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**PROFESSIONAL HORN PRACTICE: A CASE STUDY EXAMINING THE  
PRACTICES, PROCEDURES, TECHNIQUES, AND HABITS OF EXPERT  
PROFESSIONAL SYMPHONY ORCHESTRA FRENCH HORN PLAYERS**

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A dissertation submitted to the

Mason Gross School of the Arts

Rutgers, The State University of New Jersey

In partial fulfillment of the requirements

For the degree of

Doctor of Musical Arts

Graduate Program in Music Education

Written under the direction of

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May, 2020

## ABSTRACT OF THE DISSERTATION

Professional Horn Practice: A Case Study Examining the Practices, Procedures, Techniques, and Habits of Expert Professional Symphony Orchestra French Horn Players

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Research in expert performance has investigated the acquisition of expertise in various domains, the characteristics, skills, and knowledge of experts that distinguish them from novices, and the highly replicable skills of exceptional performers. Current research continues these lines of inquiry in a wider variety of domains. Researchers are also investigating the generalizable traits of experts across domains to determine if there are common mechanisms that mediate the phenomenon of expertise, and they are exploring how experts organize and utilize their skills and knowledge. Research in musical expertise indicates that practice is essential in the achievement of expertise, but relatively few studies have investigated the practice procedures of expert musicians. Using semi-structured interviews, this descriptive case study examined the practices, procedures, techniques, and habits of eight expert professional French horn players from six major American symphony orchestras, three in the Northeast and three in the Midwest. Results indicate that the maintenance and advancement of expertise for these eight horn players is highly intentional, and is actively pursued each day. The findings also confirm the recommendations of leading horn pedagogues for the practicing of specific areas of horn technique.

To my mother:

Phyllis R. Martin (1929-2017)

*Steadfast example of patience, resilience, and perseverance.*

*Your enduring love made all the difference; you are greatly missed.*

And to my three sons:

Dan, Drew, and DJ

*Life's greatest blessings*

## ACKNOWLEDGEMENTS

There are many who have contributed to this research study in significant ways, and without whom its completion would not have been possible. Sincere thanks to my doctoral advisor, Dr. William Berz, whose patience, encouragement, wisdom, and humor gave me the confidence to pursue this work. Our many conversations, your thought-provoking questions, and your keen and critical insights have always helped clarify my thinking and writing. Heartfelt thanks and appreciation to Dr. Stephanie Cronenberg, who patiently guided me through the many nuances of qualitative research design, and whose calm manner and quick wit were often critical in maintaining perspective. Special thanks to Dr. Douglas Johnson, for your encouragement, support, and knowledge. Your wider perspective and thoughtful analysis helped ground my work and my thinking. Special thanks also to my expert reader, Professor Emeritus Randy Gardner. Your long and distinguished career, both as second horn of the Philadelphia Orchestra, and then as Professor of Horn at the University of Cincinnati College-Conservatory of Music, made you the perfect addition to my dissertation committee. I am honored that you so willingly partnered with me on this research study, particularly as you were just beginning your “retirement.” I am deeply grateful to you for sharing your wisdom and knowledge, and for your keen eye in reading the final drafts. Thanks also to Dr. Robert Grohman for serving on the committee, and for your care in attending to numerous related and important details. Finally, my sincere appreciation to the following scholars and former professors who have long-inspired my love of learning: Dr. Bennett Reimer (Northwestern), Dr. Steven Laitz (Eastman), and Dr. Bernard Dobroski (Northwestern). I am so fortunate to have had the opportunity to work with each of you.

Perhaps the greatest honor of conducting this study was the opportunity to spend time with eight preeminent orchestral horn players in the United States. A sincere thank you to these horn experts, each of whom enthusiastically embraced this study and generously and joyfully shared their time, thoughts, and perspectives:

Richard Deane, New York Philharmonic  
Thomas Jostlein, St. Louis Symphony Orchestra  
Richard King, Cleveland Orchestra  
Jeff Lang, Philadelphia Orchestra  
Jennifer Montone, Philadelphia Orchestra  
James Smelser, Chicago Symphony Orchestra  
Jason Snider, Boston Symphony Orchestra  
Leelanee Sterrett, New York Philharmonic

Special thanks and appreciation to Rutgers Professor Emeritus, Dr. Scott Whitener: teacher, mentor, colleague, friend. We have long-shared a deep interest in horn playing and brass pedagogy, which led to many enlightening conversations, and also to the design of this investigation. Your influence and encouragement have been significant; I am deeply grateful. Special thanks also to Jeff Nelsen, French hornist of Canadian Brass, and to Josef Burgstaller, former lead trumpeter of Canadian Brass. Our friendship and various collaborations over the years directly inspired this study, and helped me see, hear, and understand the impact of expert habits on both music students and on music educators.

My love for horn playing and horn pedagogy has been nurtured by the good fortune of studying with a number of renowned horn experts and inspirational teachers throughout my career: Jeff Nelsen, Verne Reynolds, Peter Kurau, Norman Schweikert, Dale Clevenger, Joe Anderer, Vincent Schneider, Herbert Pierson, Chris Wilhelm, Bruce Bradshaw, Joe Mundi, and Cleon Currie. It is said that we all stand on the shoulders of giants; I am deeply grateful to have had so many.

A heart-felt thank you to doctoral friends and colleagues who have in varying ways, shared this journey with me. To Dr. Anthony Branker: you have long-been an inspiration and a strong example of professional integrity, musical excellence, and passionate, student-centered teaching. Your influence across the decades has been significant, exceeded only by your friendship, which I treasure deeply. Thanks Tony, for keeping me “on the path,” and for the many laughs that we have shared through the years. Thanks also to Dr. Brian Hunter, Dr. Karen Pinoci, and Dr. Jennifer McDonel, for the various ways that each of you have assisted and encouraged me. The long, arduous journey was less so because of you.

To my father, Edwin Martin (1927-2018), himself a former horn player: you planted the seeds that took root and blossomed into a long and fruitful career. From boy choir to horn, from high school band to Rutgers, Northwestern, Eastman, and back to Rutgers again, you cheered every milestone; thank you.

Lastly, and perhaps most significantly, thank you to my remarkable sons, Dan, Drew, and DJ, for the joy, love, and laughter with which you have imbued our lives. Your endless optimism, energy, and encouragement are more valuable than you know; thank you for keeping me on target (...which ought to trigger a few jokes!).

Most especially, much thanks, admiration, and appreciation to my beloved wife Dori, who has walked every step of the doctoral journey with me. Without your constant love and support, this might not have been completed. You are indeed my good and perfect gift.

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## **Chapter 1 – Introduction**

Extraordinary human achievement has always been a source of fascination (Kaufman, 2013a). There is something inherently compelling about expert performance and what Gruber (1986) calls “an interest in...human beings...at their best” (p. 248). Interest in the superior knowledge of experts in their domains can be traced back to the writings of Socrates and Plato, both of whom noted that questions about specific matters were to be directed to those with substantial experience (Ericsson, 2018a). In the Middle Ages, the craftsmen of the time created guilds to protect themselves, to set standards of quality, and within which to train apprentices (Epstein, 1991). In the twelfth and thirteenth centuries, scholar’s guilds were established as guilds of masters and students (Krause, 1996). Similar to universities of the time, the goal of the scholar’s guilds was the organization and dissemination of the existing knowledge of a particular domain (Ericsson, 2018a). After the mid-19<sup>th</sup> century, more specialized schools were established to develop expert skills, such as the Royal Academy of Music (Rohr, 2001), and various academies established by countries to train Olympic athletes (Bloomfield, 2004). Over time, improving economic conditions, more and better schools, and the increasing accessibility of information have served to increase awareness of, and access to opportunities for the improvement of expertise in a variety of domains. Within the last two decades there has been a proliferation of research about experts and expertise (Ericsson, 2018a). Interest in this topic is further underscored by several popular books recently published, including those by Colvin (2010), Coyle (2009), Gladwell (2008), and Ericsson and Poole (2016).

Most of the popular understanding of expertise, unusual talent, and creativity is based on evidence that cannot be subjected to scientific analysis (Ericsson & Charness, 1994). Researchers studying human achievement tend to focus on abilities, competencies, or expertise, but relatively few, notably Howard Gardner, have looked for scientific connections (Sternberg & Grigorenko, 2003). Early empirical studies in expertise focused on knowledge-competence within a specific domain (Glaser & Chi, 1988), the most famous of which were investigations in chess playing by Simon and Chase (1973a), which compared master and novice players. However, the search for a generalizable theory of expertise, or mediating characteristics that are consistent across domains, is relatively recent. Ericsson (2018a) notes that all domains of expertise are “created by humans and thus the accumulated knowledge and skills are likely to reflect similarities in structure reflecting human biological and psychological as well as cultural factors” (p. 9). His premise is that since there are similarities in the theoretical principles that give rise to the phenomena, arriving at a general theory of expertise and expert performance is possible.

As Ericsson and his colleagues pursue a deeper understanding of the mechanisms that contribute to the development of expertise, other researchers have different approaches. These include searching for patterns of development in exceptional individuals (Simonton, 1996), the general characteristics of the childhoods and early lives of geniuses (Howe, 1996), and the role of differences in learning abilities that could influence the development of expertise (Posner, 1988). A major problem in the investigation of extraordinary achievements is their uniqueness (Ericsson, 1996). The focus of some researchers has therefore been on the highly replicable skills of exceptional performers (Ericsson, Krampe, & Tesch-Romer, 1993). Those researching from this



perspective assert that expertise in a given field is largely the result of domain-specific knowledge acquired through many hours of deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993; Syed, 2010; Colvin, 2010; Coyle, 2010).

Other researchers suggest more integrative approaches, including issues related to both nature and nurture (Simonton, 1976; 2000; 2013). A growing body of findings suggests that the origins of expertise and greatness are far more complex than previously believed (Marcus, 2012; Schenk, 2011; Kaufman, 2013a). Examples of this include the motivating elements of practice, such as passion and persistence (Duckworth, 2016; Cordova & Lepper, 1996; Duckworth et al., 2007; Ryan & Deci, 2000), which are likely influenced by genetic factors, and which also interact with environmental factors (Kaufman, 2013a). These factors include the influence of parents, community, and supporting resources such as private teachers and coaches (Harris, 1999; Pinker, 2003). Adding to the inherent complexity is the fact that very few people reach expertise in any given domain, no two paths are the same (Kaufman, 2013a), and not everyone who wants to be an expert becomes one (Sternberg, 1996). It seems that the nature of expertise, extraordinary achievement, and greatness is far more nuanced and intricate than previously thought, or than any single perspective can explain (Marcus, 2012; Shenk, 2011). More detailed discussion on the primary theories of expertise acquisition occurs in chapter two.

As the discipline of cognitive psychology has emerged, the research emphasis has been on the study of expertise acquisition as the basis of elite performance in several domains (Kaufman, 2013a). Simon and Chase (1973a) conducted a landmark study of chess players and concluded that a decade of intense work was required to become an expert. Ericsson and his colleagues extended this research to other domains, including

medicine, sports, acting, dance, and music (Ericsson et al., 2006). More detailed discussion of studies in these domains occurs in chapter two. Recent studies have examined additional domains such as expertise in transportation (Durso et al, 2018), professional design (Cross, 2018), teaching (Stigler & Miller, 2018), drawing (Kizbelt & Ostrofsky, 2018), and expertise in second language vocabulary (Macis et al., 2018). Broadly, these studies examine the characteristics of an expert, the acquisition of expertise, and in some cases, cognitive or brain changes with the acquisition of expertise. Other theoretical frameworks guiding the study of expertise acquisition have included differences in mental capacities (Galton, 1869/1979; Stoeger, 2007; Detterman, 2014), differences in how expert knowledge is organized (Chi, Feltovich & Glaser, 1981), differences in learning environments as expertise is developed (Zuckerman, 1977; Bloom, 1985; Simonton, 2018), and the reproducibility of superior performance by experts on representative tasks in controlled settings (Ericsson & Smith, 1991).

### **Definitions**

The term expert has been defined as “one who has acquired special skill in or knowledge of a particular subject” (*Webster’s New Collegiate Dictionary*, 1979, p. 400), or as one who “has gained special skills or knowledge representing mastery of a particular subject through experience and instruction” (Ericsson, 2014, p. 508). Expertise then, is “elite, peak or exceptionally high levels of performance on a particular task or within a given domain” (Bourne, Kole, & Healy, 2014, p. 246). Expertise refers to “the characteristics, skills and knowledge that distinguish experts from novices and less experienced people” (Ericsson, 2018a, pp. 3-4). Expertise can describe knowledge, ability, or skill in a variety of activities, tasks, jobs, or sports (Farrington-Darby & Wilson, 2006), or, can more broadly describe the inherent resources, the knowledge, and

the specific skills of a person who performs in a given domain at the very highest level, and achieved by few others (Bourne, Kule & Healy, 2014). Anderson (1980) stated, “One becomes an expert by making routine what to the novice requires creative problem-solving ability” (p. 292). The root of the term expert is the same as that for experience and experiment, all of which refer to the act of learning from experience and instruction (Ericsson, 2014).

### **Differing Perspectives on Expertise**

Other researchers have different conceptions and perspectives of the term expert and expertise. Guthrie (1952) defined expert skill as “the ability to bring about some end results with maximum certainty and minimum outlay of energy, or of time and energy” (p. 136). Hubert Dreyfus and Stuart Dreyfus (1986; 2004), and Fitts and Posner (1967) hold to the notion that experts proceed without awareness of their physical actions. Goldman (2001) espouses the classic idea that experts are those who have accumulated extensive knowledge about a particular domain and possess the know-how to deploy that information in meaningful ways. Hunt (2006) concurs, stating succinctly, “an ignorant expert would be an oxymoron” (p. 31).

Peer recognition is often used, not to define expertise, but to identify an expert within a specific domain (Montero, 2016). While this approach is common, Shanteau (1988) has noted a potential problem with this view, specifically that identification could be influenced by “outward signs of extreme confidence” rather than expertise itself (p. 211). Montero (2016) concurs, noting that it is reasonable to question the reliability of peer nominations. Regardless, sometimes expertise is determined by domain-related experience and reputation (Chi et al., 1988). Hoffman (1996) has noted that in certain domains there “are ‘gold standards,’ that is, documentation that exhausts the domain

knowledge, or senior experts who establish standards and procedures that are used by the other practitioners in the domain” (p. 82). In these cases, it is the senior expert that defines who or what an expert is. Prior to work of Chase and Simon (1973a), expertise was often defined by societal expectation and by length of professional service. This perspective has been rejected by Ericsson (2006b; 2008), who notes that there are “experts” with extensive experience and education whose decision making is no better than less skilled peers. Salthouse (1991) states that reliance on amount of experience, academic credentials, or professional classification (teacher, supervisor, trainee) as the sole basis of defining one as an expert should be avoided, particularly in expertise research. For example, in a study on expertise in dinosaur classification (Chi & Koeske, 1983), the experts were children who displayed a remarkable depth of understanding despite their young age, and despite not having attained professional certification or credentials.

Ericsson (2006a) defines expertise in terms of reproducibly superior performance. Experts in his view are consistently better than others in their domain. He also notes that experts are “able to perform at virtually any time with relatively limited preparation” (Ericsson, 2008, p. 989). Yarrow et al. (2009) note that an expert is one who “has had the motivation to practice one thing far more than most people could endure” (p. 588). Bereiter and Scardamalia (1993) describe expertise as a process rather than an endpoint. They suggest that expert performance is a result of a different mindset, and that experts push themselves to reinvest the cognitive space freed by pattern learning and deep memory. More recently, Montero (2016) defined experts as those “who have engaged in around ten or more years of deliberate practice, which means close to daily, extended practice with the specific aim of improving, and are still intent on improving” (p. 64).

### **General Characteristics of Experts**

While a specific definition of the term “expert” may have a degree of variability, the term can be illustrated by some of the defining characteristics of experts noted in research. Expertise research tends to be domain-specific but there are several characteristics that appear across domains. These characteristics are factors that distinguish experts from novices, particularly organization and retrieval of knowledge, reasoning strategies, and pattern recognition. Experts within their specific domains think differently and are more skilled and competent than novices (Anderson, 2000; Chi, et al., 1988). Experts have greater skill in anticipating, can encode new information more quickly, and have a more global and functional view of a situation (Cellier, et al., 1997). Glaser and Chi (1988) found that experts excel mainly in their own domain and are faster than novices in performing domain-specific tasks. Experts can see and represent a domain-specific problem at a deeper level than novices (Chi, Feltovich & Glaser, 1981). Shanteau (1992) noted that experts have extensive and up-to-date content knowledge, can simplify complex problems, and are better at identifying and adapting to exceptions and changing conditions than are novices. Jarvis (2006) found that experts have the humility to recognize their need to learn, while non-experts will act on the presumption that their current knowledge base is sufficient.

Experts are also more successful in choosing appropriate strategies to use in problem-solving situations and are more likely than novices to choose strategies that have been proven to be more effective (Chi, 2006; Lemaire & Siegler, 1995). This is consistent with Hallam (1997a) who stated that, “experts know how to do the right thing at the right time” (p. 91). Experts’ superficial understanding becomes a more principled and conceptual understanding through the accumulation of skill based on experience and

practice, and expert knowledge is different from novice knowledge in both organization and extent (Hoffman, 1996). Identifying different reasoning processes in experts is less clear. However, findings have shown that experts are very good at usual and familiar tasks (Hoffman, et al., 1995), although their performance can suffer rather severely if their task is disrupted (Chase & Simon, 1973b). Generally, expertise develops over a long period of time within a given domain (Chase, 1983; Glaser, 1987), and experts have greater conceptual perspective and recall than novices (Chase & Simon, 1973a; Murphy & Wright, 1984). Ericsson and Towne (2010) found that experts evaluate alternative courses of action, anticipate future actions, and can control related internal and external factors to generate superior performance. Experts also immediately recognize patterns rather than engaging in analytical thinking (Anderson, 1982; Fitts & Posner, 1967; Dreyfus et al., 1986). Within a given situation, experts extract more useful and reportable information (Abernathy et al., 2001; Ward et al., 2013).

Despite their abilities, research has shown that there are some tasks in which experts do not excel. Expertise tends to be limited to a specific domain. For example, a chess expert's recall of specific piece positions is far more accurate than random placements (Gobet & Simon, 1996a). Experts possess deep and broad understanding of situations and issues but tend to overlook more mundane details (Adelson, 1984). Experts can misjudge their abilities through over-confidence (Chi, 1978; Oskamp, 1965). There is also the danger of rigidity, or of becoming so entrenched in a particular skill or viewpoint it becomes difficult to see things differently (Adelson, 1984; Frensch & Sternberg, 1989; Hecht & Proffitt, 1995). Of particular concern to researchers of expert performance is the fact that experts often cannot articulate their knowledge or processes because so much of their knowledge is tacit (Chi, 2006). The paradox is that as experts gain greater expertise,

they lose awareness of what they do and how they do it. For example, Kidd and Welbank (1984) found that some developers of expert systems perform their tasks without knowing how or why. Hinds (1999) found that the greater the expertise, the lesser the ability to predict a novice's ability to perform a task. Additionally, Chi (2006) notes that bias is one of the most serious handicaps of experts. For example, cardiologists tend to produce more cardiology-type hypotheses and hematologists produce more hematology-based hypotheses when looking at the same cases (p. 27). Researchers who study experts also contend with the issue of the confirmation bias, or, looking for confirmation of what they already believe, even in the presence of inconclusive or even contradictory data (Lord, Ross, & Lepper, 1979; Wason, 1960; Sternberg, 1996).

Describing and defining an expert in terms of individual differences is a primary area of interest for researchers. Ericsson and Smith (1991) suggest that experts are characterized by those who stand out from the majority. The study of expertise then, is “seeking to understand and account for what distinguishes outstanding individuals in a domain from less outstanding individuals in that domain, as well as from people in general” (p. 2).

### **Need for This Study**

As noted above, much of the research in expertise has focused on the structure and acquisition of expertise in various domains, as well as comparisons between experts and non-experts in the performance of representative tasks within a specific domain. Current expertise research expands this line of inquiry to new domains, investigates the generalizable traits of experts across domains, and explores how experts organize and utilize their skills and knowledge. This study falls into the latter category and investigated expert French horn players in order to learn how they use their skills and knowledge in

the maintenance and advancement of their expertise. If we have a deeper knowledge and understanding of the practices and procedures that experts employ in the maintenance and advancement of their expertise, we might be able to design programs and environments that will better facilitate the training of student musicians and future experts.

The research literature in music expertise indicates that practice is essential to the acquisition of expertise in music performance (Hallam, 1997a, 1997b; Harnum, 2013). However, much less is known about the maintenance of expertise once that level has been achieved. We know that practice is essential, but as Smith (2005) notes, “questions about the role of what (task), how (strategy), and why (goal) remain to be investigated” (pp. 36-37). Hallam (1995) noted, “Although musicians spend a considerable amount of time practicing, historically there has been little research into the ways they go about it” (p. 3). Research involving the practice strategies of professional musicians has been undertaken with professional pianists (Wicinski, 1950; Gruson, 1981; Miklaszewski, 1989), which detailed strategies for learning new repertoire and memorization, and with professional musicians representing several orchestral instruments (Hallam, 1995). In her study, Hallam (1995) found a wide diversity in the amount and regularity of practice, and a range of specific strategies to deal with varying issues. Her findings also indicate the extensive metacognitive abilities of professional musicians, including awareness of strengths and weaknesses, a range of strategies to meet specific needs, and issues relating to concentration, planning, monitoring, and evaluation. Interestingly, Hallam (1995) included professional musicians who played a variety of orchestral instruments, but intentionally studied musicians who were not full-time symphony orchestra players because of “the limited time they have to practice” (p. 5).



