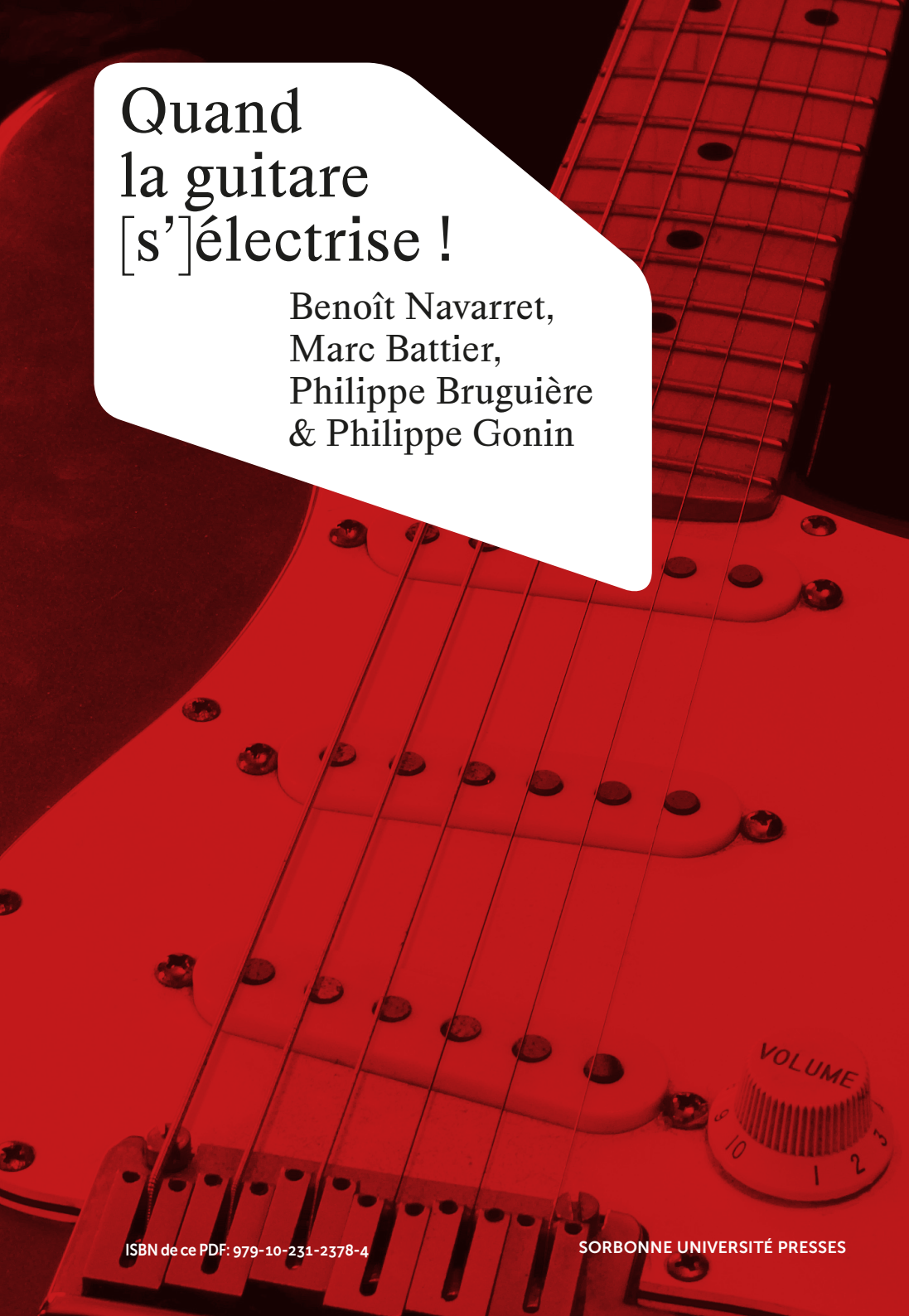
Quand la guitare [s']électrise !

Benoît Navarret,
Marc Battier,
Philippe Bruguière
& Philippe Gonin



ISBN de ce PDF: 979-10-231-2378-4

SORBONNE UNIVERSITÉ PRESSES

MusiqueS

La guitare électrique serait-elle l'instrument emblématique du XX^e siècle ? Son histoire a marqué plusieurs générations de musiciens et d'auditeurs : sa sonorité et sa puissance (qu'elle doit aussi à ses composants externes : pédales d'effets, amplificateurs et haut-parleurs), sa versatilité, son impact visuel et toutes les significations qui lui ont été associées en font un objet incontournable, une véritable icône planétaire.

Et pourtant l'étude scientifique de son histoire, de son répertoire ou de sa technologie n'a fait que commencer, tout en allant en s'amplifiant. Peu connue, la recherche menée autour de cet instrument mérite qu'on s'y attarde, tant les approches possibles sont riches et variées : car l'instrument ne peut s'étudier en-dehors de son contexte, ni sans raconter l'histoire de ces pionniers qui se mirent à bricoler des formes hybrides d'instruments, puisant dans l'organologie classique en la mêlant aux techniques de la radio, du microphone et de tout ce que « la fée électricité » a pu apporter en matière d'innovation sonore. L'on ne peut aussi ignorer la construction symbolique de ces figures mythiques, les *guitar heroes*, qui font rêver les foules et alimentent les fantasmes de nombreux amateurs. Sans oublier la multiplicité de ses usages, du club intimiste aux gigantesques stades ou festivals, de son expérimentation dans la musique contemporaine au refus délibéré de la virtuosité dans des genres plus nihilistes, et même dans certaines pratiques religieuses !

Image de couverture : Music wood photography – pxhere.com

QUAND LA GUITARE [S']ÉLECTRISE !

