they used video or audio recording less than twice a month, allowing us to be confident that the study results would verify how video feedback could affect the self-regulation skills of musicians who had not previously used it regularly.

Participants ($n = 16$) were randomly assigned to either a control ($n = 8$) or an experimental group ($n = 8$) using a random allocation software (http://mahmoodsaghaei.tripod.com/Softwares/randalloc.html). To ensure an even distribution, we first matched the participants for their instrumental level in the institution's programme (first-year or second-year) and then paired them according to the grade they had obtained on their most recent performance exam (Table 1).

Materials

All participants learned the same piece of music, a waltz by French composer Thierry Tisserand (see Figure S1 in the Supplemental Material Online Section for an excerpt of the piece). The piece comprises 78 bars in the key of E minor with an ABA' form. It involves a wide variety of guitar techniques, such as harmonics, arpeggios, slurs or barrés. The guitar teachers from the institution validated the choice of the piece as being appropriate for the students' level. The chosen piece had not yet been commercially released and we altered the music sheet to hide the title and the name of the composer to avoid external influence. Participants were also asked not to discuss the music with their teacher or peers during the period of time when they were engaged in the experiment.

Procedure

Both groups of participants ($n = 16$) practised the piece during ten video-recorded practice sessions that lasted 20 minutes each. We scheduled the practice sessions according to the participants' availability, and 12 to 18 days were needed to complete all ten sessions. In the first

Table 2. Summary of the research protocol.

Practices	Control group ($n = 8$)	Experimental group ($n = 8$)
1	Practice[a]	Practice
2	Practice	Practice
3	Practice followed by perf[b] 1	Practice followed by perf 1
4	Practice	VF[c] 1 followed by practice
5	Practice followed by perf 2	Practice followed by perf 2
6	Practice	VF 2 followed by practice
7	Practice followed by perf 3	Practice followed by perf 3
8	Practice	VF 3 followed by practice
9	Practice followed by perf 4	Practice followed by perf 4
10	Practice	VF 4 followed by practice

Note. [a]20-minute recorded practice session, [b]Performance of the piece followed by verbal self-evaluation, [c]Video feedback followed by verbal self-evaluation.

practice session, participants received a personal copy of the score that they could annotate, but were asked to give it back after each session to ensure that practising the piece happened only within the research protocol. There was no obligation to learn the entire piece by the end of the study to avoid influencing their practice behaviour.

After practice sessions 3, 5, 7 and 9, participants from both groups ($n = 16$) played the piece, or any part they were able to perform, while being filmed, as if they were performing the piece in a concert. We asked the participants to provide verbal self-evaluative comments immediately after each of these 'performances'. Just before beginning the next practice session on the following day, the experimental group ($n = 8$), watched their own recorded performance on a laptop computer equipped with speakers and provided self-evaluative verbal comments once again. This intervention, watching their own recorded performances and self-evaluating afterwards, will henceforth be referred to as 'video feedback'. Table 2 summarises the procedure for both groups.

Approach to analysis

The videos

In this study, we asked the participants to verbalise their thoughts whenever they stopped playing during the recorded practice sessions. The practice videos were divided into *playing segments* and *thinking-aloud segments* using NVivo 8. The playing segments were identified according to Williamon and Valentine's definition of a practice segment: 'the amount of music (i.e. the number of bars in a given composition) that a musician executes in one attempt, without stopping to correct mistakes' (2000, p. 367). Therefore, a new playing segment was demarcated whenever the participant stopped playing to start again or to think aloud.

In this article, we focused on the observation of practice strategies among the participants. For each playing segment, we described the strategies used concerning the starting place in the score, tempo, length of the passage played, use of the metronome and use of particular strategies. Sometimes, participants would play the same segment repeatedly with the same choice of strategies and without stopping to think aloud or correct a mistake. These multiple repetitions were considered as a single practice segment and coded in a 'playing in a loop' category.