In a later study, Hallam (1997b) synthesized research on instrumental music practice, investigating different paradigms, processes, and approaches to see if a systematic model might be adopted that might influence future research. She notes,

There has been a tendency to assume that practice is a uniform activity. In fact, the activities undertaken in practice depend on the specific purpose of any single practice session. Goals may include developing or maintaining an aspect of technique, learning new music, memorizing music or preparing for performance. The specific activities undertaken further depend on the nature of the music to be learned, its style, technical difficulty, length, complexity, historical period and the musical demands it makes; the level of expertise at which the individual is operating; and the nature of the performance for which the musician is preparing, solo, chamber music, orchestral, formal, or informal and how immediate it is. These factors will influence the nature of any particular practice session, the strategies adopted, the length of time spent, and the motivation of the musician. To date, these issues have been neglected by research. (p. 199)

Among her conclusions, Hallam (1997b) states that “research needs to be specific in its focus taking account of particular tasks, learning environments, learner characteristics and processes” (p. 217). Within her list of under-researched areas is the question of what constitutes effective practice at differing levels of expertise.

A recent study by Harnum (2013) examined the practice habits of professional musicians in four genres of music, which included two symphony orchestra brass players, a trumpet and a tuba player. Results indicate the critical importance of daily practice and a strong growth mindset directed toward mastery. Research investigating the habits and practices of full-time professional symphony orchestra musicians in the maintenance and improvement of their expertise is limited, and in the case of Hallam (1995), was intentionally avoided. Since Gladwell (2008) has asserted that obtaining an understanding of expert performance is of great importance and has practical implications, this study investigated the practices of expert full-time musicians in professional symphony orchestras, filling the gap left by Hallam (1995). This study also investigated what Hallam (1997b) identified as an under-researched area: what

constitutes effective practice at the highest levels of musical expertise. Finally, this study extends the work of Harnum (2013) to professional symphony orchestra French horn players. To date, there have been no studies undertaken to investigate the habits and practices of expert professional symphony orchestra French horn players; this study is intended to fill that gap.

### **The Purpose of the Study and Research Question**

The purpose of this study was to investigate the practices, procedures, techniques, and habits of expert professional symphony orchestra French horn players. The goal was to learn what the experts do, and then to consider how or if these findings might improve the horn pedagogy of instrumental music teachers, enhance the practice procedures of horn students and aspiring professionals, and enlarge the body of research in both music practice and in the study of expertise. This goal is consistent with Hallam (1997a) who states that researching the practice activities of expert musicians “might provide a useful framework for teaching students to practice more effectively” (p. 92). Since expertise is a continuum and not an endpoint (Sosniak, 2006), perhaps the findings of this study might also add to or improve the maintenance of expertise in other professional French horn players. The study of experts is important because, as Bereiter and Scardamalia (1986) note, “experts are not merely better at doing the same thing that others do; they do things differently” (p. 16). Sosniak (2006) adds that, “we should, then, teach people from the start how to work as experts do” (p. 297). Ochse (1990) makes a similar point, emphasizing that we should teach the perspectives, practices, and procedures of experts. Sloboda (1991) notes, “one of the principal reasons for studying expertise is practical. Given that it would be socially desirable for certain manifestations of expertise to be

more widespread than they are, we want to know what we can do to assist people to acquire them” (p. 156). Ericsson (2018a) concurs, noting that,

...if someone is interested in the upper limits of human performance, and the most effective training to achieve the highest attainable levels, they should study the training techniques and performance limits of experts who have spent their entire life striving to maximize their performance in a particular domain. (p.17)

Finally, Ericsson (2018b), in pondering the possibilities of future directions in expertise research, states that,

We may even be able to work in collaboration with world-class performers who are working on improving their performance to new and undiscovered heights. At the highest levels of expert performance, the drive for improvement will always involve search and experimentation at the threshold of understanding, even for masters dedicated to refining the meaning of excellence in their fields. (pp. 764–765)

The research question for this study is therefore: how do expert symphony orchestra French horn players maintain their expertise? Stated more specifically, what are the practices, procedures, techniques, and habits of expert symphony orchestra French horn players that enable them to maintain and advance their expertise?

### **Organization of the Dissertation**

The remainder of the study is organized into four chapters, a list of references, and appendices in the following manner. Chapter 2 presents a review of related literature in the study of expertise. This includes research on the primary theories of expertise acquisition, and a review of literature in the most commonly-studied domains of expertise, specifically, medicine, chess, and sports, and concluding with arts domains: dance and music. A brief review of research in acting, drawing, and writing is also included. Chapter 3 outlines the research design and methodology of the study, including the design of the interview questions and the selection of participants. This chapter also addresses data collection and analysis, limitations, and issues of trustworthiness,

reliability, and researcher bias. Chapter 4 presents the findings of the study and analysis of the data. Chapter 5 contains the summary of the study, discussion of the findings, conclusions, and recommendations for further study. A complete list of references and appendices completes the document.

## **Chapter 2 – Review of Literature**

Research in expertise is a broad and expanding field. This review surveys the primary theories of the acquisition of expertise, and then focuses on five specific domains in which there has been a considerable amount of research. The acquisition of expertise has been the dominant paradigm in expertise research for many years. Study in this area has largely been guided by three theoretical frameworks: Nature, Nurture, and the combination of Nature & Nurture and Environment. Each of these frameworks is briefly explored, followed by a survey of relevant literature. Research in expertise is also domain-specific. Five of the more commonly investigated domains are included: medicine, chess, sports, dance, and music, with a review of literature in each. The chapter concludes with a review of factors contributing to expertise in music, deliberate practice in music, music practice in general, and observations from expert French horn players from the later 20<sup>th</sup> century.

### **Primary Theories of the Acquisition of Expertise**

#### **Nature – Inheritance, Innate Ability**

The acquisition of expertise by inheritance or innate ability is a perspective that has been held for centuries. An important characteristic of the innate view is the notion that genius and talent are present in the absence of training and learning (Bate, 1989). In ancient times, expertise or greatness had spiritual connotations; those who were experts were considered divine (Kaufman, 2013a; Murray 1989), a belief also held by 16<sup>th</sup> century humanists (Ericsson & Charness, 1994; Ericsson, 2005). The concept of attributing exceptional ability to gifts and inheritance rather than to experience persisted well into the 18<sup>th</sup> century. Samuel Johnson (1791), author of the first English dictionary stated that, “the true Genius is a mind of large general powers, accidentally determined to

some particular direction” (p. 5). John Dryden (1693/1885) wrote, “genius must be born, and never can be taught” (p. 60). Kant (1790/1952) also believed that genius was inborn and could not be taught. Diderot and D’Alembert (1751-1780/1966-1967) assembled the first encyclopedia with the purpose of collecting available human knowledge. In this age of master and apprentice, the professional guilds tended to guard their knowledge and techniques, thus furthering the notion that exceptional ability was likely the result of inherited gift (Ericsson, 2006).

Advances in science, particularly in biology and genetics, prompted the search for more plausible reasons for expertise and giftedness. Francis Galton (1869) believed that individual differences were inherited and abilities followed a normal distribution. He studied the genealogical records of eminent scientists, poets, painters, and musicians. This was probably the first empirical investigation into the idea that excellence has a set of common causes across various fields. He noted that such people possessed an innate ability, a particular zeal and “an adequate power for doing a great deal of very laborious work” (p. 37). He concluded that such exceptional abilities arise from innate ability. Galton acknowledged that some instruction was necessary, but it was not sufficient to explain the presence of genius or expertise. Galton’s finding that creative genius tended to run in family lines was replicated by Bramwell (1948), while others (Candolle, 1873; Kroeber, 1944) claimed that environmental factors also have a role.

Research in the 20<sup>th</sup> century began to question the nature of differences between experts and novices (Ericsson, 2005). Investigators searching for differences in characteristics of processes, such as speed in calculation or reaction time and memory did not find an overall superiority (Djakow, Petrowski, & Rudik, 1927; Taylor, 1975). Results showed low correlations between performance and indices of ability (Guilford,

1967). Efforts to find specific cognitive processes to account for individual differences were inconclusive (Baron, 1978; Cooper & Regan, 1982; Hunt, 1980). Tests measuring general intelligence, such as IQ tests, while useful in some situations, are less so in others and have generated a fair amount of controversy (Resnick, 1976, Sternberg, 1982).

Reducing the search for individual differences to a single dimension, as is done in IQ tests, fails to account for important qualitative differences (Connell, Sheridan, & Gardner, 2003). In a study examining the personality profiles of eminent researchers in physics, biology, and psychology compared with similar profiles in the general population, Cattell (1963) found that the researchers exhibited a consistent profile (more self-sufficient, emotionally unstable, introverted, reflective). This is consistent with Galton's opinion that eminence is rooted in inherited ability and in aspects of personal motivation.

Despite hints of certain personality traits, research seeking links to specific inherited abilities as deciding factors in superior performance have largely been inconclusive (Ericsson & Smith, 1991). In a study from the field of behavior genetics, the theory of emergenic inheritance has been proposed (Lykken, 1982). This view states that there are specific essential component traits that must be inherited if a certain characteristic is to be inherited at all. In other words, since an individual must inherit just the right configuration of traits, it is extremely unlikely that a genius will have similarly gifted offspring (Simonton, 2003).

A more recent and prominent view of the biological theory of talent and expertise is from Howard Gardner (1973). Referring specifically to musical talent, Gardner notes that most outstanding musicians are discovered at a very early age (usually before 6), even in homes where little music is heard, and training seems to have little effect in reducing these differences (p. 188). Interestingly, this view is consistent with Suzuki

(1963/1981), who proposed that all children had certain degrees of musical talent.

Gardner's conclusion, however, was that an individual with strong intellectual ability "does not merely have an easy time learning new patterns; he learns them so readily that *it is virtually impossible to forget them*" (pp. 385-386, italics original). Gardner's more recent books (1993a, 1993b, 2011) indicate that his ideas regarding the influence of innate talent are unchanged. Describing expertise in creativity, Gardner (2011) states that creative breakthrough involves the linkage between "a thorough, precocious mastery of relevant domains of practice, and a form of understanding and a variety of intention that is rooted in an earlier point in their lives" (p. 371). While circumstance and supportive relationships are indispensable, the root of the creative expertise is innate. Gardner (2011) states, "I believe that creativity is an emergent of individuals 'at promise' when they live in a specified society, with certain values and opportunities" (p. xx).

**Prodigies.** The study of prodigies is often used to support the concept of innate talent. The subject has been of keen interest in music. Child prodigies are those who perform at an adult professional level by age 10 (Feldman, 1986), or by adolescence (McPherson, 2006). The premise of this view is that if participants are studied in identical environments, all differences between individuals must be the result of genetic origin (Thorndike, 1908). Studies of child prodigies provide evidence for the existence and importance of innate talent (Ruthsatz, J, Ruthsatz, K., & Stephens, K. R., 2014). Ellen Winner (1996) notes that exceptional achievers have high ability before they begin work, and ordinary children cannot be motivated or forced to work to the extent that a precocious child willingly does; talent therefore comes first. "Talent leads to hard work, which in turn leads to ever-increasing levels of achievement" (p. 297). Winner (2000) noted that exceptionally gifted children have extraordinary intrinsic motivation to ascend



to higher levels of expertise within their domains. Morelock (2013) states that the study of prodigies argues for a “primordial biological foundation for the emergence of extraordinary achievement and greatness” (p. 83). The talents of prodigies seem to appear very early in life, often without a family member who is able to provide instruction. It seems very likely that there is a genetic basis for prodigies (Ruthsatz, Ruthsatz, & Ruthsatz-Stephens, 2014).

The notion of prodigies as evidence of innate talent seems compelling, but not all researchers agree. Feldman (1980, 1986) found that prodigies attained skill levels in similar stages as others, but at much higher rates of speed, and this is what accounts for the differences. He also found that those with such specialized gifts still need an active and supportive environment, and it is rare that such skill and support coincide. Barlow (1952) and Feldman (1986) found that child prodigies rarely attain exceptional performance as adults. Bloom (1985) found that most exceptional adult musicians were not prodigies as children but have excelled due to early instruction and continued training. Ericsson and Charness (1994) have also concluded that the evidence from research on prodigies does not support the notion of innate talent, but it does indicate that exceptional ability is acquired in supportive and optimal environments. Howe, Davidson, and Sloboda (1998) found that differences in early experiences, preferences, opportunities, habits, and practice are the primary drivers of excellence. Ackerman (2014) notes that arguments for extreme views of either nature or nurture as a basis for expertise have been discredited. He states, “it has been shown repeatedly that providing equal practice to groups of individuals does not yield zero differences in performance” (p. 8).

**Savants.** The study of savants has also garnered interest and been used in support of innate talent. Savant syndrome has been described as “islands of genius and ability in persons with certain limitations or disability” (Treffert, 2013). Savants are those who, despite generally low levels of intellectual functioning, are able to perform at high levels on specific tasks. These tasks are often in art, music, calendar calculating, and lightning calculating, and are always accompanied by a deep but narrow memory (Treffert, 2013). A savant is a forceful argument for the presence of innate talent because these individuals, despite being severely limited, clearly know things they have never learned. As part of the explanation of savant ability Treffert (2013) has proposed the concept of genetic memory. Genetic memory is “inherited knowledge of the rules, regularities, and systems of their particular ability to accompany their inborn talent” (p. 116). In a controlled study of a musical savant, reproduction of short sequences or chords were only possible if the examples were in the familiar Western scale. Examples in unfamiliar contexts resulted in poor recall (Charness, Clifton & MacDonald, 1988). A similar result was found by Sloboda, Hermelin and O’Connor (1985) who studied the ability of a savant to memorize a new piece of music. Results indicate memorization was far more successful with a conventional piece (tonally) as compared with an unconventional work. It seems that musical savants, like their normal counterparts, need access to stored patterns and structures in order to retain and produce new musical patterns (Ericsson & Charness, 1994). Ericsson and Charness (1994) conclude that findings from research provide no evidence for innate talent or giftedness but do show that exceptional abilities are often acquired in optimal environments. While psychologists have noted that many specific traits may contribute to talent, no researcher claims that any is completely deterministic (Kaufmann, 2013a). There is agreement that no talent is fully formed at

birth, and much variation has been noted, such as late bloomers and prodigies who do not last (Kaufman, 2008; Protzko & Kaufman, 2010).

### **Nurture – Practice, Acquired Ability**

The notion of acquired expertise through practice was famously articulated by the founder of behaviorism, John Watson (1930), who stated, “practicing more intensively than others...is probably the most reasonable explanation we have today not only for success in any line, but even for genius” (p. 212). In a groundbreaking study investigating the thought processes of expert world-class chess players, De Groot (1946/1978) found that world-class players selected better moves than did lesser players. Skilled chess playing was attributed to prior knowledge and extensive chess experience. This study led to a general theory of expertise proposed by Simon and Chase (1973), which concluded that with extended experience, experts acquire increasingly larger patterns of chess piece positions, referred to as chunks, for future retrieval. This finding led to their theory that to win in international competition, at least a decade of intense work was required to become an expert in a given domain. This has become known as the “10-year rule” (Ericsson, 1996b; Hayes, 1989).

**Deliberate Practice.** Other studies have suggested that expert performance is the result of deliberate practice rather than innate ability or talent, and that such practice is the crucial factor leading to continued improvement and attainment of expert performance (Ericsson, Krampe, & Tesch-Romer, 1993). Deliberate practice is defined as “engagement in highly structured activities that are created specifically to improve performance in a domain through immediate feedback, that require high levels of concentration, and are not inherently enjoyable” (p. 368). Ericsson, Krampe, and Tesch-Romer (1993) further state, “the differences between expert performers and normal adults

reflect a life-long deliberate effort to improve performance in a specific domain” (p. 400). The concept of deliberate practice was further clarified three years later by Ericsson and Lehmann (1996) as “individualized training activities specifically designed by a coach or teacher to improve specific aspects of an individual’s performance through repetition and successive refinement” (pp. 278–279).

The purpose of deliberate practice is to develop effective mental representations, which in turn, create new possibilities for improved performance (Ericsson & Pool, 2016). In a study of expertise in instrumental music Lehmann (1997) found that increasing levels of deliberate practice accounted for expert performance, particularly if the practice is optimal and efficient. While allowing that heredity may contribute to an individual’s willingness to practice, the view that innate ability can account for why some people become experts and others do not is rejected. This view was reiterated by Ericsson, Nandagopal and Roring (2005): “individual differences in genetically determined capacities and fixed structures required for the development of elite performance appear to be quite limited, perhaps even restricted to a small number of physical characteristics” (p. 305). Ericsson and his colleagues contend that the traditional view of individuals having unique and special innate ability is not consistent with continuing reviewed evidence. A more accurate explanation is that expert performance reflects adaptations attained through long-term effort to specific demands in well-defined domains (Ericsson & Charness, 1994). Hallam and Bautista (2012) assert that as individuals engage in different learning experiences over long periods of time, permanent changes occur in the brain. Increasing expertise leads to greater speed in learning, problem solving, and greater capacity to draw on prior knowledge. Length of time in an

activity is therefore a better predictor of level of expertise attained (Hallam & Bautista, 2012).

In the framework of deliberate practice, performance improvement does not occur as a function of further experience but rather, by changes in the cognitive mechanisms mediating how the brain and nervous system control performance (Ericsson, 2006b).

What sets experts apart from non-experts is that the years of practice change the neural circuitry in the brain to produce highly specialized mental representations. This in turn, enables the pattern recognition, unusual memory, advanced problem solving and ability needed to excel (Ericsson & Pool, 2016). The key to attaining expert level performance is to “induce stable specific changes that allow the performance to be incrementally improved” (p. 698). Such an approach requires a systematic and deliberate method. In music and in sports, deliberate practice consists of pressing and extending current capacities, reinforcing strengths, and correcting weaknesses (Ericsson, 2006b).

Additionally, professional coaches and teachers play an essential role in guiding and sequencing practice activities (Ericsson, 2006b). Deliberate practice assumes that acquired skill can allow experts to circumvent basic innate limits, particularly in short-term memory and reaction speed (Ericsson & Charness, 1994). In the pursuit of expertise, learners need motivation, goals, feedback, and repetition (Ericsson, 2008). Perseverance, encouragement, and social support are also important components in sustaining practice in the pursuit of expertise (Lehmann & Gruber, 2006).

More recent work by Ericsson and his colleagues focuses the concept of deliberate practice to the expert-practice expert-performance approach. This view is centered on the study of the structure and development of reproducibly superior (expert) performance that captures the essence of expertise in a domain (Ericsson & Towne,

2010). In this approach, once expert performance on representative tasks is attained, specific physiological and cognitive mechanisms responsible for the expert performance are identified. For example, Ward, et al., (2004) found that it is possible to measure decision processes in various sports such as soccer or golf. Hill (1999) found that specific motor actions produce reliable outcomes, such as reproducing the same putt many times. This is one of the most reliable differences between expert and novice golfers.

The future direction of research in expert performance and deliberate practice, according to Ericsson, will involve the identification of causal biological mechanisms that influence the development of expert performance (Ericsson & Towne, 2010). The current excitement in deliberate practice research is based on observed changes in targeted performance (Ericsson, 2013). More precisely, the expert-performance concept is an empirical approach that first identifies reproducibly superior performance in the real world (the highest levels of observable performance in a domain), and then captures and reproduces this performance with standardized tasks in the laboratory (Ericsson, 2015). The concept of deliberate practice has also captured the imagination of the authors of several popular best-selling books, including Malcolm Gladwell *Outliers* (2008), Daniel Coyle *The Talent Code* (2009), Geoff Colvin *Talent is Overrated* (2010), and David Schenk *The Genius in All of Us* (2010) with the implication that, with enough hard work, almost anyone can become an expert.

**Criticisms of Deliberate Practice.** There are critics of deliberate practice. The 10-year rule, originally proposed by Simon and Chase (1973) and underscored by Ericsson, Krampe, and Tesch-Romer (1993) has come under specific scrutiny. In some domains within the arts and sciences, achieved expertise required much less than ten years' time (Simonton, 1991, 1992, 1997, 1999). In creative writing, for example, there

appears to be no early advantage to achieving greatness (Kaufman & Gentile, 2002), and in some instances, an additional 10 years of professional-level expert work is necessary for greatness (Kaufman & Kaufman, 2007). Sternberg (1996) cautions that the relationship between the accumulated amount of deliberate practice and acquired skill level may not be all that it seems. He suggests that more talented individuals see greater benefits from deliberate practice, while those attaining less benefit will be more easily discouraged and be likely to reduce their practice. The more talented persist in high levels of practice, which could create a false impression that amount of deliberate practice is the cause of elite performance. Sternberg (1996) also notes that most people who want to become experts do not and end up quitting. He also directly challenges the research methodologies of Ericsson and his colleagues, stating that they confuse correlation with causation, lack control groups, and ignore dropout rates and common sense.

Other researchers also have concerns. Schneider (1998) questioned the premise that progress is primarily a function of deliberate practice. Anderson (2000) challenged the work of Ericsson, Krampe, & Tesch-Romer (1993) stating that their findings do not “really establish the case that a great deal of practice is sufficient for great talent” (p. 324). Winner (2000) observed that Ericsson’s findings underscore the importance of hard work but fail to eliminate the role of innate talent. Campitelli and Gobert (2011) concluded that deliberate practice is necessary but not sufficient in explaining the acquisition of expert performance. These findings agree with Hambrick and Meinz (2011) and Hambrick et al., (2014), who reached similar conclusions.