À la mémoire d'André Duchossoir (1949-2020)

MusiqueS

Série « MusiqueS & Sciences » – Instrumentarium

Issue des travaux interdisciplinaires soutenus par l'Institut Collegium Musicæ de l'Alliance Sorbonne Université depuis sa création en 2015, la série « MusiqueS & Sciences » est une collection dont le but est de susciter, développer et valoriser les recherches ayant pour sujet les musiques, passées et présentes, de toutes origines. Elle invite ainsi à mêler les disciplines des sciences humaines et des sciences exactes telles que l'acoustique, les technologies de la musique et du son, la musicologie, l'ethnomusicologie, la psychologie cognitive, l'informatique musicale, mais aussi les métiers de la conservation et de la lutherie.

*

Le Collegium Musicæ – institut de Sorbonne Université – regroupe des organismes de recherche et de formation spécialisés dans le domaine musical. Il favorise, depuis sa création en 2015, les travaux menés en interdisciplinarité entre sciences exactes, sciences humaines et pratiques musicales. La collection « Instrumentarium », consacrée aux instruments et familles d'instruments, est la première des séries de publications issues des travaux scientifiques du Collegium Musicæ. Suscitant le croisement des regards entre acousticiens, musicologues, musiciens et luthiers, ces travaux permettent la confrontation inédite de données et analyses acoustiques, organologiques et techniques, historiques et culturelles, ainsi que celles relevant de la création et de l'innovation.

Composantes du Collegium Musicæ : IReMus, Institut de recherche en musicologie (UMR : CNRS, Sorbonne Université, BnF, ministère de la Culture) ; équipe LAM, Lutheries, Acoustique, Musique (Institut Jean-le-Rond-d'Alembert, UMR : CNRS, Sorbonne Université, ministère de la Culture) ; STMS-Ircam, Sciences et technologies de la musique et du son (UMR : CNRS, Ircam, ministère de la Culture, Sorbonne Université) ; ECR, Équipe conservation recherche-musée de la Musique, Cité de la musique – Philharmonie de Paris (Centre de recherche sur la conservation, USR : CNRS, MNHN, ministère de la Culture) ; équipe SCC, systématique et catégorisation culturelles (ecoanthropologie et ethnobiologie, UMR : CNRS, MNHN, université Paris VII) ; BMBI, biomécanique et bioingénierie (UMR : CNRS – UTC) ; PSPBB, pôle supérieur Paris-Boulogne-Billancourt ; COSU, Chœur & Orchestre Sorbonne Université ; UFR Musique et musicologie (Sorbonne Université) ; UFR d'Ingénierie (Sorbonne Université).

Benoît Navarret, Marc Battier,
Philippe Bruguière & Philippe Gonin (dir.)

Quand la guitare [s']électrise !

SORBONNE UNIVERSITÉ PRESSES
Paris

Ouvrage publié avec le concours du Collegium Musicæ
et de la faculté des Lettres de Sorbonne Université.
Les SUP sont un service général de la faculté des Lettres de Sorbonne Université.

Image de couverture : Music wood photography — pxhere.com

Direction des publications du Collegium Musicæ : Achille Davy-Rigaux
Direction du Collegium Musicæ : Benoît Fabre
Mise en page : 3d2s/Emmanuel Marc Dubois (Paris/Issigeac)

SUP
Maison de la Recherche
Sorbonne Université
28, rue Serpente
75006 Paris
tél. : (33) (0)1 53 10 57 60

sup@sorbonne-universite.fr

https://sup.sorbonne-universite.fr

CHAPITRE 12

PERCEPTUAL AND VISUOMOTOR FEEDFORWARD PATTERNS AS AN ELEMENT OF JAZZ GUITAR IMPROVISATION PRACTICE AND PEDAGOGY

*

MODÈLES DE PRÉDICTION PERCEPTIFS ET VISUO-MOTEURS COMME UN ÉLÉMENT DE LA PRATIQUE DE L'IMPROVISATION ET DE LA PÉDAGOGIE DE LA GUITARE JAZZ

Amy Brandon
PhD student at Dalhousie University, Halifax, Nova Scotia

ABSTRACT

Although scant, there is some qualitative evidence to indicate that expert jazz guitarists use a perceptual or visuomotor feedforward process to "sketch ahead" and roughly plan their improvisations especially in complex or repetitive musical situations. A visual patterning approach to navigating the fretboard is also heavily present in jazz guitar pedagogy from its earliest days. However, despite this apparent congruence of visuomotor patterning between the practice of experts and the pedagogy of novices, many university-level guitar instructors find the current pedagogical landscape for guitar to be problematic, and note that jazz undergraduates frequently struggle with improvisation and basic technical skills. This problem could have numerous roots; including a typically late start to training. As well, perceptual and visuomotor feedforward patterns, while they may ease the cognitive and biomechanical complexity provided by the fretboard, also have the potential to limit creative problem-solving, as well as the limiting influence of external or diagrammatic representations and schema. Jazz guitar skill acquisition is a fluid and evolving process, and most students eventually sort out fretboard and creative complications, but it seems that perceptual or visuomotor feedforward patterning may have a dual effect of both easing and complicating guitar performance in an improvisatory context; allowing for fluid navigation of the "labyrinthine" layout of the fretboard but also potentially limiting creative exploration and constricting musical decision-making.

BIOGRAPHY

Holding degrees in jazz guitar performance and composition, Amy Brandon is currently completing an interdisciplinary PhD in music cognition at Dalhousie University in Halifax, Nova Scotia. She has performed internationally (Canada, USA, Brazil, Australia, New Zealand, UK) and at several experimental music festivals. In addition to performing and academic work, she has written contemporary choral, chamber, orchestral and acousmatic work premiered internationally including National Sawdust (NYC), Chorus Festival (London, UK), Cerisy castle

(France) and the MISE-EN Festival. In 2017 she received the Roberta Stephen Composition Award from the Association of Canadian Women Composers.