Table 3. Coding scheme.

Strategies	Sub-categories
Starting place in the score-Section of the piece	• Section A (bars 1 to 22) • Section B (bars 23 to 45) • Section C – a variation of section A (bars 46 to 78)
Starting place in the score-structural/non-structural bar	• Structural (beginning of a section or sentence) • Non-structural (all other bars)
Length of the segment played	• 4 bars or less (small segment) • 4 bars and 1 beat – 16 bars (medium segment) • More than 16 bars and 1 beat (large segment)
% of the final tempo of 136 bpm	• 50% or less • Between 51 and 75% • Between 76 and 100% • Faster than 100% • Irregular tempo (impossible to determine, often seen in sight-reading segments)
Use of metronome	• With metronome • Without metronome
Playing the segment once or in a loop	• Playing once • Multiple repetitions in a loop
Use of specific strategies (emergent from the analysis)	• Tapping with a foot • Playing only the harmony/melody/bass • Saying fingerings/notes/rhythmic figures out loud • Gradually increasing tempo while playing • Playing without the score/with eyes closed

Qualitative analysis of practice strategy choice

The coding scheme for practice strategies, shown in Table 3, was based on similar coding schemes used by Nielsen (1999) and Leon-Guerrero (2008). Sub-categories associated with *Playing the segment once or in a loop* and *use of specific strategies* emerged from the coding and were added to the existing categories.

Quantitative analysis

We used the number of coding entries in each category of strategies from practice video 3, 4, 6, 8 and 10 (see Table 2) for the statistical analyses. Practice 3 was just before the first performance of the piece while practices 4, 6, 8 and 10 were just after each of the four performances for all participants, and after each of the four video feedbacks for the experimental group only.

During practice, participants could start and stop playing whenever they wished, leading to differences in the total number of playing segments per practice session, although these differences were not statistically significant. The experimental group played between 12 and 66 practice segments per practice session ($M = 28.05$, $SD = 12.36$) while the control group played between 12 and 80 practice segments per practice session ($M = 35.73$, $SD = 18.62$).

To answer our research question, we compared the two groups according to the percentage of coding entries they generated for each category and for each practice session (to calculate the percentages, we divided the number of coding entries in each category by the total number of playing segments). In this way we were able to verify if video feedback had had an effect on the participants' choice of strategies during practice.

We analysed the quantitative data following recommendations by authors advocating a new paradigm for statistical analysis called *new statistics* or *statistical reform* (Cumming, 2009, 2012, 2014; Cumming & Fidler, 2005; Kline, 2008, 2013), which we considered appropriate for a study with a small sample of participants. According to Cumming (2008), the traditional *p* value gives only vague information about replication, irrespective of the number of participants. In fact, he suggests that effect size and confidence intervals provide more complete information than does null hypothesis significance testing (Cumming, 2012, p. ix). Kline (2013, p. 117) adds that,

> [n]ot only does the width of the confidence interval directly indicate the amount of sampling error associated with a particular effect size, it also estimates a range of effect sizes in the population that may have given rise to the observed result.

Cumming (2014, p. 13) thus suggests that 'it is better to report confidence intervals and make no mention of null hypothesis significance testing or *p* values'. Accordingly, in this study, the results of the participants who used or did not use video feedback were compared using the confidence intervals, and the effect size of the video feedback treatment is reported using Cohen's *d*.

In Kline (2008, p. 153), effect size is defined as 'the magnitude of the impact of the independent variable on the dependent variable'. Cohen's *d* is a measure of effect size that represents change expressed in standard deviation units. The interpretation of this change can be reported using Cohen's reference values: 0.2 for a small effect, 0.5 for a medium and 0.8 for a large effect.

To interpret the results for the confidence interval, Cumming (2012, p. 158) suggests a rule of eye that works as follows.