Ackerman (2014) concluded that factors beyond deliberate practice play an important role in expert performance. Specifically testing for variance in chess and music performance on empirical grounds, Hambrick, et al. (2014) found that on average,

deliberate practice explained only 34% of the reliable variance in chess performance (p. 38), and about 30% of reliable variance in music performance (p. 40), leaving approximately 66% and 70% respectively, unexplained, and potentially explained by other factors. The authors conclude that “deliberate practice is not nearly as important for explaining individual differences in performance as Ericsson and colleagues have argued it is” (p. 36). Furthermore, correlations between deliberate practice and the acquisition of expertise cannot be safely viewed as practice causing expertise because people are not passive recipients of training (Plomin, Shakeshaft, McMillan, & Trzaskowski, 2014). There is also the issue of those innovative individuals whose training is marginal rather than essential to their field of major achievements (Simonton, 2003; Simonton, 1984; Hudson & Jacot, 1986; Kuhn, 1970). Other obvious exceptions are prodigies and savants who display extraordinary ability well before the requisite 10 years of deliberate practice (Feldman & Goldsmith, 1991; Feldman & Morelock, 2011; Treffert, 2011; Winner, 1997).

### **Nature & Nurture and Environment & Syzygies**

The study of expertise and its acquisition is beginning to adopt a wider perspective as more integrative viewpoints are embraced (Simonton, 1976, 2000, 2013). Extreme positions citing nature or nurture as the primary cause for expert performance began to be discredited in the mid-20<sup>th</sup> century (Anastasi, 1958; Anastasi & Foley, 1948). The achievements of those who have been regarded as “great” demonstrate a diversity of patterns and skills (Howe, 2004). Detterman and Ruthsatz (1999) proposed that becoming an expert is better understood through a combination of factors, including general intelligence, domain-specific skills, and deliberate practice. Plomin, et al. (2014) found that in a variety of domains, all performance is limited by context in some ways, such as



gender, age, and disability. Discovering a “genetic influence on expertise does not imply that practice is unnecessary or that environment is irrelevant...genetically sensitive research implicates nature as well as nurture” (p. 116). The intense practice most athletes endure is now being augmented by new findings from genetic research on sports (Epstein, 2013). Expert performance in sports is rooted in physical, psychological, motor, and perceptual cognitive abilities that lie in the upper limits of human capacity, but motivation, commitment, and optimal environments for training and development are crucial (Ford, Hodges, & Williams, 2013). Ackerman (2014) asserts that both nature and nurture are “necessary determinants of expert/elite performance, but neither alone represents a sufficient causal factor” (p. 6). He states that employing basic common sense, the following can be easily stipulated: (1) practice is an essential component of expert/elite performance; (2) not everyone gets to be an elite performer in every (or perhaps any) domain, and it is not just a lack of deliberate practice; (3) amount of practice does not explain a substantial amount of individual variance among expert/elite performers (p. 8-9).

Feist (2013) states that scientific talent is shaped by nature and nurture and underscores the role of specific forms of intelligence and the nurturance of family, teachers and culture. He states, “Nature vs. nurture is dead. Scientific talent is nature shaped by nurture” (p. 257). Brody (2013) examined research on precocity in mathematics and found evidence that talent “develops as a result of the *interaction* between innate abilities *and* appropriate learning experiences” (p. 287; italics original). In the domain of visual arts, Winner and Drake (2013) argue for the decisive role of talent in achieving expertise. They define talent as an innate ability to learn a particular domain. “Only when children have an intense interest are they willing to engage in extensive

deliberate practice. And an intense interest in a domain is almost always a sign of innate talent” (p. 333). Studies of chess masters have indicated that some players reach grandmaster level in vastly less time than others, indicating that other factors (a proclivity to learn, environmental support) enable some players to progress rapidly (Gobet & Campitelli, 2007; Howard, 2009). Recent empirical findings increasingly suggest that the origins of expertise and greatness are far more complex and nuanced than can be accounted for by any single approach (Marcus, 2012; Shenk, 2011; Kaufman, 2013a; Kaufman 2013b).

The complex integrative nature of the factors influencing expert performance continues to be studied. The genetic basis has been examined by exploring the effect of cognitive and dispositional traits (Bouchard et al., 1990; Loehin, McCrae, Costa, & John, 1998). Cognitive abilities and general intelligence are known to be highly heritable (Plomin, McClearn, & McGuffin, 2008), and appear to play a role in the acquisition of expert performance (Hambrick, et al., 2014). Working memory capacity, which is the ability to retain information in an active state, is also an important factor (Engle, 2002; Meinz & Hambrick, 2010). Cognitive abilities have also been shown to affect the variables of deliberate practice (Kuncel et al., 2004; Park, Lubinski, & Benbow, 2007).

Dispositional traits including personality, interests, values, and motivation, have a direct effect on deliberate practice (Harris, 2004; King, Walker, & Broyles, 1996; Duckworth et al., 2007). For example, what makes one want to practice? Researchers are acknowledging the influence of intrinsic motivation on learning and long-term goals (Cordova & Lepper, 1996; Ryan & Deci, 2000). Duckworth et al. (2007), examining perseverance and passion for long-term goals, found that in the achievement of difficult goals, talent must be accompanied by sustained focus on achievement over time.

Kaufman (2013a) states that motivation, perseverance, and persistence are likely influenced by genetic factors, but they also continually interact with environmental factors. This is in agreement with the findings of Simonton (1997), Walberg et al. (1980), and Schafer and Anastasi (1968), which indicate that various environmental factors affect personality, interests, values, and motivation. Personality factors may explain why certain individuals engage in more deliberate practice, but do not explain individual differences in performance (Hambrick, et al., 2014).

Motivation has been defined as the direction of effort, the intensity of effort, and the persistence of effort expended (Kanfer, 1990). Hayes (1962) asserted that differences in motivational traits are genetically determined. However, environmental factors for or against motivated behaviors also affect orientation toward or away from specific activities (Ackerman, 2014). Holland (1997) found that an individual's level of interest is dependent on their patterns of successes and failures in childhood, on the larger family environment, and the resulting interactions that influence the individual's self-concept and confidence. The development of interests, motivation, and abilities occurs through feedback from the individual's various successes and failures. Interest and motivation increase with success feedback and decrease with failure feedback (Ackerman, 2014). Expertise acquisition is also influenced by other extrinsic factors such as awards and peer recognition (Simonton, 1997; Feist, 1993). The development of expert performance is likely a complex function of cognitive, affective, and motivational traits that also influence the direction, duration, and effectiveness of practice.

The integrated perspective on the nature and acquisition of expertise is further underscored by Davidson and Faulkner (2013), who draw heavily on the concept of syzygies. Syzygy is a construct from the field of astronomy and refers to how conditions

align to produce a unity of purpose and direction. Components include individual characteristics, personality traits, domain-specific skills, general intelligence, and a variety of environmental factors, including social and cultural. The term *syzygy* accounts for these various permutations and examines how they might lead or contribute to achievement (Davidson & McPherson, 2017). Davidson and Faulkner argue that many of these components and factors “are interrelated and often have gravitational connection to one another that are not products of chance, rather [are] syzygistic outcomes of the systems and structures we inhabit in our social world” (p. 367). Some of the key components and their alignments that they discovered include “(a) the freedom to play within the domain to develop creative thought; (b) the challenge to develop skills to solve problems; and (c) the social contacts to inspire, model, support and celebrate the change to the musical self” (p. 367). While recognizing that high-level skill development is necessary, consistent with Ericsson, Krampe, & Tesch-Roemer (1993), there is a summative impact of domain-specific skill, practice, and general intelligence, consistent with Ruthsatz et al. (2008). These findings are consistent with Howe, et al. (1995) who revealed a series of factors favoring a supportive learning environment in music (parents singing, parental support for practice, optimal teachers, and quantities of practice).

Echoing the syzygistic concept, Burland and Davidson (2006) identified crucial elements that seem to lead to high levels of musical achievement. These elements include positive experiences with people and institutions, music as a major element of self-concept, support of parents, teachers and peers, optimal coaching opportunities, and ability to cope with related stressors. Far from originating from simply nature or nurture, the acquisition of expertise and greatness must take into account how traits, tendencies, and characteristics are aligned with abilities and capacities and various environmental

factors to form syzygies that generate particular trajectories (Davidson & Faulkner, 2013).

### **Domains of Expertise**

The origins of the present interdisciplinary research model of expertise are relatively recent and can be traced to a paper by Chase and Simon (1973) wherein they proposed a general theory for the structure and character of expertise across a range of domains. Prior to that, the study of extraordinary achievement had been confined to examination within specific disciplines, as evidenced by the work of Galton (1869) and De Groot (1946/1978). While the interdisciplinary model of research in expertise is prevalent, discipline-specific study holds considerable interest, particularly in the areas of the arts, sports, and sciences, which have long been a source of fascination (Ericsson, 1996). Since the accumulation of knowledge about the nature and acquisition of expertise has occurred nearly exclusively within specific domains (Ericsson, 2006), what follows is a brief review of the literature specific to some of those areas. The most commonly studied areas include: medicine, chess, sports, and in the arts, dance, and music.

#### **Medicine**

Medical expertise requires mastery of a wide diversity of skills and knowledge, including cognitive, motor, and interpersonal skill, and involves coordination of analytical and experiential knowledge (Norman et al., 2006). Medicine is unique not only in the broad and diverse knowledge base required, but also in the fact that with the development of new drugs, therapeutic recommendation is continually changing and “keeping up” is a major responsibility (Choudry et al., 2005). Training in medicine involves the acquisition of generic expertise in medical school, followed by a residency program in which a specific expertise (specialty) is acquired (Patel, Kaufman, & Magder,

1996). Much of the research investigating medical expertise has focused on comparing physicians and students in laboratory-based tasks representing actual medical practice (Patel, Kaufman, & Magder, 1996). Research has targeted the understanding of the structure and use of science in medical tasks (Kaufman, Patel, & Magder, 1996), and the process and accuracy of diagnostic reasoning (Patel, Arocha, & Kaufman, 1994). There is also increasing evidence that deliberate practice may help surgeons develop and maintain their expert skills through simulation training (Issenberg, McGahie, & Gordon, 2002; Wayne et al., 2008; Causer, Barach, & Williams, 2014; Ericsson, 2015).

A major topic in medical expertise is diagnostic accuracy. Given a particular patient's medical history and physical exam, the focus of inquiry is on how physicians choose among the various treatment alternatives (Norman et al, 2006). Diagnostic error, the second largest cause of adverse events overall, highlights both the importance of the diagnostic process in medical care, and the importance of developing diagnostic expertise in medical students (Groves, 2008). Early research assumed that experts employed general skills and approaches to diagnostic challenges (Barrows et al., 1982; Neufield et al., 1981). It was found that experts had higher accuracy in diagnosis, not because they employed a different process, but because they knew more and organized their knowledge differently (Feltovich et al., 1984; Neufield et al., 1981). Expert diagnosticians see symptoms and other relevant data as pieces of larger patterns rather than as isolated bits of information (Ericsson & Pool, 2016). The superior organization of information is a distinguishing characteristic of experts. This is consistent with the findings of Simon and Chase (1973) who observed similar traits in the study of chess masters. It appears that experts have superior memory, especially in their ability to chunk information, reflecting expertise in medicine similar to expertise in chess (Burns, 2004).

Another dimension of expertise in this area is the acquisition of the facts and rules regarding the connection of signs and symptoms to diseases (Feltovich & Barrows, 1984). Experts tend to classify prototypical diseases faster and more rapidly than novices. (Bordage & Zacks, 1984). In a study investigating how expertise influences the relations between perceptual and conceptual processing, findings indicate that expertise in medical image diagnosis involves not only the development of both perceptual and conceptual processing, but also the development of an ability to connect the two components (Morita et al., 2008). Nakashima et al. (2015), investigating the influence of domain-specific knowledge on experts' performance in their domain, found that radiologists have a specialized ability to detect only lesions that are relevant to their specific medical practice. Custers et al. (1992) found that expert physicians' diagnostic performance improves when contextual information about a patient is available, while the performance of novices is not influenced by this source of information. He concluded that with increasing expertise, knowledge structures qualitatively change toward more mature illness scripts. As expertise develops, the proportion of patient characteristics in the subjects' descriptions of diseases increases, while the proportion of biomedical knowledge grows as well. Similar to the findings of Chase and Simon (1973b), medical experts and novices are similar in the types and frequency of concepts employed in medical problem solving but differ in appropriate use of these concepts (Elstein, Shulman, & Sprafka, 1978). With medical experts, disease knowledge is richly detailed and precise, and their interpretation of symptoms is finely tuned (Johnson et al., 1981). Experts have a hierarchical system relative to diseases that is highly organized and extensively differentiated, and they can discern variants in pathophysiology, severity, and age influence (Reed, 1978; Wortman, 1978). Additionally, experts are able to persevere

toward a correct diagnosis in the presence of a combination of weak clues and in the absence of strong clues (Johnson et al., 1981). From the patient perspective, physicians who recommend an active treatment regimen are considered to have greater medical epistemic authority and expertise than those who prescribe a more passive approach (Stasiuk, Bar-Tal, & Maksymiuk, 2015).

Diagnostic reasoning (medical problem solving) is primarily concerned with classifying patient findings as belonging to a specific disease category, or more simply, a process of coordinating theory and evidence (Patel, Kaufman, & Magder, 1996). This is consistent with the findings of Clancey (1988) who described diagnostic reasoning as a process of heuristic classification of variables in a disease schema. Research in diagnostic reasoning has found that experts use “forward-directed” reasoning in solving routine problems (Patel & Groen, 1986, 1991). This is characterized by a chain of inferences linking data to hypothesis and leading to a diagnostic solution, and is a function of a highly structured knowledge base and pattern-recognition ability (Patel, Kaufman, & Magder, 1996). This type of reasoning is consistent with findings in the study of experts in mathematics (Hinsley, Hayes, & Simon, 1977) and physics (Larkin, McDermott, Simon, & Simon, 1980). Forward reasoning has been found to be strongly correlated with accuracy in experts (Patel, Kaufman, & Magder, 1996). Experts have also been found to select more relevant and critical clues from case history reports, and they demonstrate better organization of their domain knowledge (Causer, Barach, & Williams, 2014). By contrast, novices tend to employ backward reasoning in which a hypothesis is developed, and then tested against available data (Patel & Groen, 1991).

Medical research has shown that when experts are working outside of their domain of expertise their performance processes are less effective (Patel, Kaufman, &



Magder, 1996). In this situation, the physician will generate more hypotheses resulting in less coherent explanations than do experts in that specialty (Joseph & Patel, 1990). Both forward and backward reasoning strategies are used more frequently with a greater likelihood of an inaccurate diagnosis (Patel, et al., 1990). This is consistent with the findings of Glaser and Chi (1988) that experts excel mainly in their domain of expertise and their performance suffers if familiar tasks are disrupted. It is also consistent with Gobet and Simon (1996) who found that chess experts' recall of specific chess piece placement is far less accurate with random placements.

Medical expertise also includes technical skill and surgical expertise. In comparison to diagnostic research, there has been comparatively little study of expertise in surgery and related technical fields (Norman et al., 2006). Surgical experts have been defined as those who have consistently better outcomes, and those who consistently demonstrate superior performance in diagnostic and operating skills than non-experts (Schaverian, 2010). Expert surgeons use MRIs and CT scans to develop vivid mental representations of the entire surgical procedure before making the first incision (Ericsson & Pool, 2016). Experts in surgery display greater movement economy, consistency, and automaticity in performance as a result of domain-specific memory skills and long-term memory (Schmidt et al., 1990; Ericsson & Kintsch, 1995). Expert surgeons have also demonstrated skill in monitoring and evaluating their actions, and in detecting and correcting errors (Glaser, 1996; Ericsson & Lehman, 1996). Studies have reported a positive relationship between surgeon volume and patient outcome (Halm, Lee, & Chassin, 2002; Patel, Groen, & Aroclia, 1990). Volume alone, however, does not account for skill level among experienced practitioners because variation in performance has been discovered among surgeons with high volumes (Schaverian, 2010).

Highly experienced surgeons have been found to cognitively slow down and have a longer “quiet eye duration” than less experienced surgeons (Harvey et al., 2014). Expert surgeons have also been found to have higher eye fixation frequency and to dwell more on the operative site than junior surgeons (Tien et al., 2014). In a comparison of expert and novice surgeons, Uemura et al. (2013) found that the hands of experts are significantly more stable when performing laparoscopic procedures. Studies have also demonstrated that the performance of experts improves as a direct result of increases in knowledge through training and experience (Arocha, Patel, & Patel, 1993; Patel, Glaser, & Arocha, 2000). Furthermore, a surgeon’s expertise will vary with team members, stress and fatigue (Aggarwal et al., 2004). Despite the relatively limited body of research on surgical expertise, there is evidence that it is acquired and highly specific (Norman et al., 2006), and is domain, context, and time specific (Alderson, 2010). For example, an expert in open surgery may be a novice in endoscopic surgery.

The advent of medical simulators in surgical training programs has enabled surgeons and surgical teams to engage in deliberate practice (Causer, Barach & Williams, 2014; Alderson, 2010), and there is evidence that suggests that simulation has an important role in the acquisition of surgical skills (Gurusamy et al., 2008; Korndorfer, Dunne, & Sierra, 2005; Park, MacRae, & Musselman, 2007). In a review by McGaghie et al. (2006), it was demonstrated that deliberate practice with simulators was associated with improved performance. Medical simulators enable practitioners to engage in scenarios that involve processes, procedures, diagnosis, error detection, problem solving, and repetition of skills within an environment requiring full concentration (Barach, Satish, & Steuffert, 2001). A wide range of cognitive and technical skills can be practiced and learned in the pursuit of surgical expertise under controlled conditions representing

real patient care (Seymour et al., 2002; Gallagher et al., 2005; Ericsson et al., 2009). Simulators have been shown to be reliable (Schaverien, 2010), and the successful transfer of skills learned and practiced to actual surgical situations has been demonstrated (Aggarwal et al., 2007).

The attributes of expert surgeons suggest that deliberate practice may have a role in formal training and skill acquisition (Issenberg, McGahie, & Gordon, 2002; Wayne et al., 2008). Moulaert et al. (2004) found that deliberate practice had positive effects on academic performance. Wayne et al. (2008) found that deliberate practice improved the performance of surgical residents on clinical skills tests. McGahie et al. (2006) found a strong association between the hours of deliberate practice accumulated on medical simulators and learning outcomes. Finally, Wanzel et al. (2003) found that surgical expertise is directly related to repeated practice under carefully controlled conditions during residency, rather than to complex spatial abilities or manual skills.

Ericsson (2015) embraces the use of simulators in medical training as a way to provide deliberate practice in the acquisition and maintenance of medical expertise. Medical training has traditionally consisted of acquiring large amounts of theoretical knowledge followed by experience in real-life situations. The focus on knowledge acquisition and the near neglect of skill acquisition in medical training is the opposite of other skill domains such as music, chess and sports (Ericsson, 2015). Medical research indicates that the reduction of surgical errors is a function of the number of completed procedures (Moore & Bennett, 1995). Studies of surgical outcomes indicate that the length of time between surgeries of a particular type is significantly related to patient outcome: the larger the gap, the worse the patient outcomes (Hockenberry et al., 2008), and is consistent with related research in other skill areas (Moxley et al., 2014; Krampe &

Charness, 2006; Krampe & Ericsson, 1996). Typically, continuing medical education consists of attending lectures or viewing procedures on video, which has been shown to be relatively ineffective (Davis, 2009). The opportunity to pursue deliberate practice on simulators answers the concerns of these studies for both the maintenance and acquisition of medical expertise.

Ericsson's expert-performance approach identifies reproducibly superior performance in the real world, and then reproduces this performance with standardized tasks. Deliberate practice with simulators provides goal-directed training with immediate feedback. Ericsson (2015) concludes that the acquisition and maintenance of medical expertise would benefit if the ratio between practical or technical training and theoretical training were reversed, as it is in the domains of music, ballet, chess, and sports.

## **Chess**

The domain of chess has long been a model for research into expert psychological processes (Charness, 1992). Cleveland (1907) seems to be the first to recognize the concept of what now might be labeled as chunks, or complex patterns as a function of skilled play in chess experts. The modern age of research using chess play was initiated by De Groot (1946/1965), who studied small groups of expert and grandmaster players. The most notable finding in De Groot's work was the separation between thinking skills and memory skills. The most proficient players did not plan moves further ahead than less-skilled players, but rather, they possessed superior memory for chess positions after very brief exposure. Building on the findings of De Groot (1966) and Chase and Simon (1973a; 1973b) discovered that the perceptual memory recall of skilled players was obtained only when they observed structured chess piece positions. When viewing randomly placed positions, there was little advantage. This finding has been the catalyst

for the expert-performance approach championed by Ericsson and his colleagues, as it suggests that skill differences are based on acquired skills rather than innate abilities. These findings are also the foundation of Chase and Simon's (1973b) theory of chunking in skilled chess performance.