Contact : amygbrandon@gmail.com

RÉSUMÉ

Bien que peu nombreux, certains éléments d'ordre qualitatif semblent indiquer que les guitaristes de jazz experts utilisent un processus de prédiction perceptif ou visuo-moteur pour « esquisser » et préparer leurs improvisations, surtout dans des situations musicales complexes ou répétitives. Une approche reposant sur la visualisation de modèles pour l'apprentissage du manche de la guitare est également très présente depuis ses débuts dans la pédagogie de la guitare jazz. Cependant, malgré cette apparente convergence des modèles visuo-moteurs entre la pratique des experts et la pédagogie des novices, de nombreux professeurs de guitare de niveau universitaire considèrent l'actuel cadre pédagogique de la guitare comme problématique et notent que les étudiants de premier cycle ont souvent des difficultés à improviser et à acquérir les compétences techniques de base. Ce problème pourrait avoir de nombreuses origines, parmi lesquelles une entrée généralement tardive dans l'apprentissage. De plus, les modèles de prédiction perceptifs et visuo-moteurs, bien que pouvant réduire la complexité cognitive et biomécanique dans l'appréhension du manche, peuvent également réduire la créativité dans la résolution de problèmes, ainsi que l'influence des représentations externes ou diagrammatiques et de schémas. L'apprentissage de la guitare jazz est un processus fluide et évolutif, et la plupart des étudiants font finalement un tri parmi les difficultés dues au manche et à la créativité. Mais il semblerait que les modèles de rétroaction perceptifs et visuo-moteurs puissent à la fois faciliter et compliquer la performance guitaristique dans un contexte d'improvisation, en permettant une navigation fluide dans la couche « labyrinthique » du manche mais aussi en limitant potentiellement la créativité dans l'exploration créative et en contraignant les prises de décisions musicales.

BIOGRAPHIE

Diplômée en interprétation et composition en guitare jazz, Amy Brandon termine actuellement un doctorat interdisciplinaire en cognition à l'université Dalhousie de Halifax (Nouvelle-Écosse). Elle s'est produite sur des scènes internationales (Canada, États-Unis, Brésil, Australie, Nouvelle-Zélande, Royaume-Uni) et dans plusieurs festivals de musique expérimentale. En plus de ses concerts et travaux académiques, elle a composé des œuvres contemporaines pour chœur, musique de chambre, orchestre et des pièces acousmatiques, dont le National Sawdust (New York), le Chorus Festival (Londres, Royaume-Uni), le Cerisy castle (France) et le festival MISE-EN. En 2017, elle a reçu le prix de composition Roberta-Stephen de l'Association des compositrices canadiennes.

Contact : amygbrandon@gmail.com

The use of patterns in jazz or improvised music can be conceived as simultaneously musical or intervallic, as well as kinaesthetic or motor programming (Finkelman, 1997; Norgaard, 2014; Owens, 1974; Pressing, 1988; Weisberg *et al.*, 2004). According to Pressing's (1988) cognitive model of improvisation, with experience, practice and training, audiomotor programs or formulas gain fluidity and flexibility and can be manipulated in an improvisatory context. Audiomotor connectivity has been shown to be particularly strong in musicians (Palmer, 1997; Zatorre, Chen, & Penhune, 2007). For example, recruitment of motor areas is noted in trained musicians listening to musical pieces (Brown *et al.*, 2013 Haslinger *et al.*, 2005; Lahav *et al.*, 2007). The production effect (the influence of physical practice on memory recognition) is pronounced in the recall of melodies (Brown & Palmer, 2012). In particular, a study by Mathias *et al.*, (2016) found that adult pianists were better able recognize alterations in melody when it had been previously performed rather than simply heard. Some research also indicates that audiomotor connectivity is instrument-specific, as musicians are better at recognizing incongruent melodies when they are performed on their own instrument (Drost *et al.*, 2007; Proverbio & Orlandi, 2016).

In guitar improvisation, this type of audiomotor programming is alluded to in musicological research across multiple genres. In their work on folk blues guitarists, (Baily & Driver, 1992) indicated that the musicians improvised "... not solely as aural patterns, but as sequences of movement patterns which have visual, kinaesthetic, tactile as well as auditory repercussions..." (Baily & Driver, 1992; as qtd. in Scott, 2003: 70). Audiomotor patterning or "motor grammars" are also featured in research of other fretted stringed instruments such as the Afghani dutar and rebab (Baily, 1977). In jazz guitar, references to intervallic formulas and audiomotor patterns turn up in analyses of jazz guitarists as varied as Grant Green, Sonny Greenwich, Pat Metheny, and Charlie Christian:

> [Grant] Green is able to make considerable music using this formula and his repeated usage of it [in I'll Remember April] and elsewhere affords

him an effective strategy with which to navigate musically in any number of contexts[1]...

Additionally, [Sonny] Greenwich uses the phrase, with some melodic variation, to organize his improvisation. By articulation or alluding to the theme twenty-two times... Greenwich employs the formula as the initial "call" – to which a "response" occurs later[2]...

The analysis [of Pat Metheny's approach to soloing] has also demonstrated that faster passages can tend to be less purely improvised, the technique often relying more on variations of a set of muscle memories in rhythmically denser passages of music[3]...

[Charlie] Christian would vary from his own formulas and innovate upon previously assimilated material. An indicator that Christian was still developing his own sound is that most of these exceptions to the formulas are found in later recordings, particularly the ones taken at the jam sessions at Minton's[4].

In examining the improvisatory style of jazz guitarist Pat Metheny, (Dean, 2014) indicates that these audiomotor programs can result in distinctive musical signatures and fretboard usage patterns. In addition, he makes the point that in complex improvisational situations, motor programs may overtake auditory feedback in decision making. This idea can also be seen in a study by (Norgaard *et al.*, 2016) where jazz pianists relied on patterns more often in situations where cognitive load was increased. This reliance on motor programs is not unusual or unmusical but is rather an essential component of improvisation and consistent with Pressing's model (1988). As Metheny himself states: « I don't care if it's John Coltrane, or the Art Ensemble of Chicago, or the greatest or the worst improvisers that ever lived, if you play 200 nights in a row, you are not going to be playing different shit every night. You're just not ... » (as qtd. in Dean, 2014, p. 70).