1. An absence of overlap between two 95% confidence intervals implies that the outcome of the independent samples *t* test of the mean difference is $p < .01$. If the confidence intervals just touch end-to-end, *p* is approximately .01.
2. A moderate overlap of the 95% confidence intervals (about one half the length of each error bar in a graphical display) implies that the *p* value for the *t* test is about .05, but less overlap indicates $p < .05$.

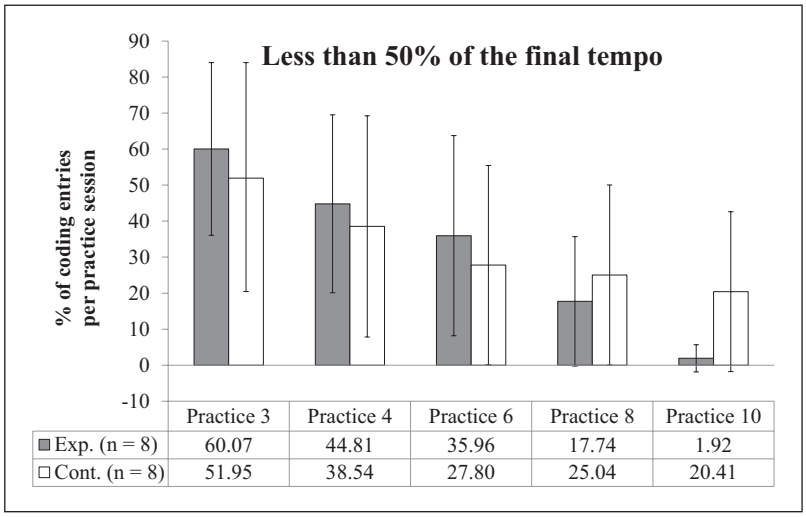
This rule would work best when $n \geqslant 10$ and the group sizes and variances are approximately equal.

Results

Choice of tempo

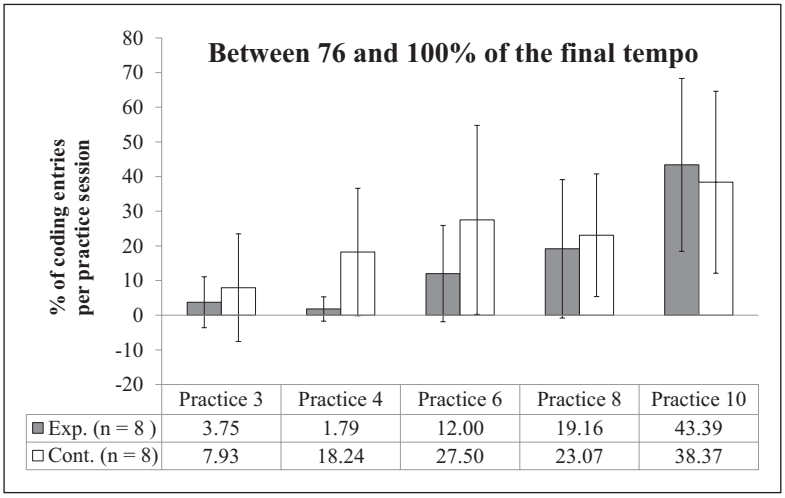
For each practice segment, choice of tempo was coded in categories representing the percentage of the final tempo of 136 bpm, as in previous studies (Leon-Guerrero, 2008; Nielsen, 1999). The categories included *50% or less than final tempo, between 51 and 75%, between 76 and 100%, faster than 100%* and *irregular tempo*.

Figure 1 presents the results for the percentage of occurrences for the segments played at a slow tempo (slower than 50% of the final tempo; see Table S1 in the Supplemental Material Online Section for additional information on the average number of practice segments and Cohen's *d* coefficient for each practice session). Figure 1 demonstrates that the video feedback group (Exp. $n = 8$) played more frequently at a slow tempo for practices 3, 4 and 6 than the



	Practice 3	Practice 4	Practice 6	Practice 8	Practice 10
Exp. (n = 8)	60.07	44.81	35.96	17.74	1.92
Cont. (n = 8)	51.95	38.54	27.80	25.04	20.41

Figure 1. Between-group comparison for the category 'Less than 50% of the final tempo'. The bars represent the mean percentage of coding entries per practice session and the 95% confidence interval is displayed for each result.