More recent study of expertise in chess has continued along similar lines. Gobet and Simon (1998), and Gobet and Clarkson (2004) replicated the work of Chase and Simon (1973b) and proposed that chess skill is not the result of differences in short term memory or encoding speed, but in the ability to apply structure to information, which is normally done in long term memory. Studies by Freyhoff, et al. (1992) and Gobet (1998) demonstrated that grandmasters use larger structures than the previously identified chunks. This led Gobet and Simon (1996a, 2000) to revise the chunking theory to a template theory. Connors, et al. (2011) replicated de Groot's study in order to empirically test his claims and to see if there have been changes over time. Results indicate that grandmasters search faster than less skilled players, and faster than players in earlier studies. The findings support de Groot's conclusions and are consistent with pattern recognition models. De Groot and Gobet (1996) revisited the work of Jongman (1968), who examined the eye movements of expert and less expert players. Findings indicate that expert players fixated more on the edges of squares than did weaker players and were more likely to have greater distances between fixations. Reingold, et al. (2001) found that more skilled players needed a larger area around fixation to detect changes in successive chess positions, suggesting that better players had a larger visual field to perceive positioning and movement. Charness, et al. (2001) found that expert chess players had fixations widely spaced across the board that were more likely to be between pieces rather than on them, thus underscoring the importance of pattern recognition. The

characteristics of chess experts include reliance on a broad network of chess patterns stored in long term memory to enable a wider visual span for perceiving placement and possibilities. Experts perceive and decipher chess piece information more quickly and more accurately than non-experts (Gobet & Charness, 2006).

As in other domains, the role of talent and practice and how they might interact in the acquisition and maintenance of expertise in chess is still largely inconclusive (Gobet & Charness, 2006). Some studies suggest a link between IQ level and chess skill level (Grabner, Stern, & Neubauer, 2007; Horgan & Morgan, 1990). Howard (2009) found indirect signs of greater innate talent in top players, suggesting that top performers are identifiable from the start. Variables contributing to chess ratings are individually the subjects of serious study, particularly serious study alone (deliberate practice) and current age (Gobet & Charness, 2006).

Similar to other domains, expertise in chess requires a considerable investment of time and energy (Gobet & Charness, 2006). Based on computer simulations of pattern recognition in chess, Simon and Chase (1973a) proposed a 10-year rule for the development of chess expertise. It has also been determined that chess players at the highest level of play (grandmasters) have invested 5,000 hours of serious practice alone during their first decade of serious play, strongly suggesting that deliberate practice plays a critical role in the acquisition of chess expertise (Charness et al., 2005). These findings are consistent with Ericsson and his colleagues (Ericsson, Krampe, & Tesch-Romer, 1993; Ericsson & Charness, 1994) who argue that deliberate practice (defined as appropriately challenging tasks chosen with the goal of skill improvement) is the key activity in the acquisition of expertise. Research into the development and maintenance of expertise in chess has focused on types and levels of practice, similar to how expertise

in music is acquired and maintained (Charness, Krampe, & Mayr, 1996; Sloboda et al., 1996). In fact, chess has been a key testing area for the practice-alone theory because it has objective performance measures and much longitudinal data (Ross, 2006; Ericsson & Harris, 1990). Evidence that chess skill is dependent on practice alone comes from using a correlational retrospective recall paradigm (Ericsson, 2006b). Employing this paradigm, studies ask participants from varying skill levels to estimate their hours of practice. The possible effects of external variables, such as starting age and the extent of various types of practice, are taken into account (Howard, 2013). Typically, the stronger players report more practice hours (Charness et al, 2005). Similar to the findings of studies of young musicians (Sloboda et al., 1996), those who practice more intensively appear to gain more skill over time. The cumulative hours of serious study alone have been shown to be the best predictor of a chess player's rating (Charness et al., 2005). While tournament play and coaching provide positive learning opportunities, the concentrated analysis and memorization of chess tactics and positions is essential in order to achieve success in highly competitive tournaments (Charness et al., 2005).

With the importance of deliberate practice in chess, one would expect that impressive training methods have been developed, but information about this in the literature is sparse (Gobet & Charness, 2006). It has been determined that few players reach the level of master with less than 1000 hours of serious study, which is defined as deliberate practice (Charness, Krampe, & Mayr, 1996). Practice in chess includes receiving coaching, reading chess books, studying opening variations and endgame positions, playing over past games, using computer databases, playing computers, and playing actual games (Howard, 2013; Gobet & Charness, 2006). The necessity of having a coach has been debated. Charness, Krampe, and Mayr, (1996) found little correlation

between chess skill and coaching, while Charness, et al. (2005) did find correlation. The use of computer databases and practice in playing against computers may provide for more efficient practice than that based on books (Gobet, Campitelli, & Waters, 2002).

Despite the research on chess expertise, questions remain. Howard (2013) found that the total number of study hours (preparatory activities that are not actual playing) in chess is not a strong predictor of peak player ratings, but actually playing internationally rated games is a strong predictor; the more the better. This finding is notably different from the findings of Gobet and Charness (2006) who determined that in-depth analysis of the games played by masters is the single most important predictor of a chess player's ability.

## **Sports**

Among all domains, recognizing expertise in sports is perhaps the most obvious. Exceptional achievement in this domain is clear and its measurement is widely agreed upon: the most points scored, the fastest time achieved, or the greatest weight lifted. Success in sports is based on the athlete's ability to develop and perfect a specific set of perceptual, cognitive, and motor skills (Hodges & Williams, 2012). Much of the research on the topic of expertise in sport has been approached from a cognitive perspective and has demonstrated that expertise is a complex interaction of perception, decision-making, and movement (Hodges, Starkes, & MacMahon, 2006). This is consistent with Chase and Simon (1973a) regarding the differences between expert and novice chess players, and has been further demonstrated by Starkes, Clullen and MacMahon (2004) in a study on skill acquisition in perceptual-motor performance.

Fleishman (1972) demonstrated that the underlying processes for sport performance likely change with practice. Fleishman and Rich (1963) and Parker and



Fleishman (1961) suggested that perceptual and motor capacities may interact with deliberate practice to determine a specific level of performance. Research on expert performance in sport in the 1970s and 1980s resided primarily within the paradigms of experimental and cognitive psychology (Hodges, Starkes, & MacMahon, 2006). This research focused on testing skilled and novice athletes in sport-specific tasks measuring recall and recognition, anticipation, and temporal and spatial occlusion (Abernathy, Thomas, & Thomas, 1993). Verbal analysis of expert athletes was also studied (Chiesi, Spilich, & Voss, 1979; McPherson, 1993). By the early 1990s analyses of eye movements (Goulet, Bard, & Fleury, 1989; Vickers, 1992) enabled the study of the differences in eye movement between expert and novice athletes. By the later 1990s, in addition to perceptual-cognitive research with the purpose of distinguishing differences between experts and novices within a particular sport, researchers designed tasks that use measurable and reproducible aspects of expert performance to determine underlying mechanisms responsible, and which yield consistent expert performance (Hodges, Starkes, & MacMahon, 2006).

One of the defining attributes of expertise in sport is the ability to quickly process domain-specific information. Research has therefore been directed to cognitive-based theories on information processing (Fitts & Posner, 1967; Schneider & Shiffrin, 1977). Furley and Wood (2015) found a positive relationship between working memory and control of attention in sport, suggesting that working memory capacity may contribute to sport expertise. Experiments designed to study the mechanisms responsible for expert performance in sport include those in the area of anticipation and decision-making. Abernethy (1991) describes a time paradox in which athletes under extreme time limits seem to have limitless time. These athletes quickly recognize familiar scenarios and

construct them into meaningful wholes, which greatly speeds their decisions and response time (Ward & Williams, 2003). Studies in tennis (Goulet, Bard, & Fleury, 1989), baseball (Paull & Glencross, 1997), and soccer (Savelsburgh, et al., 2002) found similar results.

Studies in occlusion further underscore the advantage of experts over novices in sports performance. When a typical game clip is edited just prior to ball contact (with foot or racquet) experts successfully predict shot direction as compared with non-experts (Goulet, Bard, & Fleury, 1989; Savelsburgh et al., 2002). These studies suggest the types of information used by skilled players to make decisions. Studies of eye-movement have revealed that expert athletes generally have fewer fixations than novices (Abernethy, 1985), supporting the theory of pattern recognition as experts absorb more information from a single fixation (Allard & Starkes, 1991). Williams and Davids (1998) and Williams and Elliott (1999) have noted that experts have an anchored eye position or quiet eye, which further enables peripheral absorption of critical information. Causer, Holmes and Williams (2011) found that the efficiency of gaze behavior and improved quiet eye can be trained and doing so improves shooting accuracy and develops a more efficient visuomotor control strategy in skeet shooting. Additional research in perceptual skill training has been demonstrated to improve response time of tennis players (Williams, Ward, Knowles, & Smeeton, 2002). The effect of perceptual training has been studied only within a short-term, immediate performance context. Long-term improvement because of perceptual training is still undetermined (Hodges, Starkes, & MacMahon, 2006).

Additional characteristics of expert athletes include better recall of structured game sequences in a variety of sports (Allard, Graham, & Paarsalu, 1980; Bouregard & Abernethy, 1987; Garland & Barry, 1991; Starkes & Deakin, 1984; Williams & Davids,

1995). Anticipatory skills, particularly in a specific domain, are markedly more advanced in expert athletes (Reilly et al., 2000), indicating that perceptual skill and cognitive development are similar in importance to physical skill (strength, speed, agility). High correlations have also been demonstrated between decision accuracy and recall (Helsen & Starkes, 1999), demonstrating the advantages of chunking, and underscoring the importance of memory in the cognitive-perceptual dimension of expertise in sport. Expert cyclists have demonstrated a strong link between cycle rate (cadence) and respiration (Bernasconi & Kohl, 1993), and expert runners have been shown to have specific respiration/step ratios (1:4, 1:3, etc.) (Dietrich & Warren, 1995). In both cases, these strong links enable much greater efficiency and economy of performance, and are characteristics largely absent from novice athletes.

Among researchers there is wide agreement that many years of task-specific practice, or deliberate practice, is necessary to acquire expert performance in sports (Helsen, Starkes, & Hodges, 1998; Hodges & Starkes, 1996; Hodge & Deakin, 1998; Ward et al., 2004; Hodges, Starkes, & MacMahon, 2006; Ford, Hodges & Williams, 2013). Rooted in the work of Ericsson et al. (1993), different performance levels are related to the number of hours spent in deliberate practice, and such practice is specifically designed to modify the mechanisms of performance to induce improvement (Ericsson, 2003). Domain-specific deliberate practice causes adaptations and improvements to the attributes of a performer (Williams & Ericsson, 2008). Sports that have been studied from the perspective of deliberate practice include field hockey and soccer (Helsen, Starkes, & Hodges, 1998), figure skating (Starkes et al., 1996) and karate (Hodge & Deakin, 1998). In each case, skill-based difference in performance is correlated with sustained sport-specific practice (Ward, et al., 2004). Research has shown

that expert athletes engage in deliberate practice over an extended period of time beginning in childhood as early engagement (Ford et al., 2009), and then progressing to deliberate play (Cote & Hay 2002) before sport-specific deliberate practice in adolescent years (Kaufman, 2013a). The use of the deliberate practice model in studying the development of expertise has also been influential in the fields of sport psychology and motor learning and is used as a means of distinguishing expert athletes from non-experts (Baker & Young, 2014). A recent review of this research by Baker and Young (2014) indicates that deliberate practice is important in developing expert sport performers, but that there is a need for more rigorous research designs and statistical models.

Some researchers have concern with various components of deliberate practice (Hodges & Williams, 2012). Specifically, there is contention with the stipulation to practice alone rather than in combination with other activities, that practice must be deliberate to be beneficial, and to the influence of hereditary factors as limits to expert performance (Abernethy, Farrow, & Berry, 2003; Baker & Horton, 2004; Sternberg, 1996). Exceptions to the deliberate practice model have also been noted in shorter, more anaerobic sports (swimming, cycling, running) where physical factors of height, muscle, and body-fat ratios limit performance irrespective of practice (Hodges, Starkes, & MacMahon, 2006). A recent study of expert volleyball players revealed that in addition to structured activities, unstructured activities with older peers played an important role in expertise achievement (Coutinho et al., 2016). Several researchers have also demonstrated that some athletes who reached elite levels had diversified backgrounds in childhood, engaging in deliberate play rather than early specialization and deliberate practice in one specific sport (Baker, Cote, & Deakin, 2005; Berry, Abernethy, & Cote, 2008; Bloom, 1985; Soberlak & Cote, 2003). This suggests that a diversified approach to

early athletic development may not be at odds with the linear profile of the practice-proficiency relationship outlined by Ericsson and colleagues in 1993 (Cote, Murphy-Mills, & Abernethy, 2012). Exceptions to this are sports requiring expertise at early ages, such as women's gymnastics (Law, Cote, & Ericsson, 2007), and women's figure skating (Deakin & Copley, 2003). Studies of elite athletes in ice hockey (Soberlak & Cote, 2003), field hockey and basketball (Baker et al., 2003), baseball (Hill, 1993), tennis (Carlson, 1988; Cote, 1999), and rowing (Cote, 1999) demonstrate that sampling a variety of sport activities often precedes expert performance in a specific sport.

The influence of genetics and environmental factors has also been studied in the acquisition of expert performance in sport (Ford, Hodges, & Williams, 2013). There are physical characteristics, such as height, stature, muscle, and bone structure, which predispose certain individuals toward certain sports, but the research in genetics is not to the point where firm conclusions can be drawn in the development of expertise (Bray et al., 2008; Davids & Baker, 2007; Ford, Hodges & Williams, 2013; Kaufman, 2013a). Some individuals are born with a relative distribution of muscle fiber types that favor power-based or endurance sports, but this distribution can be altered through extended amounts of training (Ford, Hodges & Williams, 2013). Environmentally, expert athletes tend to have positive and supportive influence from parents (Cote, 1999), are more likely to be later-born children, suggesting that siblings may play a role in expertise development (Hopwood et al., 2015), and they tend to be born in smaller cities of less than 500,000 (Cote et al., 2006). The influence of coaches, who control practice and environment, appears to be substantial (Cote et al., 2007), directly impacting the achievement of goals and sport development (Ford, Coughlin, & Williams, 2009).

## **Expertise in the Arts**

Expertise in the arts, unlike sports and chess, tends to defy clear definition, and is the domain in which the nature-nurture debate is most active. Noice and Noice (2013) note that accounting for expertise in the arts according to a strict dichotomy of talent versus practice requires a restrictive definition of talent and an expansive definition of practice. They note, “proponents of the practice view tend to regard talent as being exclusively genetic, and practice as being *everything else*” (p. 310; italics original). Noice and Noice (2013) believe that talent is an indispensable part of the equation and that the talent/practice balance is highly variable across disciplines. This is consistent with other researchers who have noted differences across disciplines, and the varying effects of genes and environment on developing expertise (Ceci, Barnett, & Kanaya, 2003; Harris, 1999; Pinker, 2003; Kaufman, 2013a).

### **Acting, Drawing, and Writing**

Research in many of the various artistic domains is not extensive. Among the domains subject to investigation more recently are acting, drawing, and writing. Study in these areas is relatively in its infancy and therefore only briefly reviewed here. In the acting domain, few studies have investigated acting expertise (Ando, 2007). Studies investigating the characteristics of expert actors have found that experts worked to understand the ideas behind the words and the reasons the character used those words before embarking on serious memorization (Noice, 1992). Expert actors tend to segment the script into units called “beats” that are chunks of dialog in support of a single intention (Noice & Noice, 1993). This is similar to the concept of “chunking” demonstrated by experts in chess (Chase & Simon, 1973a). More recently, Noice and Noice (2006) investigated expertise in acting from the perspective of acquisition, process,

and memory. They also explored the use of deliberate practice focusing on specific skills, such as vocal projection, and found a positive correlation (Noice & Noice, 2006). The same authors (Noice & Noice, 2013) investigated the influence of talent, experience, and training on expertise in acting. They concluded that talent is a central underlying mechanism of expertise in acting.

In drawing, Winner and Drake (2013) argue that talent is essential in achieving expertise. They acknowledge that hard work, or their term, “rage to master” is necessary but is not sufficient to achieve or maintain expertise. Kozbelt and Ostrofsky (2018) reviewed psychological research on drawing expertise, investigated the potential differences in perception between artists and non-artists, and pondered the possible strong influence of an artist’s expertise on their perceptual abilities. The findings are suggestive. Due to the inherent complexity and interdisciplinary nature of visual art, the authors state that “there is a seemingly late start of a significant research tradition on expertise in the domain of art,” including a scarcity of empirical studies investigating drawing expertise (p. 592).

Regardless, and consistent with expertise researchers in other domains, there have been studies which have noted characteristics of drawing expertise, and which have compared experts and non-experts. In a comparison of artists and non-artists, Tchalenko (2009) found that artists use systematic eye-hand strategy while non-artists do not or do so arbitrarily. Perdreau and Cavanaugh (2014) found that experts in drawing are more efficient and accurate in perceptual processing than non-experts. Chamberlain and Wagemans (2015) have suggested that extensive drawing experience may enable the ability to shift between global and local elements of a visual stimulus. While researchers in sports have investigated motor processes as a function of expertise, similar efforts in

visual art have been inconclusive due to the challenge of isolating fine motor differences (Cohen & Bennett, 1997).

Research in writing expertise has noted the characteristics of expert and advanced writers. Kellogg (2006) found that expert writers have high cognitive ability, are skilled in using concrete language, and manage long-term memory well. Experienced writers generate more words in the creative process than do less experienced writers (Chenoweth & Hayes, 2003). As expertise grows, “writers use words fluently, precisely, and in sophisticated syntactic structures” (Kellogg, 2018, p. 417). Haswell (2000) found that more experienced writers use longer sentences and clauses, and a greater elaboration of ideas. Alamargot et al. (2010) found that advanced writers could do high level planning and sentence construction, and lower level transcription and mechanics, seamlessly. Consistent with other domains, a recent study by Kellogg (2018) underscored the need for purposeful practice, and that starting at an early age is critical.

## **Dance**

Due to the physical demands of dance, most formal instruction begins between the ages of seven and nine while the body is still malleable (Noice & Noice, 2006). In a survey of the developmental history of elite professional ballet dancers from the United States, Mexico, and Russia, Hutchinson, Sachs-Ericsson, and Ericsson (2013) found that the level of ballet expertise attained by age 18 was predicated by the accumulated hours of dance practice through age 17, and by the age of first aiming to become a professional dancer. The physical preparation of the initial years is directed to posture, balance, control, elevation, and the ability to initiate and terminate physical movement to match musical phrases (De Mille, 1962). Beyond these fundamental components, expertise in dance is notable for its many components, some clearly defined, others far less so (Bruhn,



1968).

Early inquiry into dance expertise focused on memory and memory processes. Starkes et al. (1987) found that ballet dancers demonstrated superior memory recall for domain-specific information. Compared to non-experts, experts demonstrated advantage in structured recall, but no difference in unstructured situations. This is consistent with the findings of Chase and Simon (1973b) in which expert chess players exhibited no difference compared to non-experts in recalling random chess piece placement. Starkes et al. (1990) found that expert modern dancers remembered all sequences better than novices. Noice and Noice (2006) note that there is an inherent problem with expert/novice research in dance because non-experts are often incapable of performing even rudimentary techniques. In designing test routines to compare the two groups, one easy enough for a novice is typically too easy for an expert. Poon and Rogers (2000) compared a university dance class with selected professional dances and encountered the same result. They found that novice dancers lacked the strategies to cope with difficult routines and experts tended to abandon their usual strategies for the simple routines.

Given the integral link between music and dance, researchers have investigated the role that music plays in task and routine recall. Starkes et al. (1987) found that music exerted a significant recall advantage, particularly for recent sequences. Poon and Rogers (2000), in a comparison between experts and novices, found that expert dancers made far greater use of music cues, and were more sensitive to rhythms, note ranges, and phrases. Experts tended to use musical counts to create larger chunks, while novices tended to find the music distracting and attempted to ignore it.

## **Music**

Unlike other domains, people in most cultures engage in music-related activities

every day (Lehman, 1997). Given the ubiquitous nature of music, it is surprising that so few people undertake study of an instrument or voice, and that those who do often abandon their efforts within a few years (Sloboda, 1996). Among the millions of people who do learn to play an instrument, relatively few succeed in reaching the standard of excellence that might be termed elite or expert performance (Krampe & Ericsson, 1995). This is even more remarkable since most school children in the United States receive classroom music instruction from an early age. As Sloboda (1996) sadly concludes, “Music education in Western cultures produces a dismal yield of achievement” (p. 123). An explanation for this lack of musical accomplishment was proposed by Sloboda, Davidson, and Howe (1994) who suggested that a folk psychology of talent exists, which postulates that the capacity for musical achievement is innately determined: few people become musical experts because few people have the necessary talent. This perspective is present in the culture and rhetoric of the music conservatory (Kingsbury, 1988), and is in evidence in young school children who already believe that music ability cannot be improved by effort like a sporting skill could be (O’Neill, 1994). A survey of educational professionals by Davis (1994) demonstrated that the majority of his sample (75%) believed that musical skill (composing, singing, playing an instrument) required natural talent or special and unusual skill. Other activities, such as playing chess and performing surgery, were thought to require talent or special gift by less than 40% of the sample. The notion of innate talent is also used to explain child prodigies, unusual technical prowess, and exceptional performance ability by older musicians (Krampe & Ericsson, 1995).

The study of expertise in music has largely been focused on questions of talent (nature) and practice (nurture) (Kaufman, 2013a). As noted above, there has been particular emphasis in expertise in music focusing on giftedness. An early example is a

study by Barrington (1770) who studied Mozart's early performance achievements, providing detailed descriptions. While informative, the study concluded that exceptional achievement is attributed only to exceptional talent. In the 19<sup>th</sup> century, a study by Billroth (1895) investigated the question, "Who is musical?" It is believed that this work was the starting point for research on musical ability in the 19<sup>th</sup> century (Lehman & Gruber, 2006). In the early decades of the 20<sup>th</sup> century Carl Seashore developed his "Measures of Musical Talents" which assessed perceptual discrimination in young music students (Seashore, 1938/1967). Most musical aptitude tests have attempted to predict the potential for music performance (Boyle, 1992), but have had limited success because musically active children tend to score higher on aptitude tests (Shuter-Dyson, 1999). Early researchers in expertise acquisition were interested in the antecedents of exceptional achievement (Bowerman, 1947; Cox, 1926; Ellis, 1926; Raskin, 1936). Many of these studies have been replicated and extended in more recent years (Goertzel, et al., 1978; Walberg, Rasher, & Parkerson, 1980; Simonton, 1987).