1 Scott, 2009, 7.
2 Scott, 2003, 68.
3 Dean, 2014, 70.
4 Finkelman, 1997, 168 as paraphrased in Salmon, 2011, 54.

What makes jazz guitar improvisation potentially unique in the context of this audiomotor pattern model is the additional heavy presence of visuomotor feedforward in improvisational decision making, through the projection of perceptual patterns of notes onto the fretboard as phrases are planned. Figure 1 presents a generic example of this type of perceptual patterning. These familiar scale patterns can be seen in most guitar pedagogical materials, from online tutorials to method books such as jazz guitarist Pat Martino's *Linear Expressions* (Martino, 1980).

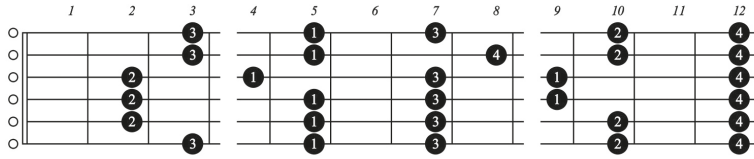


Figure 1.

Pressing's model of improvisation rarely addresses visualization or visuomotor patterns (1988). When instruments did have a visual feedback component (such as piano or guitar), Pressing saw this visual monitoring as more as a learning stage – where, with growing expertise, auditory feedback would eventually take precedence (1988).

> There must also be a developed priority given to auditory monitoring over kinesthetic and especially visual monitoring. This idea is supported by research on typists [West, 1967], which showed that the dominant visual control used for optimal results in early stages of learning to type gave way later to reliance on tactile and kinesthetic cues. It also seems likely that sensory discrimination and motor control functions make increasing use of higher-order space-time relationships (velocity, acceleration) as skill learning progresses [Marteniuk and Romanow, 1983][5].

Related research does support a lessening of reliance on visual feedback (or visual monitoring of hand position and error correction) with gained expertise. For example, (Reuter *et al.*, 2015) found that although visual attention reduces over time as a new visuomotor skill is acquired, it is still

5 Pressing, 1988, p. 9.

needed for the execution of complex movements. In executing complex motor tasks, (Säfström *et al.*, 2014) found that gaze behaviour frequently shifts to the next target well before the completion of the previous sequence. So there is a case to be made that expert guitarists may have a reduced need for visual feedback for hand positioning or error correction as outlined in the (Pressing, 1988) model. However, this idea is muddied by a heavy amount of qualitative evidence indicates that for expert jazz guitarists, visuomotor or perceptual feedforward (as distinguished from visual feedback for hand positioning or error correction) is also significant feature in improvisational decision making.

One of the clearest indications of a potential model of visual feedforward in jazz guitar improvisation is how often expert jazz guitarists speak of mentally projecting visual patterns onto the guitar fretboard while describing their skill to others. In Norgaard's "Descriptions Of Improvisational Thinking By Artist-Level Jazz Musicians" (2008), post-improvisation interviews were conducted with guitarist Mitch Watkins, who was the only jazz musician in the survey (n=7) to describe a visual process of improvisation. In referencing a previously recorded improvised phrase, he said: "... I try to look at it like say I have a bunch of lights on my fingerboard that light up for... all the eligible notes at a given point in time, and then it is up to me to sort of choose which ones" (Norgaard, 2008: 136). In his 1982 thesis, graduate student J.M. McLaughlin also quotes a variety of guitarists (drawn from magazine and personal interviews) illustrating how they perceived the fretboard in visual patterns, offering further evidence for his visual theory of guitar improvisation. Jazz guitarists quoted include: Tal Farlow, "boxes"; Joe Negri, "chord shapes"; Vic Juris, "graphs"; and Howard Roberts, "sonic shapes" (McLaughlin, 1982: 4). Jazz guitarist and educator Howard Roberts in particular focused several articles in Guitar Player magazine in the late 70s regarding his concept of "sonic shapes" fretboard patterns (McLaughlin, 1982). Another researcher noted the apparent patterning in the improvisations of jazz guitarist Barney Kessel, as influenced by Charlie Christian:

> Since Charlie Christian influenced Barney Kessel, it is easy to see how Barney visualizes his melodic ideas based on certain chord forms ... Barney

> outlines a Bm9 (B, D, F#, A, C#) arpeggio and then moves this same pattern down to third position so that it is now outlining a Gm9 arpeggio (G, Bb, D, F, A) (Marquez, 2000, p. 26.)

Quoted in a 2002 interview, Canadian jazz guitarist Sonny Greenwich also spoke in similar phrases, saying: "I see the fretboard in diagrams ...", in reference to the graphic artwork of Paul Klee (Scott, 2003, p. 65). More recently, guitarist Vernon Reid described seeing the fretboard as "a grid" in a 2012 interview with *Guitar Player* magazine (Demasi, 2012). Examined in context, these visual or perceptual feedforward patterns seem to be related to improvisational decision-making and the direction of future phrases. For example, jazz guitarist Rez Abbasi says, "... I use targeting in my phrasing; I try to look ahead of where my phrases are going to end. " (Solstad, 2015, p. 96). Jazz guitarist and researcher Stein Helge Solstad, writes of his own improvisations along similar lines, saying:

> ... reflecting on this process from an improvising perspective, I quite often imagine phrases ahead with a defined beginning (including exact visualization on the fretboard) but leave it to harmonic and rhythmic impulses from the other players to shape the actual form of the phrase. (Solstad, 2015, p. 96.)

In his thesis on schema and chunking theory in jazz guitar improvisation, Solstad brings these ideas of visuomotor and audiomotor patterning together, writing that generating a "chunk" (or individual visuomotor pattern) in a jazz guitar improvisation context is "...dependent on a coordinated auditive, visual and motor system" (Solstad, 2015, p. 133).