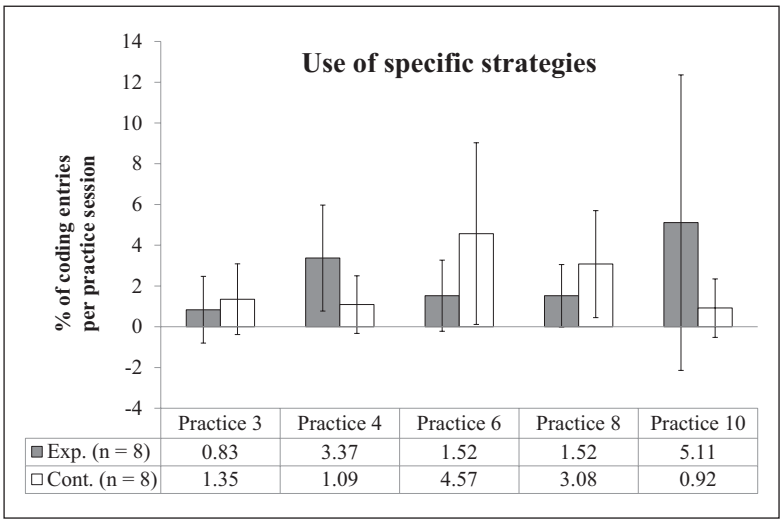


	Practice 3	Practice 4	Practice 6	Practice 8	Practice 10
Exp. (n = 8)	3.75	1.79	12.00	19.16	43.39
Cont. (n = 8)	7.93	18.24	27.50	23.07	38.37

Figure 2. Between-group comparison for the category 'Between 76 and 100% of the final tempo'. Again, the bars represent the mean percentage of coding entries per practice session and the 95% confidence interval is displayed for each result.

non-video feedback group (Cont. $n = 8$). However, they greatly reduced their use of this tempo over time, especially for practice 10. For this practice, the overlap rule of eye did not apply, but the Cohen's d for practice 10 was $d = 0.79$ which is conventionally considered a medium-large effect.

Figure 2 shows the percentage of segments played between 76 and 100% of the final tempo (see Table S2 in the Supplemental Material Online Section for additional information on the average number of practice segments and Cohen's d coefficient for each practice session). The



	Practice 3	Practice 4	Practice 6	Practice 8	Practice 10
Exp. (n = 8)	0.83	3.37	1.52	1.52	5.11
Cont. (n = 8)	1.35	1.09	4.57	3.08	0.92

Figure 3. Between-group comparison for the category 'Use of specific strategies' with mean percentage of coding entries and 95% confidence intervals displayed.

participants in the video feedback group played much less frequently at this tempo for practices 3, 4 and 6, and that they increased their use of this tempo in a more accentuated way for practices 8 and 10 than the non-video feedback group did (Figure 2). For this result, the overlap rule of eye did not apply in any practice session, but the Cohen's *d* for practice 4 was 0.85, which is conventionally considered a relatively large effect.