The argument in favor of innate ability also has roots in the dynasties of musical families, such as the Bach, Corelli, Couperin, Mozart and Strauss families. The influence of innate or inherited ability is based in the presumption that the capacity for musical achievement is a "species-defining characteristic" (Sloboda, 1996, p. 108). In the same way that humans are primed to learn a language and develop motor skills, Sloboda (1996) says that most humans are primed to become musicians, and therefore the reason for those who do not develop performance skill must be due to something else rather than a lack of talent. Kaufman (2013a) notes also that even if a trait has a genetic contribution that does not mean it is immutable. "The pathway from genes to talent to greatness is often very nuanced and complex" (Kaufman, 2013a, p. xii). Sloboda (1996) notes that

determining the impact of heritability on musical talent is also difficult because there is no accepted measure of musical intelligence that has the validity and reliability of standard measures of intelligence. Also, studies on twins, a common source of the heritability of certain psychological characteristics, seem to conclude that differences in musical ability are far less dependent on inherited factors than on differences in IQ (Coon & Carey, 1989). Further underscoring the complex nature of the origins of musical expertise, Simonton (2006) notes that while world-class expertise tends to emerge from a distinctive family background, this tendency may reflect the influence of nurture rather than nature.

While interesting, the heritability of expertise is not totally justified as genetic backgrounds and environmental effects are inevitably woven together; alternative explanations therefore cannot be refuted (Lehman & Gruber, 2006; Krampe & Ericsson, 1995). Recent investigations have not supported the notion that musical talent runs in families (Sosniak, 1985; Sloboda & Howe, 1991). Outstanding music performers are more likely to come from a more general musical background than from the families of professional musicians (Krampe & Ericsson, 1995). Ackerman (1988) found that inborn ability does account for differences between untrained individuals, but that its effect becomes increasingly smaller as skills are acquired. Krampe and Ericsson (1995) suggest that the belief in musical talent may exist simply due to a lack of plausible alternatives. A brief review of history also reveals that the best performances have improved through time. Tchaikovsky's Violin Concerto was considered unplayable in his day (Platt, 1966), but is now considered a standard part of the violin repertoire. Paganini's legendary virtuoso technique, considered nearly superhuman in his day, is far more common-place on the modern concert stage (Roth, 1982). Also, methods of training and the acquisition

of musical technique have risen considerably (Krampe & Ericsson, 1995), further suggesting that expertise in music is influenced by a variety of factors. As Simonton (2013) succinctly states, talent is best viewed as “a set of cognitive abilities, dispositional traits, and (where necessary) physical attributes that have substantial heritability coefficients” (p. 22). These traits determine and enhance the rate at which domain-specific expertise is acquired. “Nature is what facilitates and accentuates nurture” (Simonton, 2013, p. 22). Studies examining the genetic origins of passion and persistence and the drive to practice have been undertaken with results indicating some evidence for genetic contribution (Cordova & Lepper, 1996; Ryan & Deci, 2000; Kaufman, 2009, Vallerand et al., 2003).

The importance of environmental factors in the development and promotion of musical expertise has been noted in several recent studies (Kaufman, 2013a; Lehman & Gruber, 2006; Sosniak, 1985; Csikszentmihalyi, Rathunde, & Whalen, 1993). Exceptional musicians, creators and leaders often come from homes replete with intellectual, cultural and aesthetic stimulation (Walberg, Rasher, & Parkerson, 1980). Particularly in the beginning stages of musical development, parents are the primary source of motivation and support (Bloom, 1985; Davidson, Sloboda, & Howe, 1996), even if they do not have musical training and experience (Davidson et al., 1996). Siblings who play musical instruments are also a strong influence (Howe & Sloboda, 1991). While no causal relationship is established, Simonton (2013) states that openness to experience may be a strong predictor of potential expertise. The socioeconomic condition of a young musician’s family has an impact on choice of teacher, quality of instrument, and other conditions fostering the growth of expertise (Lehman & Gruber, 2006). A study of successful Polish musicians demonstrated common patterns in families: emotional

stability, task orientation, and strong support of musical activities (Manturzewska, 1985). Csikszentmihalyi, Rathunde, and Whalen (1993) noted that families of high-achieving children changed their lives to accommodate the needs of their talented children (see also Easton, 1989).

**Deliberate Practice in Music.** Practice in music is both prevalent and necessary (Lehmann, Sloboda, & Woody, 2007; Harnum, 2013). There is general agreement that long-term deliberate practice is necessary for high levels of expert performance (Mosing et al., 2014; Hambrick et al., 2014; Ericsson & Lehmann, 1996). Music proficiency in particular has been used as a general model of expertise, and associations between deliberate practice and musical expertise have been interpreted as supporting the concept that deliberate practice inevitably results in increased ability (Mosing et al., 2014). A growing body of evidence suggests that expertise derives not from genetic fortune, cognitive ability, or from sheer experience, but rather is developed from specific forms of training and practice that enable the perceptual, physiological, neurological and cognitive changes necessary for the acquisition of domain-specific skills (Ericsson, 2017; Kaufman & Duckworth, 2017). Deliberate practice in the attainment of expert performance is rooted in the work of Simon and Chase (1973), who suggested that a decade of intense work is required to obtain expertise in chess. Extending this research, Ericsson, Krampe and Tesch-Romer (1993) sought to identify the specific training activities that would be directly related to performance improvement in music. Specifically, the authors investigated the practice time of musicians and related those times to attained levels of performance excellence. They concluded that the most effective learning “requires a well-defined task with appropriate difficulty level for the particular individual, informative feedback, and opportunities for repetition and correction of errors” (Ericsson,

1996a, pp. 20–21). When all of these elements are present, the training activity is identified as deliberate practice, “a highly structured activity with the explicit goal of improving some aspect of performance” (Krampe & Ericsson, 1995, p. 86).

Ericsson, Krampe, and Tesch-Romer (1993) found that estimates of the amount of deliberate practice are predictive of levels of expert performance. The greater the amount of accumulated solitary study (deliberate practice), the greater the musical performance. This conclusion rejected the then-prevailing notion that more gifted musicians needed less practice (Ericsson, 2017). Replicating Ericsson and colleague’s (1993) study using younger musicians, Sloboda et al., (1996) found clear support for the deliberate practice model as results demonstrated that the amount of practice is significantly related to level of performance. More recently, Ericsson (2007) reiterated his perspective, stating, “the distinctive characteristics of elite performers are adaptations to extended and intense practice activities that selectively activate dormant genes that all healthy children’s DNA contain” (p. 4).

Interestingly, differences in the number of hours necessary for high levels of performance are not consistent across the different instruments. Jorgensen (1997) found that pianists and violinists recorded the most hours, followed by woodwinds, brass and other strings, and then finally, singers. Such differences may be the result of the differing demands placed on the body (Lehmann & Gruber, 2006). Krampe and Ericsson (1995) note that optimal deliberate practice is subject to three major constraints: resources (instruments, facilities, teachers, opportunities), motivation (deliberate practice is not inherently enjoyable), and optimal intensity limits (effortful practice can only be sustained for a limited time). Additional research supporting the correlation between amounts of deliberate practice and increasing levels of expert performance, as sufficient

to explain differences in performing ability, includes Duffy, Baluch, and Ericsson (2004), Lehmann and Ericsson (1996), Tuffiash, Roring, and Ericsson (2007), Coon and Carey (1989), and Howe, Davidson, and Sloboda (1998).

Despite the considerable interest that the concept of deliberate practice has generated, not all researchers agree. Sternberg (1996) theorized that deliberate practice might be correlated with success because “we stop doing what we do not do well and feel unrewarded for” (p. 350). The problem, according to Sternberg (1996), is that hours of deliberate practice “are hopelessly confounded with talent, motivation, and other variables” (p. 350). Anderson (2000b) stated that Ericsson and Krampe’s research does not support the notion that a large amount of practice is sufficient for great talent, and Marcus (2012) concluded, “it would be a logical error to infer from the importance of practice that talent is somehow irrelevant, as if the two were in mutual opposition” (p. 94). Hambrick et al. (2014) found that deliberate practice accounted for only about one third of the variance in performance in music and chess. In a meta-analysis of the relationship between deliberate practice and human performance, Macnamara et al. (2014) found that large amounts of variance in performance are not explained by deliberate practice and are potentially explained by other factors. Also, despite many hours of practice, most individuals do not become experts (Corrigall, Schellenberg, & Misura, 2013; Hambrick et al., 2013; Ruthsatz et al., 2008; Sternberg, 1996).

Lehmann and Gruber (2006) note that the role and manifestation of practice is different for varying musical styles. Studies of musical expertise in jazz music, popular music or other vernacular styles may produce different results (Berliner, 1994). Jazz guitarists, for example, tend to start at later ages than classical musicians (Gruber, Degner, & Lehmann, 2004), as do many singers (Kopiez, 1998). Rock and popular



musicians tend to dismiss the role of formal instruction and frequently emphasize self-teaching (Green, 2002). The complex relationship between innate abilities and practice is also a continuing factor in these different genres (Ackerman, 1986, 1990; Sloboda, 1996). Additionally, the term “practice” has different meanings for musicians in different genres. Classical musicians view practice as mostly a solitary pursuit, while jazz musicians often include communal sessions, listening to others play, and studying the performances of other famous musicians in their definition of practice (Lehmann & Gruber, 2006; Gruber, et al., 2004; Harnum, 2013).

**Many Contributing Factors to Musical Expertise.** While traditional approaches to the study of musical expertise have been primarily singular investigative approaches focusing on innate talent or practice, increasingly researchers are investigating the summative impact of a variety of conditions (Kaufman, 2013a). Studies in behavioral genetics suggest that both talent and motivation are influenced by genetic and environmental influences (Johnson et al., 2010; Moore, 2003; Ridley, 2003). A recent study by Davidson and Faulkner (2013) examined how certain conditions, such as physical characteristics, personality traits, general intelligence, domain-specific abilities, and various environmental factors come into alignment to produce a clear direction and unity of purpose in an individual, which they refer to as *syzygy*. The authors conclude that such alignments often provide the “(a) freedom to play within the domain to develop creative thought; (b) the challenge to develop skills to solve problems; and (c) the social contacts to inspire, model, support and celebrate change to the musical self” (p. 367).

A similar study examining the summative impact of multiple factors was completed by Ruthsatz, et al. (2008), who argued that the sum of three factors: practice, intelligence, and music audiation, provided the best explanation for the development of

musical talent. The diversity of contributing factors to musical excellence in children include parents singing at home (Howe et al., 1995), parental involvement in practice routines (Davidson et al., 1997), quality of relationship with, and expertise of the music teacher (Davidson, et al., 1998), and quantities of practice time, consistent with the findings of Ericsson et al. (1993). Burland and Davidson (2006) identified critical elements that appeared to contribute to high musical achievement, including positive experiences with people and institutions, the ability to cope with the demands of a professional musician's lifestyle, and music as a strong determinant of self-concept. Kaufman (2013a) argues that it is not simply the presence of these varying elements, but rather the particular alignment of a range of internal and external factors that enable high musical achievement.

Other important traits that influence the rate of expertise acquisition include creativity, imagination, emotional intelligence, and body-kinesthetic, musical, artistic, and practical life skills (Gardner, 1983; Mayer et al., 2011; Stanovich, 2010; Sternberg, 1997). Less considered, but of significant importance, are those traits that influence cumulative effort over time, including optimism, passion, inspiration, goal commitment, self-discipline, self-control, and curiosity (Kaufman & Duckworth, 2017). The concept of grit, defined as working strenuously toward challenges, maintaining effort and interest for years despite failure, adversity, and plateaus in progress, has been shown to be very important and to predict a wide range of outcomes (Duckworth, 2016; Duckworth et al., 2010; Duckworth et al., 2007). This is consistent with the findings of Subotnik (2004) and Subotnik et al. (2003) who found that a variety of factors, at differing levels of importance, are critical in the development of musical expertise.

**Music Practice in General.** Research literature investigating practice in music has advanced in both sophistication and quantity over the last 30 years (Miksza, 2011). Several studies indicate that the achievement of musical expertise requires substantial practice (Jorgensen & Hallam, 2016; Sloboda et al., 1996; Bloom, 1985; Ericsson, Tesch-Romer, & Krampe, 1990), and that there is a strong positive relationship between practice and achievement in musical performance (Sloboda et al., 1996).

In addition to studies related to deliberate practice and the various other factors that contribute to growing expertise outlined above, recent research in music practice has investigated the following two questions: 1) What do people do when they practice? 2) What individual variables interact with how and why musicians practice? (Miksza, 2011). Research investigating comparisons of teacher and student opinions of practice time and behavior show inconsistencies between teacher and student expectations (Duke, Flowers, & Wolf, 1997), and inconsistencies in the use of specific practice strategies (Barry, 2007). Kostka (2002) found similar inconsistencies among college faculty and undergraduate and graduate music majors. Other studies report changes in practice behavior with advancing development and time (Ericsson, Krampe, & Tesch-Romer, 1993; MacNamara, Holmes, & Collins, 2006). The results of these studies indicate that more advanced students practiced more regularly and longer, and more sophisticated strategies were used by more experienced musicians (McPherson, 1997).

Research exploring strategies of memorization by pianists (Chaffin & Imreh, 1997, 2001, 2002; Chaffin & Logan, 2006) revealed that the subject first identified formal structural aspects of the music for use in memory retrieval, followed by more technical work, and later, interpretation. Investigating amounts of practice time Jorgensen (1997, 2002), in a study of college students, found that pianists practiced the most,

followed by strings, brass, woodwinds, and finally, vocalists. Sloboda et al. (1996) found similar results with younger students and noted that higher-achieving student musicians had greater quantity of practice time.

Much of the research exploring the quality of practice centers on practice strategies (Jorgensen & Hallam, 2016). Barry (1992) noted that practice is likely most effective when it is organized in a logical way. An early quantitative study of music practice was done by Brown (1928) in which she examined three practice strategies of classical pianists: whole sections, partial sections, and a combination of both. A study of ten highly regarded Russian pianists by Wicinski (1950; cited in Miklaszewski, 1989) found two approaches to practice, one with clearly defined objectives in their work, and the other without defined objectives. Miklaszewski (1989) studied the strategy of a single pianist in learning Debussy's *Prelude Feux d' Artifice*. The results indicate a problem-solving approach in which playing alternated between slow and fast tempi. Fortney (1992), Rosenthal (1984), and Zurcher (1975) found that the use of a model in practicing was more effective than no model. VanderArk and Murphy (1998) and Ross (1985) found that combining mental practice with physical practice resulted in greater achievement. Other researchers found improved performance and memory as a result of sleep (Duke & Davis, 2006; Simmons & Duke, 2006). Miksza (2007, 2011) studied high school and college wind players and found that use of repetition, whole-part-whole approach, use of metronome, buzzing and singing, resulted in greater achievement. Jorgensen (2004) proposed a set of four strategies for practice: planning, execution, evaluation, and meta-strategies. McPherson and Zimmerman (2006) proposed practice as self-regulated learning, including forethought, execution, and self-reflection. In a recent meta-analysis examining the influence of deliberate practice on music achievement, Platz

et al. (2014) found that “currently trackable correlation between an approximation of deliberate practice with indicators of solitary study or task-relevant experiences is related to measurements of music performance with  $r_c = 0.61$ ” (p. 11). The authors found a “remarkably strong relationship between task-specific practice and musical achievement as measured by objective means” (p. 9) and conclude that this finding “is a strong argument for the eminent importance of long-term DP [deliberate practice] for skill acquisition and achievement” (p.10).

Motivation to practice has also been studied. Miszka (2006, 2009) and Schmidt (2005, 2007) found that self-improvement and attaining personal goals were primary motivators. Ciabattari (2004) and Miszka (2006) revealed challenge as a central motivator. McPherson and McCormick (2000) found that musicians who attributed success and failure to their own efforts had higher achievement scores. Hallam (1983) found that motivation and other personal characteristics contributed to perseverance in practicing. This is consistent with Duckworth (2016), who writes that what we accomplish “depends tremendously on our grit—our passion and perseverance for long term goals” (p. 269).

**Professional Musician Practice.** In a study comparing practice differences between professional and student pianists (Gruson, 1981), expert musicians were found to repeat phrases longer than a measure and practiced for longer periods of time, suggesting that practice strategies change as expertise is developed. In another comparison of professionals and students, Hallam (2001) reported that professionals organize their practice, analyze musical problems, and engage in metacognitive thinking. An earlier study by Hallam (1997a) produced similar results and noted that professionals

employ memory strategies based on the formal structure of the music and have cognitive strategies to deal with performance anxiety.

In a study of a variety of expert musicians, Hallam (1995) studied the “individual diversity in the practicing activities of musicians in terms of the regularity and extent of practice, its content, motivation, and the relative emphasis on technique and musicianship” (p. 5). The subjects were chosen based on peer evaluations of their technical competence and musical sensitivity. A broad range of musical experience and age were represented, and most instruments of the symphony orchestra were included, along with a conductor and an organist. Hallam’s (1995) findings indicate a diversity of motivation for practice: some primarily intrinsic, some primarily extrinsic, and others a combination of both. Regarding content, nearly all begin with a warm-up, but the content and duration of the warm-up varied considerably. When learning new music, all subjects engaged in either an overview analysis or slow and careful playing.

A detailed case study by Chaffin et al. (2003) examined how an expert pianist prepared for a recording. Four stages were discovered: 1) over-all aural image – playing through, listening to recording; 2) working through in sections; 3) connecting sections, perfecting them, greater attention to interpretation; and 4) maintenance. The expert pianist in this study had an artistic image of the work in mind as she approached learning a new piece. Consistent with Chase (1983) and Gobet and Simon (1996b), the expert pianist made fast decisions and quickly anticipated later issues. The findings of Chaffin et al (2003) are also consistent with Ericsson, Krampe, and Tesch-Romer. (1993), who suggested the singular relationship between deliberate practice and acquired performance level. While Sloboda et al. (1996) believe strongly that the amount of practice is an important determinant of music performance expertise, Jorgensen, (2002), and Sloboda et

al. (1996) found large differences between quantity of practice time and attainment of professional expertise. This suggests that “attainment is not exclusively a question of quantity of practice, but also of quality, which is a result of individual engagement and knowledge of practice strategies” (Jorgensen & Hallam, 2016).

In a recent study examining the practice habits of professional musicians in four genres of music, Harnum (2013) interviewed a trumpet player from the New York Philharmonic who is “still figuring out” what practice is (p. 124). The trumpeter did emphasize a daily routine to maintain skill and stamina. Harnum sums this professional’s definition of practice as “a daily task that maintains a balance both within the practice session itself (warm-up, technique, repertoire) and balance that considers performance duties as well” (p. 126). The overall structure of this trumpet player’s practice sessions can broadly be described as warm-up, technique, and repertoire, consistent with the findings of other researchers (Jorgensen, 2004; Jorgensen & Hallam, 2009).

In another part of the same study, Harnum (2013) interviewed one of the most highly-acclaimed tuba players of our generation who has performed with the Chicago Symphony Orchestra and the St. Louis Symphony Orchestra, among others. This expert tuba player focuses on four areas in every practice session, “tone quality, range, dynamic range, and ‘as many articulations as I can’” (p.146). He also emphasizes practicing a variety of repertoire, techniques and styles, and that practice is both physical and mental. Practice, according to this tuba player, takes “determination, dedication and an unflinching willingness to do the work necessary to achieve excellence and maintain the persistence necessary to work through difficulties until they are no longer difficult” (pp. 146-147).

In concluding this portion of his study, Harnum (2013) noted that both expert brass players approach their work with a growth mindset and with an orientation toward mastery, which is consistent with the findings of Dweck (1986, 2007). The practice time of both musicians is similar to the findings of other research reports (Jorgensen & Hallam, 2009; Byo & Cassidy, 2008; Ericsson, Krampe, & Tesch-Romer, 1993; Manturzewski, 1990), and in the engagement of intentional, deliberate practice (Ericsson, Krampe, & Tesch-Romer, 1993). Both musicians also noted a strong concept of sound and the idea that there is not much of a line between practicing and performing.

**French Horn Experts.** During the latter years of the 20<sup>th</sup> century, several expert professional horn players offered their thoughts on achieving and maintaining expertise. This information comes from a foundation of pedagogy and not research. One of the most prolific international horn soloists of the period was Hermann Baumann (b. 1934), who advocated mastery of the fundamentals such as scales and arpeggios (Elias, 1983), and who was a strong advocate of singing on the horn (Meckna, 1994). The renowned British hornist Alan Civil (1929-1989) was noted for his “natural talent, sound training, and perseverance” (Meckna, 1994, p. 53), and for discouraging his students from a career in horn playing. “I give all my students the real nitty-gritty about what a dreadful profession this is and about the awful problems one has if not naturally talented” (Nash, 1975, p. 54). American hornist Philip Farkas (1914-1992) was solo horn for the Chicago, Cleveland, Boston, and Kansas City orchestras, and professor of horn at the Indiana University School of Music for many years. Farkas believed that players need the technique to play any type of music and the courage to play in public (Neidig, 1979). In the pursuit of expertise, he suggested practicing to extremes, “Play high passages a tone higher, the low ones a tone lower, the slow passages too slow and the fast passages too



fast” (Cowan, 1977, p. 67). Ifor James (1931-2004) was principal horn with the BBC Northern Orchestra, the Royal Liverpool Philharmonic, and finally the English Chamber Orchestra before launching a successful solo career and tenure with the Philip Jones Brass Ensemble. On the acquisition of horn expertise, he advocated developing the discipline to practice for long periods of time (Meckna, 1994). On the maintenance of expertise James believed that you can never be satisfied. “You can always do better; you can always improve yourself” (Braun, 1981, p. 27). On practicing, James believed that “warming up well, touching every aspect of the playing which one will encounter on a given day, is vital” (Meckna, 1994, p. 143).