Is there any empirical evidence for this visuomotor process in guitar performance? Because piano and violin tend to be the default instruments in music cognition studies, guitar skill acquisition is less frequently addressed. However, a certain amount of supporting quantitative evidence is available. Generally, visual feedback is considered dominant in multimodal tasks (Hecht & Reiner, 2009). One study (n=30) found that expert guitarists are better at chord recognition via visuomotor transformations (for example, a picture of chord or chord diagram) than by hearing the chord (Crump, 2012). As well, some early brain imaging

studies indicate that the neural action-observation network (*i.e.* mirror neuron system) may influence the imitation learning of guitar chords (Buccino & Vogt, 2004). There also appear to be similarities between the perceptual patterns of chess, frequently studied in the field of cognition and expertise, and the visuomotor feedforward patterns perceived on the fretboard by jazz guitarists. Research has found that expert chess players have heightened memory for briefly presented visual chess positions (Simon & Chase, 1973), and that expertise is defined by some theories as heightened pattern-recognition and forward search abilities that are domain-specific (Gobet, 1997). Although cognitive load is significant in multimodal complex tasks such as guitar performance, musicians are generally seen as better at multi-sensory integration (Zimmerman & Lahav, 2012). Musicians also tend to be less susceptible to audiovisual illusions such as the McGurk effect and the double-flash illusion (Bidelman, 2016; Proverbio *et al.*, 2016) suggesting they have a smaller window of integration for visual stimuli and thus more able to integrate multimodal information related to this type of perceptual and visuomotor patterning.

From the evidence given, it seems possible that perceptual or visual feedforward patterns may be used by expert guitarists to "sketch" or "look ahead" to where their musical phrase may go might go and possibly provide guidance in stressful or fast improvisatory situations, as with (Norgaard *et al.*, 2016). However, in examining these qualitative descriptions of fretboard visualizations, it seems that while they are all diagrammatic in nature, they tend to differ in information content, related to the particular training of the guitarist in question. For example, when Sonny Greenwich describes seeing the fretboard in diagrams, he is referring to the graphic artwork of Paul Klee. As Scott notes, for Greenwich, melodic choice is as equally based in the visual shapes as harmony, noting that Greenwich's preferences for quartal harmony relates to the ease of acquiring these pitches on the fretboard (where strings are tuned in fourths) (Scott, 2003). Other guitarists connect these perceptual visuomotor patterns more concretely in standard harmonic or intervallic contexts, such as (Hale, 2012) who advises students to adopt a visual "shape-shifting" of intervals and single-note lines in accordance with the guitar's particular tuning profile. When Tal Farlow describes seeing the fretboard in "boxes" (McLaughlin, 1982,

p. 4), this may connect more concretely with more particular jazz guitar concepts and systems, such as the CAGED system, where scale patterns and chord shapes are intermingled. Jazz guitarist Mitch Watkins uses visualization to navigating even more complex harmonies (Norgaard, 2008). So looking at the evidence as a whole – from Baily's work with spatiomotor skills in blues guitarists and Afghani lute (Baily & Driver, 1992; Baily, 1977), to Solstad's (2015) theory of schema and chunking in jazz guitar, it seems visuomotor feedforward may be a result of the nature of multi-stringed fretted instruments, whose frets and strings form a grid, prime for the natural human tendency to create perceptual patterns (as with the chessboard and chess pieces), while pedagogical influences shape the information contained in those visualizations – either making them graphical or symbolic, or conversely layered with intervallic or harmonic meaning.

Looking at the issue from a practical perspective, what would be the value of this type of perceptual or visuomotor patterning in jazz guitar improvisation? As a musician's performance is mediated by the instrument they play, the features of the instrument can be seen as coming before any musical considerations (De Souza, 2013). One dimension to the difficulty of guitar performance is the physical reality of the fretboard, which has many duplicate pitches in addition to a wide range. As jazz guitarist Mick Goodrick wrote in his method The Advancing Guitarist (1987), "... the average note has 2.8 locations and 9.2 possible fingerings..." (Goodrick, 1987: 93). Classical guitarist Jeffrey McFadden calls the fretboard "asymmetrical, non-literal and somewhat labyrinthine" (McFadden, 2010: 52). Jazz guitarist Rocco Matone (2005) gives a detailed analysis as to why the fretboard is so difficult to master. In addition to range and diversity, the tuning system was initially designed to allow chords to be played with ease, which results in a non-symmetrical layout that is less intuitive for single note lines. The fretboard layout is not colour-coded and directional, as with the piano. Because of the grid layout, notes can ascend and descend in pitch counterintuitively to the direction of hand motion. So as the guitarist's hand moves "up" the fretboard, not only is their hand actually moving towards the floor, but the pitches can ascend or descend depending on string choice. In addition to this complex layout,

the finger mechanics of which of the four left-hand fingers plays which note in any given situation (often there are multiple options) is almost exclusively left to the performer, compounding the difficulty (Matone, 2005; Heijink, 2000 and 2002).

This complexity is significant as recent research seems to indicate that the congruence of a musical apparatus can impact the performance of melodic material. For example, (Stephan *et al.*, 2015) found that melodic performance improved when the apparatus for key-presses and auditory stimuli were sequential or congruent – *i.e.* when the left-hand keys were lower in pitch to the right-hand keys (in the manner of a piano). This result is relevant as the non-congruence of the guitar fretboard is frequently mentioned as a pedagogical problem in jazz guitar (Hale, 2012; Matone, 2005; Zawarski, 2016) and classical guitar literature (McFadden, 2010; Heijink, 2000 and 2002), indicating that perhaps it is the biomechanical and cognitive constraints of the guitar fretboard that most frequently presents difficulties to the student, not necessarily pedagogical approach, musical idiom or complexity. The guitar is simply not very ergonomic and presents physical and cognitive challenges which must be compensated for by the guitarist. Since improvised guitar performance requires instantaneous decision-making from both a musical (harmonic/melodic) and biomechanical perspective, visual feedforward could be a means of integrating and easing biomechanical and cognitive challenges of the fretboard layout within real-time performance.