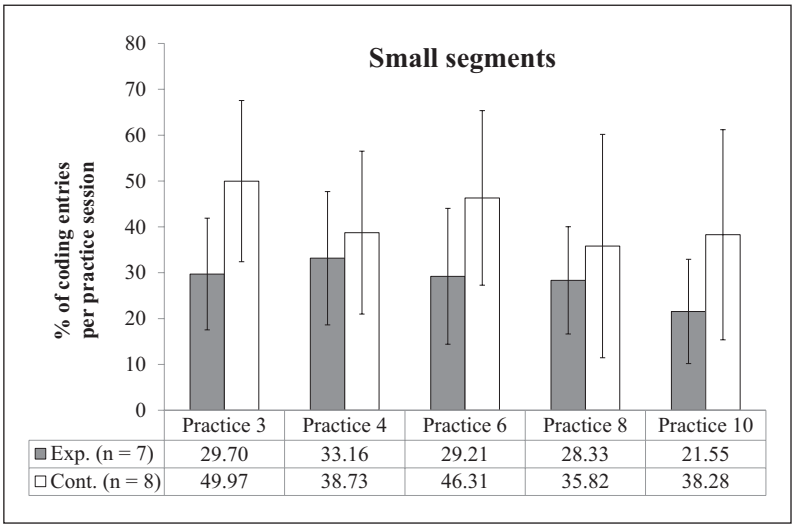
Use of specific strategies

The strategies coded in the category labelled *Use of specific strategies* included any strategy that involved a modification of the playing other than the tempo, the starting place or the length of the practice trial, or use/non-use of the metronome. The strategies that emerged from the observations included strategies like saying the fingerings or the notes or the rhythmic figures out loud while playing; or a modification of the music such as playing only the harmony, the melody or the bass; or other strategies such as gradually increasing tempo while playing and playing without the score or with eyes closed. For all participants, 2.34% of the practice trials included such strategies. Figure 3 shows the results for each group per practice session (see Table S3 in the Supplemental Material Online Section for additional information on this comparison).

One participant practised only the first section of the piece for all ten practice sessions, which was not the case for the rest of the participants. While the participants were free to practise as they wished to obtain data in a context as natural as possible, this situation created a problem with the categories concerning the section of the piece or the length of the segments that was played. Therefore, the following results for these practice elements are presented without the data from this participant in order to avoid affecting the group's mean.

Length of the segment played

The chosen piece for the experimentation comprised 78 bars. For each practice segment, the information regarding the amount of music played before stopping was coded in categories



	Practice 3	Practice 4	Practice 6	Practice 8	Practice 10
■ Exp. (n = 7)	29.70	33.16	29.21	28.33	21.55
□ Cont. (n = 8)	49.97	38.73	46.31	35.82	38.28

Figure 4. Between-group comparison for the category 'Small segments' with mean percentage of coding entries and 95% confidence intervals displayed.

regrouping numerous possibilities: *4 bars or less, from 4 bars and 1 beat to 16 bars*, and *more than 16 bars and 1 beat*. These categories will now on be referred to as small, medium and large segments.

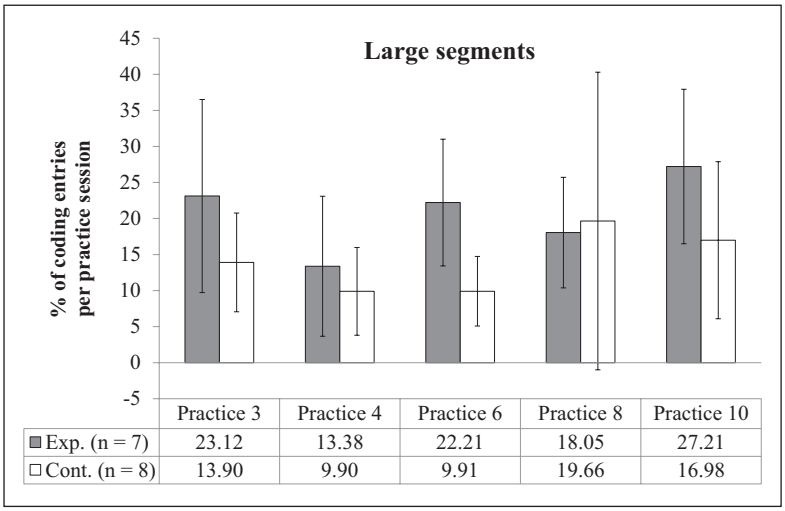
Figure 4 presents the results for the percentage of small segments played for each practice session. We observed that the largest between-group difference is for practice 3, that is, before the first time the experimental group used video feedback. Even though the overlap rule of eye did not apply for any practice session, the Cohen's *d* coefficient shows a medium effect with a $d = 0.72$ for practice 6 and $d = 0.66$ for practice 10 (see Table S4 in the Supplemental Material Online Section for additional information on this comparison).