Meir Rimón (1946-1991) was solo horn for the Israel Philharmonic for 20 years. Rimón advocated continuous scrutiny of one’s playing, with a particular emphasis on tone production (Meckna, 1994). Rimón often said, “music comes first—technique is only a tool” (Watson, 1991, p. 59). James Stagliano (1912-1987) is best known for his 26 years as principal horn of the Boston Symphony, and as a leading studio player, particularly for 20<sup>th</sup> Century-Fox. Stagliano advised practicing while standing (Meckna, 1994), and savoring each note when playing (Coghill, 1990). Norwegian horn virtuoso Froydes Ree Wekre (b. 1941) served as principal horn for the Oslo Philharmonic for more than 30 years. Her many recordings underscore her affinity for more modern and obscure music, with a particular sympathy for Scandinavian female composers (Meckna, 1994). Regarding horn practice she writes, “Most people make the mistake of practicing in long sessions without breaks, even small ones” (Wekre, 1989, p. 16). She suggests also that, “When something sounds and works great, it is very constructive to have a rest and tell oneself how good the playing was – a technique that strengthens the mental picture of Self” (Wekre, 1994, p. 57). This is consistent with the beliefs of current Canadian Brass

French hornist Jeff Nelsen, who advocates, “Practice in short bursts and end them well. When a passage or solo is finally played as intended, celebrate! Marinate in your victories” (private lesson with author, 2010). Wekre is also a proponent of participating in nonmusical activity, such as swimming, to help improve lung capacity and arm strength (Meckna, 1994). Wekre states that horn playing can be improved by “having a sensible lifestyle, helping to build and save energy rather than to destroy it” (Wekre, 1989, p. 17). She also advocates developing a good sense of humor and remembering why you became a musician in the first place (Wekre, 1994).

The most widely-recorded horn soloist of the 20<sup>th</sup> century was Australian hornist Barry Tuckwell (b. 1931). Formerly principal hornist with the London Symphony Orchestra, Tuckwell left this position in 1968 to pursue a solo career, a path which led to him performing with every major orchestra in the world. For those in pursuit of horn expertise, Tuckwell has advised, “Don’t press, don’t stress the embouchure, and breathe deeply” (Tuckwell, 1974, p. 219). Success as a hornist is the same as success elsewhere: “hard work and concentrated practice” (Meckna, 1994, p. 237). Regarding his success Tuckwell famously stated, “you must play every concert as if your life depended on it” (Mathez, 1979, p. 79). Ten years into his solo career Tuckwell noted that he had difficulty finding time to practice. Blau (1978) reported that with 200 concerts per year, an ideal practice session for Tuckwell on tour was in the hotel room: “he turns on the hotel television set, loud, and practices with a mute, mostly rudimentary exercises such as scales, arpeggios and sustained notes that he says ‘bore me stiff’” (NY Times, Aug. 5, 1978). When asked what the secret was to his virtuosic playing, Tuckwell replied, “There isn’t any secret. It’s in the head, not the lips.” Concluding his 50-year career Tuckwell noted, “Horn playing is a form of athletics as well as art – you keep in training, you

maintain your form, you get better. The difficulties of the instrument keep you on your toes, you can never, ever, afford to get complacent” (Seckerson, 1996, p. 38).

### **Summary**

There is a great deal of research in the field of expertise, and this has expanded considerably in the last 30 years. The dominant paradigm in expertise research has been the study of the acquisition of expertise, which is grounded in three theoretical frameworks: nature, nurture, and the combination of nature, nurture, and environment. The acquisition of expertise by nature is the oldest perspective, and this includes perspectives from ancient times in which experts were considered to be divine, to the 18<sup>th</sup>-century belief that genius was born and could not be taught. With the Enlightenment and the dawn of the scientific method, the study of expertise became more focused. The leading researcher was Galton (1869) who believed that exceptional ability arose from innate ability, although some instruction was necessary. Research in the 20<sup>th</sup>-century has explored the differences between experts and novices, with a focus on cognitive processes, personality traits, and behavior genetics. While shared characteristics have been discovered, the search for prominent causal factors has been largely inconclusive.

Research into the acquisition of expertise through practice is rooted in the behaviorist John Watson (1930) and was further amplified by the study of expert chess players by de Groot (1946/1978) and Simon and Chase (1973), who concluded that extended experience and practice was the most reasonable explanation for success and expertise. This gave rise to the seminal study on the acquisition of expertise through practice by Ericsson, Krampe, and Tesch-Romer (1993) wherein they assert that expertise is the result of many years of deliberate practice. As Ericsson and his colleagues continue to study this notion, and to investigate the specific aspects of reproducibly superior

performance, other researchers have questioned their findings. For example, experts in some domains have achieved their expert level in small amounts of time. Also, while large amounts of deliberate practice may be correlated, they are not necessarily causative of expert performance. Other researchers have concluded that deliberate practice is necessary but not sufficient.

Extreme positions citing nature or nurture as the primary cause of expert performance began to be discredited by researchers in the mid-20<sup>th</sup> century, who underscored the diversity of patterns and skills and the likelihood that a combination of factors, including general intelligence and deliberate practice are involved. The findings of more recent researchers indicate that expert performance is some combination of nature, nurture, motivation, and various permutations, factors, and influences that influence achievement. These factors include individual characteristics, personality traits, domain specific skills, and environmental factors (social and cultural) that are interrelated, frequently have a gravitational connection to each other, and are not products of chance.

Research in expertise has also been conducted within specific domains. While this area of research is expanding, five of the more commonly studied domains were included in this review: medicine, chess, sports, dance, and music. Recent research in acting, visual art, and writing was also briefly reviewed. In medicine, research has targeted laboratory tasks, diagnostic reasoning and accuracy, and surgical expertise. There is also increasing evidence that deliberate practice may help surgeons develop and maintain their expert skills through simulation training. Chess has long been a focus of study in expertise, and early researchers found that expert players possessed superior memory for

chess positions, stored in “chunks.” Chess has been a key testing area for the practice-alone theory because it has objective performance measures and much longitudinal data.

Research in sports that was reviewed demonstrated that expertise is a complex interaction of perception, decision-making, and movement. One of the defining attributes of expertise in sport is the ability to quickly process domain-specific information. Research has therefore been directed to cognitive-based theories on information processing. Additional research has focused on recall. Research into the effects of deliberate practice in sports demonstrates that such practice causes adaptations and improvements in the athlete and is correlated with skill improvement. Furthermore, the need to participate in copious amounts of quality activity that is sport-specific has been established as a precursor to sport expertise.

Unlike sports and chess, expertise in the arts tends to defy clear definition. Research in acting, drawing, and writing expertise was briefly reviewed, although study in these areas is relatively sparse and comparatively, is in its infancy. Early studies have explored the differences between experts and novices, and findings suggest that both talent and purposeful practice are important in expertise acquisition. Research on expert dancers has found that they possess excellent memory and memory processes, make far greater use of music cues, and tend to use musical counts to create larger chunks for memory recall.

Finally, expertise in music was reviewed. Early interest in musical expertise often centered on genius, such as the case of Mozart, or on the dynasties of musical families such as those of Bach, Corelli, Couperin, and Strauss, which are often cited as evidence of innate, genetic, or inherited ability. More recent research indicates that outstanding music performers are more likely to come from a more general musical background than

from the families of professional musicians. The importance of environmental factors in the development of musical expertise has been noted in a growing number of studies, including homes with intellectual and aesthetic stimulation, strong parental support, and the presence of musical siblings.

Since practice in music is both prevalent and necessary, and music proficiency has been used as a model of expertise, studies investigating the use of deliberate practice were also reviewed. Deliberate practice in music is “a highly structured activity with the explicit goal of improving some aspect of performance” (Krampe & Ericsson, 1995, p. 86). The greater the amount of accumulated solitary study (deliberate practice), the greater the musical performance. Despite these results, some researchers have disagreed, noting that we stop doing what we do not do well, and despite many hours of practice, most musicians do not become experts (Sternberg, 1996).

Consistent with the findings of Ericsson and his colleagues, other researchers have found that the achievement of musical expertise requires substantial practice, and there is a strong positive relationship between practice and achievement in musical performance. More advanced students tend to practice more and employ more sophisticated strategies, and organized and sequential practice is most effective. Other studies reviewed found that the use of a model was more effective than no model, combining mental practice with physical practice yielded greater achievement, and better sleep resulted in better memory and performance.

Several studies were reviewed examining the practice habits of professional musicians. Experts were found to repeat longer phrases, practice for longer periods of time, organize their practice, analyze musical problems, and engage in metacognitive thinking. High achieving musicians tend to practice in the morning and practice in two

categories: technical studies first, and then works from the repertoire. A study of a variety of orchestral musicians by Hallam (1995) found that nearly all begin with a warm-up, but content and duration varied considerably. In a recent study examining the practice habits of professional musicians in four genres of music, Harnum (2013) interviewed a trumpet player from the New York Philharmonic and a Chicago-based tuba player. Results indicate that expert brass players approach their work with a growth mindset and an orientation toward mastery. Practice sessions are intentional, well-organized, reflective of the variety of skills necessary for professional competence, and sensitive to performance schedules. This broad review of literature in expertise provides the necessary background and context for this investigation into the maintenance of expertise by the French horn experts participating in this study.

### **Chapter 3 – Research Method and Design**

The phenomenon under study is the maintenance of expertise in French horn playing in the setting of major American symphony orchestras. Since the central question of this study was the investigation of how expert professional horn players maintain their expertise, case study methodology was employed. Case study is preferred when the objective is “to gain an in-depth understanding of the situation and meaning for those involved” (Merriam, 1998, p. 19). Case study “is a good approach when the inquirer has clearly identifiable cases with boundaries and seeks to provide an in-depth understanding of the cases or a comparison of several cases” (Creswell, 2007, p. 74). Another advantage is that case study “can ‘close in’ on real-life situations and test views directly in relation to phenomena as they unfold in practice” (Flyvbjerg, 2011, p. 309). Yin (2014) adds that “case study is preferred when examining contemporary events, but when the relevant behaviors cannot be manipulated” (p. 12). Traditionally, scholars in the field of expertise have been guarded in the use of case study because the limited number of cases in a study can hinder the application of case data (Parry, et al., 2014), and expert cases are, by definition, incidents of exceptional and not average performance (Mumford, 2006). Despite these points however, case study may be the perfect vehicle in which to study expertise. Mumford, McIntosh, and Mulhearn (2018) state that “the real-world nature of cases and the richness of the data embedded in cases suggest that they provide data of unique ecological value” (p. 292). These authors therefore conclude, “case studies can and should play a more fundamental and prominent role in studies of expertise and expert performance” (p. 303).

The specific case study design employed was descriptive case study. This design is preferred when the purpose of the study is “to describe a phenomenon (the “case”) in



its real-world context” (Yin, 2014, p. 238). Moreover, this was a collective case study, as data was gathered and analyzed from several subjects within the same phenomenon. This design follows Yin’s (2014) embedded single-case (Type 2) design. The case is expert American symphony orchestra French horn players, and the “embedded units of analysis” (Yin, 2014, p. 50) are the eight subjects from six different major orchestras. The benefit of this approach is that the precision, validity, and stability of the findings are strengthened (Miles & Huberman, 1994). The investigation of eight subjects also improves the external validity of the findings (Merriam, 1998). Additionally, multiple embedded units of analysis increase the trustworthiness of the findings through both triangulation and member checking.

### **Selection of Participants**

In the selection of cases, Stake (1995) states that “the first criterion should be to maximize what we can learn” (p. 4). The selection of cases therefore needs to be made with the research question clearly in mind. Merriam (1998) delineates two basic types of sampling: probability (random) sampling, and non-probabilistic, or purposeful sampling. These two broad categories are consistent with Flyvbjerg (2011), who denotes the two categories as random selection and information-oriented selection. The phenomenon under investigation in this study was the maintenance of expertise by experts. The experts in this study are current French horn players in major American symphony orchestras in the Northeast and Midwest. The selection of cases for this study was therefore purposeful and information-oriented. This is consistent with the perspective of Patton (1990) who states, “the logic and power of purposeful sampling lies in selecting *information-rich cases* for study in depth. Information-rich cases are those from which one can learn a

great deal about issues of central importance to the purpose of the research, thus the term *purposeful sampling*” (p. 169, italics original).

The participants in this study were selected from six major American symphony orchestras, three from the Northeast and three from the Midwest. The orchestras from which the participants were selected are: the New York Philharmonic, the Philadelphia Orchestra, the Boston Symphony Orchestra, the Chicago Symphony Orchestra, the Cleveland Orchestra, and the St. Louis Symphony Orchestra. These six orchestras were chosen as they are the most prominent orchestras in their respective regions.

Additionally, all but St. Louis are from the traditional designation “Big Five,” the orchestras that “led the orchestral field since the 1950s in musical excellence, caliber of musicianship, total contract weeks, weekly basic wages, recording guarantees, and paid vacations” (Faulkner, 1973, p. 336). After Chicago and Cleveland, the St. Louis Symphony Orchestra is the other major orchestra from the Midwest, and was added to create balance in the sample: three orchestras from the Midwest and three from the Northeast.

Eight horn players from the six orchestras, at least one from each orchestra, were chosen to participate. This number of participants was chosen to enable significant opportunity for extensive analysis while balancing the larger holistic aspects of the case itself (Yin, 2014, p. 56). Within the constraints of the rigorous performing and teaching schedules that each musician maintains, selection was designed to represent a variety of playing experience, and to achieve nearly the same percentage of female musicians as in the complete horn sections of the six symphony orchestras. As of July 2018, the total number of horn players in the six orchestras was 41, of which 34 were male and 7 were female, or 21% female. The sample for this study is 8, of which 6 are male and 2 are

female, or 25% female. Participants were approached informally by email to inquire as to their willingness to participate; the participants listed below all agreed. These specific musicians were invited because of their membership in one of the listed orchestras, and because of the different number of years of experience in a major professional symphony they represent, while also achieving a similar percentage of female horn players. Once this study was formally approved, a formal invitation (see Appendix A) and a consent letter (see Appendix B) was sent to each horn player by email.

Given that all of the participants agreed to participate, that the sample was appropriately balanced by gender, and that all participants met the selection criteria, there was no participant solicitation plan. However, if an invited participant chose to remove himself/herself from the study for any reason, every effort would have been made to secure a replacement participant from the same orchestra who closely matched the experience and gender of the original participant. This step was not necessary as each horn player enthusiastically accepted the invitation to participate.

### **Participant Biographies (listed alphabetically)**

Richard Deane, Acting Principal Horn, New York Philharmonic. Richard Deane joined the New York Philharmonic in 2014, serving as Associate Principal Horn. Prior to this appointment he served as third horn of the Atlanta Symphony Orchestra for 27 years, participating in more than 80 recordings, including 20 Grammy Award winners. He also performed with the Atlanta Chamber Players and was a member of the Atlanta Symphony Brass Quintet, with which he toured Norway as part of the Olympic cultural exchange between Lillehammer and Atlanta. He has also served as principal horn with the Colorado Philharmonic and the Concerto Soloists of Philadelphia, and in 1987 he earned first prize in the American Horn Competition. Mr. Deane holds music degrees

from the Juilliard School and the University of Cincinnati College-Conservatory of Music (New York Philharmonic, 2018a).

Thomas Jostlein, Associate Principal Horn, St. Louis Symphony Orchestra.

Thomas Jostlein has served as Associate Principal Horn with the St. Louis Symphony since 2010. Prior to this appointment, Mr. Jostlein was Assistant Principal Horn of the New York Philharmonic and ultimately played all positions within the section. During his time with the Philharmonic he performed on major international tours, including the historic live broadcast from North Korea (2008). Prior to his tenure in New York, Mr. Jostlein held positions with the Honolulu, Omaha, Richmond, and Kansas City symphony orchestras. An active soloist, Mr. Jostlein won First Prize in the professional division of the American Horn Competition (2003), and Grand Prize at the Hugo Kauder Music Competition at Yale University (2005). (St. Louis Symphony Orchestra, 2018).

Richard King, Horn Section, Cleveland Orchestra. Richard King joined the Cleveland Orchestra in 1988 as associate principal horn. From 1997 to 2015 he served as principal horn, and currently serves as a horn section member. Mr. King has been featured many times as a soloist with the orchestra, including works by Britten, Haydn, and Mozart. He has also appeared as a soloist with the Richmond Symphony, Tokyo Symphony, and New Zealand's Auckland Philharmonia. Additionally, as a chamber musician and recitalist, Mr. King has performed since 1985 with the Center City Brass Quintet. Their five albums, and his albums, *Chamber Music for Horn* and *Schubert Lieder*, transcribed for horn and piano, have met with wide critical acclaim. Mr. King holds a music degree from the Curtis Institute of Music. (The Cleveland Orchestra, 2018).

Jeffrey Lang, Associate Principal Horn, Philadelphia Orchestra. Jeffrey Lang is the associate principal horn of the Philadelphia Orchestra. Prior to his appointment in Philadelphia, Mr. Lang served as principal horn of the Israel Philharmonic and the American Symphony Orchestra. He has also served as guest principal horn of the Bavarian Radio Orchestra, the New York City Opera, and the Orpheus Chamber Orchestra. An active chamber musician and soloist, Mr. Lang has performed across the United States and abroad to critical acclaim. He has also recorded for several TV, film, and commercial projects, and was principal horn of Disney's long-running Broadway hit *Beauty and the Beast*. Recently, he released a solo horn album, *One World Horn*, a charitable project featuring unaccompanied horn works from around the world. Mr. Lang holds music degrees from the Juilliard School and Temple University Boyer College of Music and Dance (The Philadelphia Orchestra, 2018a).

Jennifer Montone, Principal Horn, Philadelphia Orchestra. Jennifer Montone has served as principal horn of the Philadelphia Orchestra since 2006. Prior to this appointment, she was principal horn of the St. Louis Symphony, and associate principal horn of the Dallas Symphony. Ms. Montone has also served as third horn of the New Jersey Symphony, and performed as a guest artist with the Berlin Philharmonic, the Cleveland Orchestra, the Metropolitan Orchestra, the Saint Paul Chamber Orchestra, the Orpheus Chamber Orchestra, and the New York Philharmonic. As a soloist she has performed with many orchestras, and her recording of the Penderecki Horn Concerto with the Warsaw National Philharmonic won a Grammy Award (2013). Her other recordings include *Jennifer Montone Performs*, her first solo CD, *Still Falls the Rain*, works of Benjamin Britten, and *Gabrielli* with the National Brass Ensemble. Ms. Montone holds a music degree from the Juilliard School (Philadelphia Orchestra, 2018b).

James Smelser, Second Horn, Chicago Symphony Orchestra. James Smelser has served as second horn of the Chicago Symphony Orchestra since 2000, fulfilling a lifelong dream to join the Chicago Symphony. In addition, he has served as principal horn with the Philharmonia Hungarica, the Deutsche Opera am Rhein in Dusseldorf, Germany, and utility horn with the San Francisco Symphony. He has also performed with the Gottingen Symphonieorchester, the Dresden Staatskapelle, the Israel Philharmonic, and the Shanghai Radio Symphony Orchestra. Beyond his orchestral work, Mr. Smelser has played in many Broadway shows, ballet, and radio and TV commercials. Mr. Smelser holds music degrees from the Northwestern University School of Music (Chicago Symphony Orchestra, 2018).

Jason Snider, Fourth Horn, Boston Symphony Orchestra. Jason Snider has served as fourth horn of the Boston Symphony Orchestra since 2007. Prior to this appointment, he was second horn of the Lyric Opera of Chicago, and associate principal horn of the San Antonio Symphony. Additionally, he has performed with the Civic Orchestra of Chicago, the Chicago Symphony Orchestra, the Houston Symphony Orchestra, the Houston Grand Opera, the Chicago Chamber Musicians, and the Boston Chamber Music Society. He has also performed at numerous internationally acclaimed music festivals, including Sun Valley, Grant Park, the Grand Tetons, and the Pacific Music Festival in Japan. Mr. Snider holds music degrees from the Northwestern University School of Music, and the Rice University Shepherd School of Music (Boston Symphony Orchestra, 2018).

Leelanee Sterrett, Acting Associate Principal Horn, New York Philharmonic. Leelanee Sterrett joined the New York Philharmonic in 2013, initially serving as third horn. Ms. Sterrett holds the distinction of being the first female brass player in the

orchestra's 176-year history to earn tenure. Prior to her appointment to the Philharmonic, Ms. Sterrett performed with the New Haven Symphony Orchestra and was a regular substitute with the New York Philharmonic. She has made solo appearances at Carnegie Hall and at the International Horn Symposium. Ms. Sterrett has spent summers at the Tanglewood Music Center, the Pacific and Sarasota music festivals, the National Orchestra Institute, and the Banff Centre for the Arts. She is a past prizewinner in the International Horn Competition of America and the Yamaha Young Performing Artists Program. Ms. Sterrett holds music degrees from the University of Wisconsin-Madison and the Yale University School of Music (New York Philharmonic, 2018b).