Lending some credence to this idea is the fact that a visual patterning approach to fretboard complexity has been present from the earliest beginnings of jazz guitar literature. As jazz was developing in late 19th and early 20th Century, in American guitar communities, notation was considered superior to tablature and chord charts (Noonan, 2004: 150-156). In American guitar periodicals (*BMG Magazine*), scale patterns and tablature were frequently mocked as "the Simpleton Method" and considered a substandard learning method for the guitar (Noonan, 2004: 156). However, going against this trend was one of the very first published jazz guitar books, *Fingerboard Harmony*, ghost-written by banjoist Dave Berend in 1936 but attributed to guitarist Eddie Lang. In it, Berend includes a vigorous defense of the use of visuomotor chord charts, saying

that, *"since the notes on the staff do not follow the placing of the fingers on the guitar fingerboard as logically as for the right hand of the piano or harp (high note-high finger) the diagram idea is the best means of transferring the chords from the printed page to the instrument"* (Lang & Berend, 1936, p. 62).

Essentially, his argument was that jazz guitar skill in particular needed visualization because of the improvised nature. From his perspective, traditional notation did not always work well as a teaching tool for jazz guitar, as a guitarist needed instantaneous recall of the entire fretboard in order to improvise accompaniments. One way to do that, according to Berend, was to reduce the fretboard to easily recalled visual patterns that directly reference the hand positions and motor movements to be made. Continuing this tradition, many jazz guitar pedagogy books and techniques from the 20th century have used scale and chord patterns to instruct (*i.e.* Ted Greene's *Chord Chemistry*, the CAGED system, Howard Roberts "sonic shapes", among numerous others). They are also frequently seen (along with tablature) in popular guitar magazines and online tutorials. Although there are notable exceptions, (*i.e.* Joe Pass's *Chord Solos*, Barry Galbraith *The Fingerboard Workbook*, George Van Eps *Harmonic Mechanisms* as well as William Leavitt's *The Berklee Method*), jazz guitar is infrequently taught by notation alone.

However, here we encounter another interesting discrepancy. If jazz guitar improvisation can be conceived as using (in part) a perceptual or visuomotor patterning process, and most guitar pedagogy employs visuomotor transformations (scale patterns), why are these visuomotor patterns still widely perceived as ineffective at teaching improvisation by experts? Numerous researchers have noted how jazz guitar undergraduates struggle with improvisation, often editing or rewriting jazz guitar pedagogy they perceive as inadequate, with some particularly pointing out that visuomotor patterning leads to less creativity or other difficulties with improvisation (Elmer, 2009; Hale, 2012; Goodrick, 1987; Odegard, 2004; Matone, 2005; Berard, 1998; Balistreri, 1995; Tedesco, 1998, Zarakowski, 2016).

The phenomenon of jazz guitar undergraduates experiencing difficulties with improvisation and technical skills could have multiple roots. One

source may be the typically late start to jazz training for most guitarists, who often come to jazz from other genres such as rock. Degner & Lehmann (2003), found that both professional and student jazz guitarists (18) started their instrumental training later than classical musicians (at around age 13), and began jazz training even later (at around age 20) transitioning to jazz from playing folk, rock and other popular music. However, the role of method books and specifically scale patterns in early jazz guitar education has also been indicated as a potential source of this problem. Odegard (2004) specifically blamed poor teaching materials and a lack of university support for the struggles he saw new undergraduate guitar students dealing with. Elmer (2009) noted that most method books follow a strict "behaviourist" format, with an emphasis on rote learning, which he found to be unsuitable to the task of fostering creativity. In addition, he argued that any method relying on memorizing scale patterns instead of fully learning the notes of the fretboard is apt to be limiting to the creativity and facility of the student. Balistreri (1995) found that most methods do not give an overall comprehension of the instrument, and limit creative possibilities. Tedesco (1998) felt that jazz guitar method books too often focused on copying the styles of famous guitarists at the expense of a student's creative development. Matone (2005) found all methods lacked comprehensive fingering information. Berard (1998) noted that most method books at the university level were not comprehensive and quote "too specific to one topic, lacking in the presentation of prerequisite knowledge for the skills being taught" (Berard, 1998, p. 18).

One potential pitfall to learning scale patterns is the potentially limiting effect of the presence of familiar solutions, known in cognitive science as the Einstellung effect (Luchins, 1942). Primarily studied in the chess cognition field, the Einstellung effect describes how both experts and novices will choose the most familiar solution to a problem, rather than the most effective one in a given situation (Bilalić *et al.*, 2008). In the context of guitar scale patterns, this may also relate to the limiting aspect of visual or diagrammatic representations in problem solving. Cognitive scientist Jiajie Zhang writes that "... the form of [an external] representation determines what information can be perceived, what processes can be activated, and what structures can be discovered from the specific representation" (Zhang,

1997p. 179). In his thesis on schema in jazz guitar improvisation, Solstad echoes this by saying: "If the current schema acts as a filter for information, then only those aspects that we can comprehend or are able to act upon will be attended to. Simply stated, one cannot play the alternative if one has no idea of an alternative way of playing a specific phrase" (Solstad, 2015p. 97). So, while visual feedforward seems to be a significant element of improvised guitar performance, entrenched scale patterns may also limit creativity and exploration concurrently with easing the complexity of fretboard navigation in an improvised jazz guitar context.

The qualitative evidence presented here seems to indicate that expert jazz guitarists use a perceptual or visuomotor feedforward process to "sketch ahead and roughly plan their improvisations" (Norgaard, 2008). In addition, these visuomotor patterns can come to be relied upon in a complex or repetitive musical situation (Dean, 2014; Norgaard *et al.*, 2016). Visualization of the fretboard is also heavily present in jazz guitar pedagogy from its earliest days (Lang & Berend, 1936). However, despite this apparent congruence of visuomotor patterning between the practice of experts and the pedagogy of novices, many university-level guitar instructors find the current pedagogical landscape for guitar to be problematic and note that jazz undergraduates frequently struggle with improvisation and basic technical skills (Odegard, 2004). This problem could have numerous roots; including a typically late start to training (Degner & Lehmann, 2003). As well, perceptual and visuomotor feedforward patterns, while they may ease the cognitive and biomechanical complexity provided by the fretboard, also have the potential to limit creative problem-solving through the Einstellung effect (Bilalić *et al.*, 2008, Luchins, 1942), as well as the limiting influence of external or diagrammatic representations (Zhang, 1997) and schema (Solstad, 2015). Jazz guitar skill acquisition is a fluid and evolving process, and most students eventually sort out fretboard and creative complications, but it seems that perceptual or visuomotor feedforward patterning may have a dual effect of both easing and complicating guitar performance in an improvisatory context; allowing for fluid navigation of the "labyrinthine" layout of the fretboard but also potentially limiting creative exploration and constricting musical decision-making.