Figure 5 shows the results for the percentage of occurrences for each practice session for the playing of large segments. We observed that the video feedback group played large segments of the piece more often during the practice sessions 3, 4, 6 and 10, in comparison with the non-video feedback group. There was a between-group difference for practices 3, 6 and 10 with a moderate overlap of the 95% confidence intervals (about one half the length of each error bar in a graphical display) in practice 6. The Cohen's *d* for this practice session 6 was $d = 1.22$ which is conventionally considered a large effect, and the *d* for practice 10 was 0.67, which is conventionally considered a medium effect (see Table S5 in the Supplemental Material Online Section for additional information on this comparison).

Among these large segments, we verified how many complete practice trials each group played in each practice session. Overall, the participants from the video feedback group made 12 complete trials of the piece during practices 8 and 10 while the participants in the non-video feedback group made only four during the same practice sessions.

Discussion

This study explored how the repeated use of video feedback while learning a new piece of music might influence college-level guitar students' choice of strategies during practice. The results must be interpreted in the light of the study limitations. For example, the sample size and the



	Practice 3	Practice 4	Practice 6	Practice 8	Practice 10
Exp. (n = 7)	23.12	13.38	22.21	18.05	27.21
Cont. (n = 8)	13.90	9.90	9.91	19.66	16.98

Figure 5. Between-group comparison for the category 'Large segments' with mean percentage of coding entries and 95% confidence intervals displayed.

fact that all participants studied in the same institution where they learn classical Western written music limited the generalisability of the findings. The experimentation took place in two different college semesters, and the randomised allocation of participants yielded a difference in the groups' overall performance levels, with the experimental group having a lower average grade for their most recent performance prior to the experiment, as compared with the control group. Consequently, a more equal distribution of the participants in each group could have changed the results presented here. Finally, we asked the participants in the control group to reflect on their playing after each performance, but we cannot be sure that the time they reflected was equal to the time spent by the experimental group for the video feedback treatment. Notwithstanding these limitations, we considered that the sample size allowed an in-depth analysis of the data while still allowing the identification of tendencies that could be addressed more specifically in future research.

In this study, we sought to examine if the repeated use of video feedback would influence the participants' choice of strategies during the practice session following each viewing of the recorded performance. To attain this objective, we compared the number of observations of specific practice strategies, but other studies could also explore how video feedback could influence the thinking process of the musicians who use it via think-aloud methods (Bangert et al., 2014; Leon-Guerrero, 2008; Nielsen, 1999, 2001, 2015). The participants who used video feedback played fewer practice segments at a tempo close to final (76–100%) for the practice sessions 3, 4 and 6, and, consequently, played at a slow tempo more frequently than the other group for these same practice sessions. We also found that the participants in the video feedback group increased their use of this tempo (76–100%) in a more accentuated way for practices 8 and 10, when compared with the non-video feedback group. Video feedback appears to have induced cautiousness in the playing of the participants who used it, in the first practice sessions. These participants increased their use of a fast tempo in the last practice sessions in a more accentuated way than the participants who did not use it. The more attentive playing observed in the first practice sessions could be related to the first and second stages of thought processes identified by Hebert et al. (1998), which were *getting used to seeing themselves* and

detecting errors. In other studies, performance achievement was associated with slow practice (Duke et al., 2009; Hallam, 2001a; Miksza, 2007). Playing at a slow tempo could also be considered an effective way of encouraging careful self-monitoring during practice (Zimmerman, 1998b), which is critical in all types of self-regulated learning to identify information required for the evaluation of a performance (Butler & Winne, 1995). This reduction of the use of a slow tempo and the increased use of a faster tempo during the learning process was also found among the two advanced organ students in Nielsen's study (1999).