### **Data Collection**

Data collection was in the form of interviews. Interviews were conducted using the Skype computer program, Facetime, or phone, and the audio was digitally recorded. The interview protocol (see Appendix C) was based on specific studies in the literature review, specific books on French horn pedagogy, and on the research question itself. Topics of focus included practice routines, warm-up procedures, and approaches to specific elements of horn playing such as breathing, tone, range, and articulation.

Field notes were taken during and after each interview to clarify specific points and underscore any particular emphasis noted by a subject. Recorded interviews were transcribed professionally by Windy City Transcription, located in the Chicagoland area. As soon as the interview transcripts were received, the researcher sent the transcription to each participant for clarification, addition, deletion, or amendment.

Additional data included works authored by the participant and works written about the participant. This was material readily available, including books or published articles authored by the participant, published interviews, artists' websites, biographies,

and blog posts. This information was collected through web search, not by asking the participant, and served to prepare the primary investigator for the interview. With this background, basic preliminary and biographical information was recorded, thereby enabling more time in the interview to investigate the central research question.

### **Data Analysis**

Data collected was coded by hand and the researcher was the main analyst. Since the sample size was small, hand coding was preferred, and avoided the distance between researcher and data that is one of the disadvantages of computer use in qualitative data analysis (Creswell, 2007). The codes were a combination of predetermined (“a priori”) and emergent codes. The predetermined codes were derived from the review of literature, the content of published books on horn pedagogy, and from my professional experience as a horn player. These were organized into the following five categories (see Code Table in Appendix D):

- Practice procedure (Hallam, 1995; Harnum, 2013; Gardner, 2014; Reynolds, 1997). Practice has been defined as “that which achieves the desired end-product in as short a time as possible, without interfering negatively with longer term goals” (Hallam, 1997b, p. 181). Given that musical practice is multi-faceted, involving technical, musical, cognitive, and metacognitive skills, effective practice involves a clear procedure. Jorgensen (1995) proposes three categories: planning, the conduct of practice, and the evaluation of practice. Sloboda et al. (1996) focus on the systematic acquisition of technical, musical, and cognitive skill. This is consistent with the deliberate practice approach proposed by Ericsson et al. (1993), which is goal-oriented, effortful, and structured practice. Additionally, Hallam (1997a) found that metacognitive abilities were central in



determining the nature of the practice undertaken by musical experts. These are defined as acute self-awareness of strengths and weaknesses, the nature of varying tasks and how to complete them, goal setting, and motivation. In this study, specific questions were asked about goal setting, motivation, and practice procedure.

- Warm-up procedure (Hallam, 1995, 1997a; Harnum, 2013; Gardner, 2014; Reynolds, 1997; Farkas, 1956). The term “warm-up” broadly encompasses “the mental and physical activities that precede the playing of the instrument in a musical sense” (Reynolds, 1997, p. 21). Reynolds draws parallels with tennis players, golfers and runners and states that “warm-up serves to refresh, remind, and rehearse the physical fundamentals of the game” (p. 21). Farkas (1956) also makes a comparison to athletes, stating that it “is as essential to the brass player as it is to the athlete” (p. 31), and its purpose includes awakening the embouchure, developing deep breathing, and reviewing fundamentals of playing techniques. Gardner (2014) believes that “a brass player’s warm-up session is the most important part of their practice day” (p. 137), and adds that, “The need for a warm-up to foster long-term excellence and help prevent injuries, for athletes and musicians, increases with age” (p. 137). Research in the practice procedures of professional musicians indicates that nearly all begin their practice sessions with some form of warm-up (Hallam, 1995, 1997a).
- Horn specifics (Gardner, 2014; Reynolds, 1997; Wekre, 1994; Farkas, 1956). Many of the leading horn pedagogues and authors have organized their thoughts and writing around certain specific topics of horn playing. Questions in this category were based on the specific topics identified by those authors. They were:

breathing, mouthpiece buzzing, tone, flexibility, articulation, range, dynamic range, and endurance.

- Pre-service routines at the rehearsal and performance hall. Expert symphony orchestra horn players will likely adjust their routines based on rehearsal schedules and performance demands. Gardner (2014) notes that “your fine tuning preparations will be different if you are scheduled to play a jazz show than they will be if you are preparing to perform a Mahler or Mozart Symphony” (p. 138). Specific questions were asked about pre-rehearsal and pre-performance routines that take place after arrival at a rehearsal or performance site, but before the service begins. This included any non-horn habits that help prepare for each.
- Non-horn practices, habits, or activities that contribute to horn playing expertise. Wekre (1994) notes that an important ingredient in effective self-teaching and horn playing is “having a sensible life-style” which helps to “build and save energy rather than to destroy it” (p. 60). These included vacations, relaxation and/or focus techniques, physical activity, and food and drink that have a positive or negative impact on playing.

Emergent codes were included as new information and directions were discovered during the interviews, and because of the possibility that a predetermined code may be found to be too vague or specific, necessitating the creation of a new code. The primary analysis was cross-case. All participants were coded and then data from all cases under a specific code were brought together.

### **Trustworthiness**

One of the primary aspects of trustworthiness is triangulation. Triangulation occurred across the participants through the cross-case analysis. Further triangulation was

achieved through data collected from books, published articles, workshops, masterclasses, interviews, blog posts, or participant websites.

In addition to triangulation, trustworthiness was increased by ensuring that participants felt comfortable with how they are represented within the study. Due to the prominent nature of these participants, their names and affiliations have been used; their identities were not kept confidential. Given that their names and positions are used, it was important that each participant felt comfortable with how he/she was represented. After transcription of each interview, a copy was sent to each participant to add, delete, amend, clarify, or correct any portion or portions of the interview, and to ensure that the participant's information and perspectives were recorded accurately.

Yin (2014) states that case study researchers are prone "to substantiate a preconceived position because they must understand the issues beforehand, and this understanding may undesirably sway them toward supportive evidence and away from contrary evidence" (p. 76). Yin suggests that a test of this potential bias is "the degree to which you are open to contrary evidence" (p. 76). To that end, he recommends that preliminary findings be reported to two or three critical colleagues, who should offer alternative explanations. For that purpose, this document has been reviewed at various points by dissertation advisor William Berz, and by dissertation committee member Randy Gardner, professional French hornist, long-serving second hornist of the Philadelphia Orchestra, and Professor Emeritus of Horn at the University of Cincinnati College-Conservatory of Music. Input from the other dissertation committee members have served to further clarify and refine this document.

### **Addressing Researcher Bias**

Fay (1996) asked the question, “Do you have to be one to know one?” (p.9). Qualitative researchers have an inherent paradoxical role: to be sharply tuned-in to the experiences and understandings of others, what Maykut and Morehouse (1994) call, “to indwell” (p. 123), while at the same time maintaining awareness of one’s own biases and preconceived understandings. This insider/outsider dichotomy in qualitative research is an ongoing discussion (Greene, 2014; Chavez, 2008; Breen, 2007). The benefits of being an insider are immediate acceptance, openness, and greater willingness of the participant to share experiences. However, being an insider could cloud the researcher’s perceptions, effect analysis, and lead to inaccurate findings (Dwyer & Buckle, 2009). Being an outsider could enable the researcher to more adequately conceptualize the experience under study, to see through inherent complexity, to appreciate wider perspectives, and disentangle from various emotional elements, such as fear and self-protection (Fay, 1996). While awareness of this dichotomy is essential, Acker (2000) concludes that the insider/outsider question cannot be fully resolved, but rather, we should find a way to work creatively within the inherent tension. Dwyer and Buckle (2009) call this “the space between,” and urge researchers to embrace the complexity and richness found between these two entrenched perspectives.

As a researcher I hold both an insider and an outsider perspective on this topic. I hold an insider perspective because I am a French horn player. My history of French horn study and performance spans more than 45 years, and includes formal study during undergraduate, graduate, and post-graduate education years with highly regarded horn performers and pedagogues. It also includes formal study as part of my continuing education throughout my long career as a public school music educator. As a performer, I

have been a member of a local symphony for decades. I have an outsider perspective because I am not a professional symphony orchestra musician and have not had the responsibility to maintain a high level of performing expertise throughout my career. While I have had brief interaction with three of the subjects in this study in the past (one more than 10 years ago, and two more than 30 years ago), the remaining participants were unknown until the informal invitation was accepted.

Confirmation bias connotes “the seeking or interpreting of evidence in ways that are partial to existing beliefs, expectations, or a hypothesis in hand” (Nickerson, 1998, p. 175). Research shows that those who study expertise must always contend with looking for confirmation of what they believe even in the presence of inconclusive or contradictory evidence (Lord, Ross, & Lepper, 1979; Wason, 1960; Sternberg, 1996). As this study was undertaken, a few additional biases were stated. I believe that the musicians in this study practice regularly to maintain their expertise, and I believe that their practice resembles the concept of deliberate practice outlined by Ericsson et al. (1993). I suspect that their practice includes a daily warm-up routine, which I assume remains largely unchanged from day to day. I believe that certain specific topics are addressed regularly, such as breathing, tone, flexibility, range, articulation, intonation, dynamics, and endurance, but likely, approaches to each vary within and between players. During analysis, careful attention was given to both similarities and differences in these areas. Because of these natural biases, it was important to remain intentional about maintaining an open mind when analyzing data from all areas to enable the discovery of emergent themes, and/or any contrary evidence.

### **Confidentiality**

This study was approved by the Rutgers Institutional Review Board (see Appendix E). Participants were specifically asked to confirm that their full name and orchestral affiliation can be included in this study (see consent letter, Appendix A). In accordance with IRB procedures, all data has been kept on the secure Rutgers OneDrive. The researcher is the only person with access to this password protected file. Hardcopies of data files were shared with my doctoral advisor or research director as needed during the analysis and writing stages of the dissertation. Recorded interviews were submitted for professional transcription via a secure link to the files, preventing the transcription company to access anything other than the audio files. All audio files will be destroyed once this study is complete.

### **Limitations of the Study**

The study of expertise in any domain contains unique challenges due to the nature of expertise itself. Chief among them is the fact that because so much of their knowledge is instinctive, experts often have great difficulty attempting to, or simply cannot, articulate their knowledge or processes (Chi, 2006). Additionally, a paradox sometimes occurs when, as an expert increases their expertise, they lose awareness of what they do and how they do it (Kidd & Welbank, 1994). Skills and knowledge that have been mastered become so integrated, autonomous, and virtually unconscious that verbal description is nearly impossible (Harnum, 2013). In addition to carefully-designed questions and sequencing of questions, sensitivity to, perception of, and quick adaptation to the subtleties, nuances, and idiosyncrasies of each subject during each interview is essential. The questioner must be able to quickly adapt to the subject's personality, style, and potential agenda (Hoffman & Lintern, 2006). Furthermore, Yin (2014) notes that

case study data collection is not simply the act of recording data, but rather, the ability “to *interpret* the information as it is being collected and to know immediately, for instance, if several sources of information contradict one another and lead to the need for additional evidence—much like a good detective” (p. 76, italics original).

Regarding the use of case study methodology, Flyvbjerg (2006) identifies several common disadvantages, including difficulty of generalizing from a single case, difficulty summarizing case studies, and the possibility that case studies can contain a bias toward verification. This case study investigated eight horn experts. While the results provide rich and specific information about the habits and practices of these musicians, their practices may not necessarily be the same as horn experts from other major symphony orchestras, or the same as horn experts not currently performing in symphony orchestras. Generalizing and summarizing beyond the participants in this sample is not recommended. Yin (2009) notes that case studies are often seen as preliminary or exploratory and cannot be used to test theories. This case study was indeed exploratory and was not intended to test any theories. However, the findings of this study could provide the foundation for further research in the practices of expert musicians in which specific theories and questions could be tested.

Merriam (2009) cautions that the thick, descriptive nature of case studies may prohibit investigation due to constraints of time and money and may be too detailed and lengthy to use by practitioners. This is consistent with Harnum (2013) who believes that the complex nature of cases, and the complexity of data collected, could be a limitation. To address these concerns, the interview protocol was carefully designed to address specific areas of the maintenance of horn expertise, and were reviewed by committee members and outside readers for this purpose. According to Yin (2009) the greatest

concern is lack of rigor, specifically, not following systematic procedures, and the possibility of bias and/or questionable evidence influencing findings and conclusions. Some have also questioned case study's value because of the interactive role of the researcher. Rather than acting or observing at a distance, the researcher may unwittingly guide the subject(s) toward desired results (Garger, 2013). The concerns about systematic procedure and the interactive role of the researcher were addressed by staying very close to the interview protocol, and by consistent note-taking procedure. Data collection, coding, and analysis were all conducted within very specific and limited time periods to ensure that time did not interfere with systematic and consistent research procedure. The issue of bias is present in every researcher and is discussed in the "Addressing Researcher Bias" section above.

Finally, the number of subjects studied could be problematic in this type of study. Merriam (1998) has noted that with a greater number of cases or subjects included in a study, there likely will be a lack of depth in any single case. The inclusion of eight subjects in this study, however, was intended to understand the habits and practices of expert professional French hornists more deeply, while recognizing the potential limits of generalizability. The goal was to learn what the experts do, and then to consider how or if these findings might improve the horn pedagogy of instrumental music teachers, enhance the practice procedures of horn students and aspiring professionals, and potentially enlarge the body of research in both music practice and in the study of expertise. Additionally, the evidence from multiple subjects is more robust (Herriott & Firestone, 1983), and therefore more generalizable. The results provide more compelling support for initial propositions, similar to a single-case replication design, or the replication logic of multiple case studies.



## Chapter 4 – Results

The purpose of this study was to identify the practice procedures and habits of expert French horn players in six major American symphony orchestras, three from the Northeast and three from the Midwest. The orchestras represented are: the Boston Symphony, the New York Philharmonic, the Philadelphia Orchestra, the Cleveland Orchestra, the Chicago Symphony, and the St. Louis Symphony. One horn player from each orchestra, and two from New York and Philadelphia, were included in the study. Data was collected through semi-structured interviews conducted by phone or online through Skype. Each interview was digitally recorded and professionally transcribed. A wide range of professional experience is represented in the participant group, as detailed in Table 1.

Table 1

*Professional Experience of the Participants (as of December 2018)*

<b>Participant</b>	<b>Orchestra</b>	<b>Years</b>	<b>Years Pro</b>
Richard Deane	New York Philharmonic	4	33
Thomas Jostlein	St. Louis Symphony	9	24
Richard King	Cleveland Orchestra	30	30
Jeff Lang	Philadelphia Orchestra	16	36
Jennifer Montone	Philadelphia Orchestra	13	21
James Smelser	Chicago Symphony	19	28
Jason Snider	Boston Symphony	12	23
Leelanee Sterrett	New York Philharmonic	6	9

This chapter presents the findings of the study and is organized by the categories of questions detailed in the Interview Protocol (Appendix C). The categories included are: Warm-up Procedure, Practice Procedure, Horn Specifics, and Non-Horn Practices. In the discussion of each of these topics, findings will be presented, areas of similarities and differences noted, and representative statements from the participants will be included when appropriate.

### **Warm-up Procedure**

The concept of “warming up” has long-been an accepted practice among horn players. Farkas (1956) notes that the “warm up is a necessity in the morning or when first picking-up the horn for the day...it will start the embouchure off properly for the entire day” (p. 31). Reynolds (1997) defines the term warm up as a “convenient way to encompass the mental and physical activities that precede the playing of the instrument in the physical sense... and should gently and gradually awaken all of the elements of playing and particularly those related to response and flexibility.” (p. 21). Hill (2001) notes that a warm up reacquaints the embouchure with the mouthpiece and should cover “all of the basic technical needs of horn playing” (13). Warming up for practice and for performance were each investigated.

#### **Warm up: Practice**

Each of the participants in this study perform some form of warm up each day, but approaches vary. All but three of the participants have a flexible warm up routine. Of the remaining three, one has a consistent routine with some variability, one has a very strict routine, and one has nearly no routine at all.

**Flexible Routines.** These routines have similar elements from day to day, but vary based on the current performance schedule and/or the personal conditioning or

fatigue of the player. Jeff Lang stated, “I do not have a strict warm-up routine that I do every day.” He has tried using a strict daily routine but found that it leaves him, “very stiff and tired.” Instead, he will “warm-up to my needs for the playing that day and how I feel. My warm-up is basically different every day.” Lang elaborated:

I always start with a little light mouthpiece buzzing with very light breath attacks on the mouthpiece just to get the lips vibrating, and then I put it in the horn and do the same thing. I start in the middle and I gradually expand in both directions, higher and lower as I start to warm-up. The key elements for me in a warm-up are very little pressure, not loud, not high, and with just a very even, steady, warm airstream breath attack, to get the articulation going, and to eventually expand. For example, I’ll start on a G in the staff, then eventually expand that down to the lower G and up to the higher G. I’ve covered two octaves of very easy range, not loud, and with very little pressure. I do that either with scales, usually chromatic...until I get to the two octaves. (Interview, 12/8/19)

Among his objectives, Lang uses his warm-up to assess “his chops” that day, which informs the rest of his practicing.

Similarly, Richard King does not follow a strict routine but uses his initial time with the horn to assess how things are working: “I start playing softly, middle register, chromatically, and then I see how it feels and how it sounds, and if it’s going well then, I proceed onto arpeggios and things like that.” Following this he will add, “scales and arpeggios usually at a very reasonable dynamic, depending if it’s actually a warm-up and not practicing for fitness, like warming up for work.” King served as Principal Horn of the Cleveland Orchestra for eighteen years and offered this additional thought:

...as a first horn player [my warm up] would be gauged primarily on repertoire. If it was a big orchestra piece or week, my warm-up would necessarily be extended so I could get into actual game shape for rehearsals and concerts. It’s chromatics, arpeggios, and scales, mostly slurred and then starting as articulation. I had to be careful while warming up on heavier concerts not to play into fatigue because you can get going and not even realize that you’re actually wearing yourself out after a while. (Interview, 12/3/18)

Now in his fourth season as fourth horn of the Cleveland Orchestra, after some scales and arpeggios, he adjusts his warm up to fit the coming repertoire.

James Smelser of the Chicago Symphony used to do a lengthy warm-up “because I had to; I just couldn’t play a darn thing, you know, you’re stiff and puffy or whatever.” His teacher, Dale Clevenger, insisted that he learn how to play without relying on a warm up routine. Smelser describes his current procedure:

I’ll start off on a couple of different notes, a C, or G, or F, and work a chromatic scale between C and second line G. The purpose is to feel the softness of the transition between the notes and the quality of the sound. Then, I’ll just play a chromatic scale middle C to third space C over and over and over again with different types of air pressure and different volumes, to get the air moving and to slowly, like an accordion in and out, stretch the range. (Interview, 12/19/18)

Jennifer Montone’s warm up is also flexible, and is a mixture of different things from many sources. She begins without the horn, and views her warm-up as being separate from a practice of “basics.”

I begin by stretching, doing a few of the exercises from the *Breathing Gym*, and a few yoga exercises, to get my body feeling stretched out and ready to go. Then I begin playing with a few of the Carmine Caruso exercises from his book *Musical Calisthenics for Brass*.... I like to think of my warm up as being distinctly separate from my basics practice, in that the warm up needs to help prepare us for our day. So in the morning, I’ll prioritize the exercises (or parts of the exercises) that help me be ready for whatever I am playing that day, and I’ll return to anything that is more extensive basics practice, or involves heavy lifting (high register work in particular), later in the day. (Email, 2/27/19)

Montone also does a little mouthpiece buzzing, a scale or two from the Pares Scales (1952) book with gentle crescendos and decrescendos, slurred and then tongued, and then three-octave arpeggios, slowly and loudly. She finishes her morning warm up with “noodles and snakes” from her teacher Julie Landsman. These are exercises for flexibility that “help me feel confident that I can get around the horn smoothly and efficiently, riding the air stream, not moving my chops too much or stopping the air on big leaps. They both help break registers as well.”

Echoing her colleagues, Leelanee Sterrett describes her warm up: “I’m really, really loose when it comes to a routine. I don’t do the same thing every day; I do similar

things every day and I just grab from all the different categories.” Framing that variability, there are hints of a routine. Sterrett begins her day with free buzzing and mouthpiece buzzing for about 15 minutes. This consists of diatonic patterns within a limited range. From there, she adds the extra lead pipe tuning bit from her triple horn:

...for a little bit of extra resistance on the end of the mouthpiece. I go as high as is possible for me to maintain my actual embouchure aperture. As soon as I feel myself changing things in a way that I wouldn't on the horn in order to get higher or get lower, that's my time to stop. So, I try to keep my mouthpiece buzzing exactly what I'd do on the horn in theory...those are the two pieces of my warm-up that I do every day and from there, I'm pretty divergent as far as what feels good on that day. (Interview, 12/2/18)

Sterrett notes that there are three crucial elements in her warm up from which she creates many exercises:

1) Playing on open harmonics basically, on all different combinations. 2) I play triple horn so I use all three sides of the horn, and I try to do those throughout the range too. 3) Incorporating scale arpeggio patterns and things like this just from a fundamental basis. Then everything else, like dynamics, articulations, and slurs gets layered within that framework. (Interview, 12/2/18)

In conclusion, she stated: “I definitely do a routine. Do I have a routine? No, absolutely not!”