REFERENCES

Baily, J, "Movement Patterns in Playing the Herati Dutar", *The Anthropology of the Body*, vol. 15, 1977, p. 275-330.

Baily, J. & Driver, P., "Spatio-motor Thinking in Playing Folk Blues Guitar", *The World of Music*, vol. 34, n° 3, 1992, p. 57-71.

Balistreri, Don A., *Intuition and Fretboard Intimacy: Approaching Improvisation on the Guitar*, California, San Jose State University, 1995.

Berard, Michael, *Production and Evaluation of a Self-instructional Method for Teaching Jazz Guitar*, Montreal, Concordia University, 1998.

Bidelman, G. M., "Musicians Have Enhanced Audiovisual Multisensory Binding: Experience-Dependent Effects in the Double-Flash Illusion", *Experimental Brain Research*, vol. 234, n° 10, 2016, p. 3037-3047.

Bilalić, M., McLeod, P. & Gobet, F., "Why Good Thoughts Block Better Ones: The Mechanism Of The Pernicious Einstellung (Set) Effect", *Cognition*, vol. 108, n° 3, 2008, p. 652-661.

Brown, R. M. & Palmer, C., "Auditory–motor Learning Influences Auditory Memory for Music", *Memory & Cognition*, vol. 40, n° 4, 2012, p. 567-578.

—, "Auditory and Motor Imagery Modulate Learning in Music Performance", *Frontiers in Human Neuroscience*, vol. 7, 2013, p. 320.

Buccino, G., Vogt, S., Ritzl, A., Fink, G.R., Zilles, K., Freund, H.J. & Rizzolatti, G., "Neural circuits Underlying Imitation Learning of Hand Actions: an Event-Related fMRI Study", *Neuron*, vol. 42, n° 2, 2004, p. 323-334.

Chase, William G. & Herbert, Simon A., "Perception in Chess", *Cognitive Psychology*, vol. 4, n° 1, 1973, p. 55-81.

Crump, M.J., Logan, G.D. & Kimbrough, J., "Keeping an Eye on Guitar Skill: Visual Representations of Guitar Chords", *Music Perception: An Interdisciplinary Journal*, vol. 30, n° 1, 2012, p. 37-47.

De Souza, J.G., *Musical Instruments, Bodies, and Cognition*, Chicago, University of Chicago, 2013.

Dean, J., "Pat Metheny's Finger Routes: The Role of Muscle Memory in Guitar Improvisation", *Jazz Perspectives*, vol. 8, n° 1, 2014, p. 45-71.

Degner, S., Lehmann, A.C. & Gruber, H., "Expert Learning in the Domain of Jazz Guitar Music", *Proceedings of the 5th Triennial ESCOM Conference*, September 8-13, 2003, Hanover, p. 384-388.

Demasi, V., "Vernon Reid's Abstract Fretboard Logic", *Guitar Player*, vol. 46, n° 8, 2012, p. 102.

Drost, U.C., Rieger, M. and Prinz, W., "Instrument Specificity in Experienced Musicians", *The Quarterly Journal of Experimental Psychology*, vol. 60, n° 4, 2007, p. 527-533.

Elmer, Colin, "Replacing Patterns: Towards a Revision of Guitar Fretboard Pedagogy", master dissertation, Elder Conservatorium of Music, The University of Adelaide, 2009.

Finkelman, J., "Charlie Christian and the Role of Formulas in Jazz Improvisation", *Jazzforschung/Jazz Research*, vol. 29, 1997, p. 159-188.

Gobet, F., "A Pattern-Recognition Theory of Search in Expert Problem Solving", *Thinking & Reasoning*, vol. 3, n° 4, 1997, p. 291-313.

Goodrick, Mick, *The Advancing Guitarist*, Hal Leonard, 1987.

Greene, T., *Chord Chemistry*, Dale Zdenek Publications, 1971.

Hale, J. S., *Unlocking the Guitar Fretboard: an Intervallic Approach Towards Melodic Improvisation*, Miami, University of Miami, 2012.

Haslinger, B., Erhard, P., Altenmüller, E., Schroeder, U., Boecker, H. & Ceballos-Baumann, A.O., "Transmodal Sensorimotor Networks During Action Observation in Professional Pianists", *Journal of Cognitive Neuroscience*, vol. 17, n° 2, 2005, p. 282-293.

Hecht, D. & Reiner, M., "Sensory Dominance in Combinations of Audio, Visual and Haptic Stimuli", *Experimental Brain Research*, vol. 193, n° 2, 2009, p. 307-314.

Heijink, H. & Meulenbroek, R., "A Model-based Study of Left-Hand Fingering on the Classical Guitar", *Proceedings of the 3rd International Conference on Methods and Techniques in Behavioral Research*, Nijmegen, The Netherlands, 15-18 August, 2000.

Heijink, H. & Meulenbroek, R.G., "On the Complexity of Classical Guitar Playing: Functional Adaptations to Task Constraints", *Journal of Motor Behavior*, vol. 34, n° 4, 2002, p. 339-351.

Lang, E. & Berend, D., *Fingerboard Harmony*, Robbins Music Corporation, 1936.

Lahav, A., Saltzman, E. & Schlaug, G., "Action Representation of Sound: Audiomotor Recognition Network While Listening to Newly Acquired Actions", *Journal of Neuroscience*, vol. 27, n° 2, 2007, p. 308-314.

Leavitt, William, *A Modern Method for Guitar*, Berklee Press, 1999.

Luchins, Abraham S., "Mechanization in Problem Solving: The Effect of Einstellung", *Psychological Monographs*, vol. 54, n° 6, 1942.