The participants who used video feedback played small segments of the piece less often than the participants who did not use video feedback for all practice sessions, with a significant difference especially for practices 6 and 10. Moreover, the video feedback group made complete performances of the piece more often during practice, in comparison with the non-video feedback group. The results reported here could relate to other studies where performance achievement was associated with playing large sections of a piece (Williamon & Valentine, 2000) and progressively increasing the length of the practice segments (Williamon et al., 2002), but they appeared in contradiction with studies in which achievement was associated with repeating small sections of a piece (Miksza, 2011a; Nielsen, 1999). The participants' cautiousness regarding the choice of tempo that we addressed earlier did not seem to apply in the playing of small sections of the piece.

The between-group difference for practice 3, which happened before the introduction of video feedback, for all categories of length of segments raises the question of whether video feedback could influence how its users plan their learning of a piece by simply knowing that they will use it. Other studies could explore the potential effect of using video feedback on the way student musicians organise and monitor their practice on a more global basis.

In studies on the musicians' choice of practice strategies, performance achievement has been associated with use of the metronome (Miksza, 2011a), the use of structural bars (structurally significant points in the music) in starting and stopping practice segments (Williamon & Valentine, 2002), and attending to critical sections of the piece (Miksza, 2007). No between-group difference were found in the results of this study concerning these aspects of individual practice, although our results on the choice of tempo could eventually affect how a musician uses his or her metronome. As for the start and stop on structural bars, this could be related to musical matters that could be addressed later in the learning process of a piece.

It is possible that video feedback could have helped identify different aspects or sections of the pieces that requires work, as was suggested by McPherson and Zimmerman (2002), but later in the learning process, where different matters emerge after the basic music learning task is complete. For this reason, future studies could focus on the way musicians could benefit from video feedback during the final stage of preparing a performance.

All participants were similar with regards to the variety of practice strategies they used, irrespective of their use of video feedback. In addition to the evident necessity for research to help teachers develop effective methods to encourage their students to use a wide assortment of practice strategies (Miksza, Prichard, & Sorbo, 2012) and to practise efficiently, future studies could address how developing musicians would make use of new strategies, or enjoy music practice differently, after receiving information on ways to practise more creatively and effectively.

Conclusion

It appears that video feedback could bring musicians to practise at a slower tempo in the beginning of the learning process of a piece. Such a choice of strategy could help musicians pay more

attention to details and avoid learning movements that they would later have to unlearn. Video feedback would also help musicians play longer segments of a piece earlier in the learning process, but the absence of difference concerning the playing of small segments in the first practice sessions is surprising. It appears that participants who used video feedback were more attentive upon their playing in the first practice sessions. However, this cautiousness resulted in playing at a slower tempo and not in playing smaller segments of the piece.

An important implication for music education that emerges from these findings is the need to emphasise the teaching of effective and varied practice strategies to students, which involves more than simple modifications of the tempo or of the length of the passage played. It seems that video feedback alone did not induce such practice skills among our participants, notwithstanding the fact that the planning and the choice of effective practice strategies constitute a central aspect of effective self-regulated music learning.

In self-regulated learning, the choice of strategies is based to a significant extent on feedback obtained while performing. In our study, we demonstrated that video feedback affected how musicians chose their strategies in the practice session following the viewing of a recorded performance. Video feedback would thus prove effective in modifying how musicians reflect and make decisions in the practice room in between their lessons with their teachers.

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Supplementary material

Tables and figures/audio files with the index 'S' are available as Supplemental Online Material, which can be found attached to the online version of this article at http://msx.sagepub.com. Click on the hyperlink 'Supplemental Material' to view the additional files.

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