Marteniuk, R. G. & Romanow, S. K., "Human Movement Organization and Learning as Revealed by Variability of Movement, use of Kinematic Information, and Fourier Analysis", *Advances in Psychology*, vol. 12, 1983, p. 167-197.

Martino, Pat, *Linear Expressions*, REH Books, 1989.

Marquez, Esteban, *Incorporating Barney Kessel's Methodology in Jazz Guitar Instruction*, El Paso, The University of Texas, 2000.

Mathias, B., Tillmann, B. & Palmer, C., "Sensory, Cognitive, and Sensorimotor Learning Effects in Recognition Memory for Music", *Journal of Cognitive Neuroscience*, vol. 28, 2016, p. 1111-1126.

Matone, R., *An Integral Concept for Jazz Guitar Improvisation*, New Brunswick, New Jersey, Rutgers University, 2005.

McFadden, J.J., *Fretboard Harmony for University Study: Method and Historical Context*, Toronto, University of Toronto, 2010.

McLaughlin, J.M., *A Visual Process for Deriving Single Note Patterns From Melody Chord Forms on the Guitar*, Pittsburgh, Pennsylvania, Dusquene University, 1982.

Noonan, J.J., *The Guitar in America as Reflected in Topical Periodicals, 1882-1933*, St. Louis, Washington University, 2004.

Norgaard, M., "Descriptions of Improvisational Thinking by Artist-Level Jazz Musicians", *Journal of Research in Music Education*, vol. 59, n° 2, 2008, p. 109-127.

—, "How Jazz Musicians Improvise", *Music Perception:*

an Interdisciplinary Journal, vol. 31 n° 3, 2014, p. 271-287.

—, Emerson, S.N., Dawn, K. & Fidlon, J.D., "Creating Under Pressure", *Music Perception: an Interdisciplinary Journal*, vol. 33, n° 5, 2016, p. 561-570.

Odegard, Harold James, The *Plight of Jazz Guitar Students and Proposed Solutions*, El Paso, The University of Texas, 2004.

Owens, T., *Charlie Parker: Techniques Of Improvisation*, Los Angeles, University of California, 1974.

Palmer, C. "Music Performance", *Annual Review of Psychology*, vol. 48, n° 1, 1997, p. 115-138.

Pass, J., *Joe Pass Chord Solos*, Alfred Music, 1972.

Pressing, J., "Improvisation: Methods and Models", in Sloboda, J.A. (ed.), Generative Processes in Music, Oxford, 1988, p. 129-178.

Proverbio, A. M. & Orlandi, A., "Instrument-specific Effects of Musical Expertise on Audiovisual Processing (Clarinet vs. Violin)", *Music Perception: an Interdisciplinary Journal*, vol. 33, n° 4, 2016, p. 446-456.

Proverbio, A.M., Massetti, G., Rizzi, E. & Zani, A., "Skilled Musicians are Not Subject to the McGurk Effect", *Scientific Reports*, vol. 6, 2016.

Reuter, E.M., Bednark, J. & Cunnington, R., "Reliance on Visual Attention During Visuomotor Adaptation: an SSVEP Study", *Experimental Brain Research*, vol. 233, n° 7, 2015, p. 2041-2051.

Säfström, D., Johansson, R.S. & Flanagan, J.R., "Gaze Behavior When Learning to Link Sequential Action Phases in a Manual Task", *Journal of Vision*, vol. 14, n° 4, 2014.

Salmon, S., *Imitation, Assimilation, and Innovation: Charlie Christian's Influence on Wes Montgomery's Improvisational Style in His Early Recordings (1957-1960)*, Indiana, Ball State University, 2011.

Scott, A., "I See the Fretboard in Diagrams: an Examination of the Improvisatory Style of Herbert Lawrence 'Sonny' Greenwich", *Intersections*, vol. 24, n° 1, 2003, p. 62.

—, "Exploring the Use of a Single Formula in Grant Green's First Chorus Improvisation on 'I'll Remember April' (1961)", *Current Research in Jazz*, vol. 1, 2009.

Solstad, S.H., *Strategies in Jazz Guitar Improvisation*, Oslo, Norwegian Academy of Music, 2015.

Stephan, M.A., Heckel, B., Song, S. and Cohen, L.G., "Crossmodal Encoding of Motor Sequence Memories", *Psychological Research*, vol. 79, n° 2, p. 318-326.

Tedesco, T.L., *A Jazz Guitar Manual for Intermediate Level*, California, California State University, 1998.

Van Eps, G., *Harmonic Mechanisms for Guitar*, Mel Bay Publications, 1980.

Weisberg, R.W., Brinkman, A.R., Folio, C.J., Dick, A.S., Fleck, J.I., Niederberger, B. & Bassett, F., "Toward a Cognitive Analysis of Creativity: Improvisation in Jazz", in Kessler, Annekatrin & Zimmer, Frank (eds.), *Proceedings of the Conference on Interdisciplinary Musicology*, Graz, Austria, Conference on Interdisciplinary Musicology, April 2004, p. 1-9.

West, L.J., "Vision and Kinesthesis in the Acquisition of Typewriting Skill", *Journal of Applied Psychology*, vol. 51, n° 2, 1967, p. 161.

Zatorre, R.J., Chen, J.L. & Penhune, V.B., « When the Brain Plays Music: Auditory–motor Interactions in music Perception and Production », *Nature Reviews Neuroscience*, vol. 8, n° 7, 2007, p. 547-558.

Zawarski, David, *If 6 was 1: pedagogical approaches to teaching single-string guitar playing*, Stockholm Royal College of Music, 2016.

Zhang, J., "The Nature of External Representations in Problem Solving", *Cognitive Science*, vol. 21 n° 2, 1997, p. 179-217.

Zimmerman, E. & Lahav, A., "The Multisensory Brain and its Ability to Learn Music", *Annals of the New York Academy of Sciences*, 2012.

KEYWORDS

Guitar, fretboard, visuomotor, patterning, feedforward, pedagogy, expertise, improvisation, jazz guitar

TABLE DES MATIÈRES