**Semi-Strict Routine.** This routine is largely the same each day, but varies in articulation order (slurring then tonguing), starting octave, and direction. Jason Snider uses this warm up, which comes from an out-of-print book, *Basic Technical Studies for the French Horn* by Harold Meek (1947). Snider notes that the warm-up is “simple and approachable” and it covers the full range of the instrument. Describing the routine from the book, he says:

It's literally long tones, interval studies, scales in thirds, fourths, and fifths, and octave things. I will also do some flexibility studies, scales, and arpeggios moving up and down the range of the instrument, and more long tones at the end. Whole notes starting on middle C with a fermata, no decrescendo, no crescendo, just trying to get a steady tone. I'll use just a breath entrance because I'm trying to see how the air and the chops are responding. If that's gotten blown-out in the

orchestra, that's the first thing to fix for me. It's not so much worrying about the accuracy for me, it's that the notes speak and respond quickly and easily and consistently. (Interview, 11/16/18)

From here the routine moves to interval studies. Snider varies these from day to day: "I slur on the way up so I'm practicing slurring, and then on the way down I tongue things and the next day I tongue on the way up and I slur on the way down, just alternating." Next are arpeggio and scale exercises. With the scales he starts in different octaves on different days so that, "I am practicing starting on a high C in my scales at least every other day, or a high B." As fourth horn of the Boston Symphony, Snider notes that it is easy to go weeks without playing a high passage, which is why he incorporates these high scales into his warm up. Commenting on the flexibility within his routine, Snider adds:

I like to take a simple warm-up and then vary it so that over the course of how I practice it, I'm covering everything that I need. It's always moving in different directions...I don't always start on the low note and go up. I find that it's good for my embouchure knowing and remembering that air speeds are different when you come in on a high note versus a low note. (Interview, 11/16/18)

Snider uses these basic exercises as a scaffold on which to build his practicing.

**Strict Routine.** A strict routine is one that is the same each day. This standard sequence of exercises is the point of reference that enables the player to develop consistency and strength, and to monitor themselves against a self-determined ideal.

Richard Deane uses this type of structure:

I'm a firm believer that the body needs to have a period of time every single day where you're doing exactly the same thing, and I mean exactly the same thing. So, I do about forty-five minutes of a sequence of things in order to address certain technical parameters, making sure that the feeling engendered by dealing with those parameters is something that I'm really focusing on. So, I'm addressing technique, searching for a feeling, and reemphasizing a hundred percent, the type of nerve pathways that I'm going to have to use when I play for real during the day. (Interview, 12/6/18)

Deane lists six specific exercises. The first two are major scales:

The first thing I do is a set of thirteen diatonic slurred scales, ascending by half-steps, starting on low C. So, I'll address all three octaves of the horn that way, and the main reason for that is to feel the flow of the air. My second thing is I go back down to the low C and I do the exact same thing again, but with a fairly short tongue. (Interview, 12/6/18)

Following these scales, he does a set of expanding harmonic series exercises starting on middle C through the first five harmonics, then up to the E, then add another two to the G. He then moves to the Third Study from *Technical Studies for the Cornet* (Clarke, 1984), starting on first-space F and through to third-space C. The objective with both of these is “blowing in between the notes,” the pervasiveness of the airstream, and awareness of the necessary muscular structures that enable it all.

The final step in Deane's routine comes from his book, *The Efficient Approach: Accelerated Development for the Horn* (Deane, 2017). These exercises are called “Smears” and are found on pp. 64-65 of the book. Deane describes:

I start on the F horn, 1 and 3 on the G at the bottom of the treble clef staff. I do the long tube because I want as many harmonics in there as possible. I blow through an octave up and an octave down really paying attention to what's going on with the air in the face and not worrying about the note so much. In other words, I'm more playing the tube rather than playing the notes. [From] second line G, I go all the way up to as high as I feel like I can, so I'll switch to the high F horn after I've reached the high C and I'll go starting on C sharp high F horn 1, 2, 3 and I'll go up to high C sharp, high F1, 1,3, I'll go up to high D and if I'm still feeling like it's worthwhile I'll go up to the E flat and E if it's coming out; if it's not I just kind of leave it. (Interview, 12/6/18)

Deane values of the strict routine because “just by doing the same thing over and over again it becomes hardwired in your body that way.” His routine is designed to address issues throughout the range of the horn, and the many responsibilities of his position as Acting Principal Horn of the New York Philharmonic. Regarding his routine, Deane concludes: “I just never skip it. I'm definitely not the type of horn player that picks the horn up and just plays.”

**Nearly No Routine.** At the opposite end of the spectrum are those players who do not use an organized warm up routine; Thomas Jostlein is one such example. When asked about his warm up, he replied, “I’m different; I don’t warm up except for getting my mind on music” (Email, 3/23/19). His approach is focused on the story-telling aspects of being a musician. He recalled a reply that renowned tubist Arnold Jacobs used when asked about his warm up. Jacobs would “get a cup of coffee and set his horn against a radiator.” Jostlein’s concept of warm up is rooted in his study with Jacobs:

...your warm-up should be getting your mind focused on music, so flood your brain with musical thoughts. Don’t concern yourself at all with these technical aspects of making a sound.... The reason is you want to be living in the world of storytelling where you’re not receiving information, instead, you’re one hundred percent telling a story. (Interview, 12/11/18)

While he does not have a warm-up routine in the traditional sense, Jostlein does prepare for his playing:

Every day, if I’m going to a concert, rehearsal, or personal practice, I buzz a couple of melodies on the mouthpiece. It can be the piece you’re about to perform, it can be Christmas songs, it can be a Mozart Concerto, something very simple and I buzz it very loudly. I don’t want to be in the realm of wondering if the lips are going to work. I want to be again story-telling and I do a little doodle-buzzing. Then if I’m at home, I would put on a drone, a very loud drone...to feed the singing. (Interview, 12/11/18)

He is entirely focused on the product and not the process. “If we have any awareness of our horn sound while we’re playing, what happens to our singing in our minds, it basically goes out the window.” The goal is to “...establish what is right, establish what you want to sound like. Don’t worry about reacting, don’t listen, be one hundred percent singing.” At the conclusion of this procedure, Jostlein is ready: “I can perform at the highest level.”



## Warm up: Performance

Since performance is the goal of each participant within their respective orchestras, the question of warm up procedure prior to a concert was also investigated. All eight horn players do warm up at the hall before a concert. Seven of the eight do an abbreviated version of their earlier warm up, often with excerpts from what is about to be played. Table 2 provides brief descriptions of each participant's pre-concert warm up.

Table 2

### *Warm up: Performance*

Participant	Performance Warm up
Jeff Lang	If there is a rehearsal in the morning and a performance in the evening, the amount of warm-up time backstage is very little and it's very random doodling on the horn. I'll go out onstage and play through my passages, play through my solos. That would still be categorized as a warm-up because that is more like a mental thing and more preparation for the game kind of thing. I'll often just play lightly through the solos or the tricky passages I have to play.
Richard King	Warm-up for performance is exactly the same.
James Smelser	Almost every day of a performance you've had a rehearsal or you're teaching, there is some kind of playing. I don't go back and do the warm-up again. I will make sure that I'm onstage maybe ten minutes before. I'll play the third horn solo in Brahms 3, or the Beethoven <i>Rondino</i> . I do that a couple of times softly, always lines and melodies. I'll play the opening of Bruckner 7 onstage while everybody is noodling around.
Jennifer Montone	I don't tend to do a full warm-up before a concert if I've already warmed up earlier in the day. I'll just touch it and make sure that I still feel okay. A lot of times my pre-concert routines have more to do with breathing, stretching, and meditation than it does with the face or the routine. So, it's more of a mental thing, getting myself in the zone and in the right place musically and then eventually, concentration-wise.
Leelanee Sterrett	I tend to do more noodle-type things as a pre-concert warm up. I always like to play a little bit before I go change into my concert clothes, so the horn is ready for me by the time I put the uniform on. I like to spend at least 15 or 20 minutes with the horn, the noodling thing...a combination of quick, fast harmonics with tonguing.... But nothing that is the same from day-to-day.

Table 2 (continued).

Jason Snider	I do an abbreviated version of the Harold Meek warm-ups...while I do have a routine I don't want to feel chained to it. While it might make me a better player, I think there are trade-offs to having a routine like that because...you can't always guarantee that you're going to be able to get that whole routine in.
Richard Deane	When I come in for the concert, I'll do an abbreviated version again. I figured out that that's what works for me. I hate it sometimes, and I hate having to do it, but only rarely...it makes me feel so secure.
Thomas Jostlein	I basically get onstage with seven or eight minutes to the downbeat and I buzz a couple of pieces first.... I play some excerpts of the piece I'm about to perform, but I never do arpeggios or noodles or scales or whatever. I will be onstage at 7:53, and that's my warm-up.

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### Practice Procedure

Lehman and Gruber (2006) note that “practice is omnipresent during the development of expertise in music” (p. 458). The results of this study indicate that practice is also omnipresent in the maintenance of expertise among these eight horn experts. Ericsson, Krampe, and Tesch-Romer (1993) first introduced the concept of “deliberate practice,” which they defined as, “a highly structured activity, the explicit goal of which is to improve performance. Specific tasks are invented to overcome weaknesses, and performance is carefully monitored to provide cues for ways to improve it further” (p. 368). Harnum (2013) maintains a broader perspective, stating that “anything that increases your musical ability is practice” (p. 12). Farkas (1956) calls it “the foundation of a performer’s musicianship and technical proficiency” (p. 30). Hill (2001) insists that it should be “well-planned and diverse, as well as very regular” (p. 11), and McWilliam (2014) notes that, “We have to do the work if we want to improve and we have to do it to stay in shape” (p. 24).

The findings of this study indicate that all eight participants do practice, but that the timing, duration, and content of their sessions are directly influenced by orchestral schedules, current and future repertoire, teaching schedules, and family. This is consistent with the findings of Krampe and Ericsson (1995), who in a study of distinguished violinists in the Berlin Philharmonic and the Radio Symphony Orchestra, found that “the requirements of a prestigious orchestral appointment seem to limit available time and energy for individual practice...” (p. 95). The following discussion provides statements about practicing under the following headings: motivation to practice, scheduling and length of time, practice content, specific goals, heavy weeks vs. light weeks, practice on tour, and maintaining and advancing artistry and musicianship.

### **Motivation to Practice**

Despite their level of professional attainment, all eight horn experts in this study indicated strong motivation to practice, citing both internal and external motivation. Internal motivation was defined as sounding good, improving ability, and/or enjoyment. External motivation was defined as an upcoming performance, recording, audition, or learning new repertoire. Sounding good, repertoire deadlines, maintaining fitness, and honoring the colleagues in their respective orchestras were common themes. Sterrett elaborated:

People expect that I am going to sound a certain way and internally, that really drives me too. So, I have to live up to my own standards every week. I feel like I’ve set a certain precedent for my level of preparation and what my colleagues can expect from me; they both enable each other. (Interview, 12/2/18)

She also noted that “it just feels so much better and so much more enjoyable when you’ve done your homework.” Smelser offered similar thoughts, and highlighted the motivation that comes from improvement: “I really like noticing yourself getting better, feeling that you’re getting more comfortable with something, or you’re actually achieving something

at this point.... You're still learning, you're still improving at this point; that's a great feeling."

Emphasizing his personal drive, and his desire to honor his New York Philharmonic colleagues, Deane stated:

I will not let my colleagues down, I just am not going to do it, and I'm not going to let myself down either. I'm trying to get better, and that's my motivation. When you play with people at the level that I do, it's not acceptable to go in and just play the notes, you've got to be an artist too. (Interview, 12/6/18)

King noted that his primary motivation is not the pressure of an upcoming performance, although that is certainly important. For him, his motivation is "the joy of being in shape" balanced with upcoming concerts. Similar to Deane, his motivation comes from, "the fear of letting all these great people [in the orchestra] down by not pulling your weight.... To keep up the standard, that's real motivation." Montone offered similar thoughts regarding motivation and her colleagues. She said that she is driven "to always do justice to my job. This is a ridiculous position to be in, I want to honor that and honor this orchestra."

Regarding his motivation to practice, Lang stated that, "staying in shape and maintaining playing is absolutely necessary as you get older as a brass player... I'm not practicing now to be a good horn player; I'm practicing to stay a good horn player."

Snider noted the influence of a recording or a colleague as a source of motivation:

Maybe I've listened to a recording and I think wow, that sounds great; I wonder if I can do that. Or, I've been inspired by something we've done at work recently, something I've heard my colleagues do, or a soloist. But basically, it's trying to make the sounds on the horn that I want to make that eludes me so much of the time. The control, that is what has always motivated me. (Interview, 11/16/18)

Adding chamber music or other performances outside of the orchestra provides additional motivation. He added that he enjoys the challenge of "figuring out whether it's time to beat your head against the wall and make it happen, or to move on and see if you learn it in a different way." Jostlein stated that his motivation comes from the music itself:

I really get excited by the pieces, the history of them, by the composer, why do they orchestrate this certain way, what's my role. But basically, the music is really what inspires me...how much can I liberate myself from the instrument; how much can I just be singing and not caring a speck of how I sound or how I feel? (Interview, 12/11/18)

### **Scheduling and Length of Time**

Each of the eight horn players in this study maintain busy professional schedules with their respective orchestras, teaching, outside solo work, and various other projects, all of which directly impact the scheduling of practice sessions. In their responses, three subtle patterns emerged: variable, variable and some schedule, and a focus on light days. The following discussion is divided into those categories.

**Variable.** Four of the eight horn players indicated that their practicing is scheduled based on performing and teaching schedules without additional specific scheduled times. Smelser states, "In short, there is very little time to practice, say practice for enjoyment, practice for maintenance, there is very, very little time for that because you have to be sensitive to the demands of what you have to do." Smelser elaborated further:

I find myself practicing in small little segments. If you have time between students, or after you're done teaching and you have ten or fifteen minutes, you might do a little bit of something. Or, if you're onstage in the intermission of a concert, obviously nothing loud, but some low impact things, maybe some sustained playing that you're just giving yourself a workout.... If I think I'm not in the right type of shape or I want to be in a different type of shape, I'll go after a concert and play a little bit. (Interview, 12/19/18)

Underscoring the necessity of flexibility in scheduling practice, and the influence of the orchestra schedule, Sterrett offered similar thoughts:

I am very unstructured with when in the day I practice; I find my life demands it. The orchestral schedule is mostly consistent but there is a lot of flexibility. It depends on what we're playing that week and also what else I have to cram into my day.... I've always been flexible with the time of day when I practice and the length of my practice sessions, although I tend more to sit and do a longer session

and become tired. I've never really done the short focus, short breaks type of practicing. (Interview, 12/2/18)

While emphasizing the highly variable nature of their practice sessions, Snider and Lang noted that at times, due to their busy performing schedules, they practice very little or not at all. In these cases, their warm up is all that they do. Lang explains:

Every day between teaching, family stuff, orchestra schedules, chamber music, all kinds of things, every day is really different. So, some days I do not practice. I just warm-up and there is just too much playing in the day. I try to be very mindful of basics when I'm playing in the orchestra so I'm kind of practicing while I'm playing, that kind of thing. (Interview, 12/8/18)

Snider noted that he does not have a schedule and that when he does practice, he tries to do so when he is positive about doing so:

I have times where I love to practice and times where I don't and I don't practice much. My job keeps me busy enough that sometimes just to do twenty minutes before rehearsal in the morning is sufficient: from the middle long tones and starting the notes with my breath alone to see how my chops are responding, through scales in the full range of the instrument. When things are working well, that is enough. (Interview, 11/16/18)

**Variable and Some Schedule.** Within the parameters of a busy orchestral schedule which governs their practice scheduling, two of the eight participants target certain times for practice. King prefers late morning sessions: "It's all based on schedule and teaching. I would do it later in the morning after exercise when I'm most awake." When he served as Principal Horn of the Cleveland Orchestra, there were times he would come home and, realizing that he needed to play more, "I would play the Gallay *Twelve Studies for the Low Horn*, just play it through...it takes about a half hour." As for length of time in his practice sessions, he reiterated that it depends completely on the upcoming schedule. If nothing pressing is on the horizon, "...an hour or an hour and fifteen minutes is going to do it for me now."

Also targeting specific times, Jostlein stated, “I do my heaviest practicing on Sunday, Monday, and Tuesday nights which is our weekend of sorts, and then I do not practice on days of rehearsals or concerts typically.” Regarding length of time for these sessions, “I start practicing at nine p.m. or so and go until 10:30.” Similar to the other participants, he is always aware of the upcoming repertoire. If a Mahler or Bruckner performance is on the horizon, “I definitely have to be playing for many hours to get the endurance up before that week.”

**Light Days.** Within the context of practicing around a busy orchestral schedule, two participants made special note of light days and/or weeks. Deane defines a light day as “one service or less.” On those days he will “try to practice one session, and my sessions are always an hour and a half; that’s including the warm-up.” Elaborating further, he noted:

I’m playing basically straight. I don’t take any breaks and I can usually go about an hour and a half to an hour and forty minutes before I start to feel a little bit of fatigue. Once I start to feel that fatigue, I only push through just a few more minutes and then I’ll stop.... I’ll do the forty-five minutes of a warm-up and then literally just dive right in and its basically repertoire practice. (Interview, 12/6/18)

Similar to the other participants, Montone underscored the varying nature of practice and the challenge of balancing various responsibilities:

[My practice] completely changes depending on what I have going on. I have two kids who are four and six, so I feel like my whole life is a balancing act, of trying to be able to be prepared and in shape for my job and other challenges, but also leave enough room for my family and prioritizing that as well. (Interview, 12/14/18)

Montone tends to practice in shorter sessions throughout the day. She made specific note of light days and weeks in her practicing:

A lot of times, if I’m preparing for something like a concerto with a group or something that’s a personal project or gig, I’ll do it at night at home on a night when I don’t have a concert. (Interview, 12/14/18)

On light weeks she will practice for other projects or “solo pieces and working at excerpt lists, and doing etudes to keep well rounded....” Beyond this, Montone also noted that often her practice for work will occur “at the hall during a piece that I don’t play or during the first half of a concert if I’m on the second half, or during a rehearsal like when I’m waiting to play.”

### **Practice Content**

The content of a practice session among these eight horn players, defined as that which is practiced after a warm up period, is centered in these areas: orchestral music, music for other performances, and occasionally etudes, and scales and/or arpeggios. The use of recordings in practice sessions was present in the practice sessions of all but one participant, and predominantly so with five of the eight. All eight horn players emphasized the need to always be aware of upcoming orchestral repertoire. King offered a representative perspective:

If I’m playing a Mozart Symphony this week and then next week is a Bruckner Symphony, I have to be in shape for that. If it’s a Bruckner Symphony, and then there is a Mozart or Beethoven Piano Concerto I’m playing next week, then it’s going to go the other way. You can’t be in total crushing-it shape all the time. That, as far as I can tell from my own experience, is always cyclical as to what I really needed to be working towards. (Interview, 12/3/18)

Specific comments about practicing differences between light and heavy weeks will be offered later in the discussion. The approaches within a practice session are as varied as the players themselves and the schedules that they maintain. Each player was asked to outline the content and approach of a typical practice session.

**Jason Snider.** Snider emphasized how his practice content varies according to current and future repertoire. Additionally, he noted that his practice sessions will contain technical studies:



What I practice varies, of course, depending on what I've been playing and what is coming up. If I am practicing music for an upcoming performance, and realize I've let some areas slip that are needed, I'll add in etudes and exercises to beef up that area. Sometimes I might feel my playing has become too utilitarian, and I'll add in solos or more expressive music to round out my playing. If I'm feeling burned out with music, I'll add in a half hour of "just for fun" stuff: reading solos or etudes, etc. It's all a balancing act. There are times I'm practicing to grow as a player overall, and sometimes just to prepare for specific music or maintain my skills. (Email, 11/18/18)

As for repertoire practice, Snider stated:

I've performed most of the standard repertoire a number of times now, so I know through experience what to keep an eye out for. Some pieces require very little preparation, and others have to be approached fresh each time. Fourth horn playing has a little more breathing room. (Interview, 11/16/18)

The one exception that he highlighted due to its high exposure was the fourth horn solo in the Beethoven 9<sup>th</sup> Symphony.

**Leelanee Sterrett.** Given that she is in the early stages of her orchestral career,

Sterrett tends to focus most on orchestral repertoire:

Mostly when I'm practicing, my focus is orchestral repertoire for work. I'm still at a point where the rep. is coming fast and there are things that I've only played a couple of times or not at all and I'm learning those. So, tying-in with my practice is a lot of listening and a lot of score study; a lot of playing with recordings. I do a lot of that. (Interview, 12/2/18)

Her use of recordings in her repertoire practice provides a way to measure what she has studied and practiced, and her readiness to put it all together:

It's a way to test what I've learned from the score and from listening to recordings, to put it through a trial run. It's important for me to be able to play through a piece without a conductor.... So, I need to be able to be taking one step ahead of what I'm seeing as far as a pattern in order to be really effective in the section, and how I play with the woodwind section, with the brass section, and all those things. So, my trial runs are playing with recordings. (Interview, 12/2/18)

**Richard King.** As an experienced horn player, King highlighted maintaining healthy playing habits and learning new skills for his recent transition from Principal to fourth horn:

There are always, at least in my experience, things that creep under your playing like a stutter or you know, all of a sudden you can't play in the middle register very well, things like that. Then, you've got to go back to school a little bit and figure out what's going on. For instance, me recently moving to a low horn position, there were things that I could do pretty easily, but there were also things that I just had to figure out almost from scratch, like really low attacks, soft attacks, just like the high register would be in the other [Principal Horn] situation. (Interview, 12/3/18)

In addition to his orchestral responsibilities, King is an active chamber musician and soloist. These responsibilities also inform his practice content:

I always have gigs coming up, whether they're this week or next month, so there is always going to be music on the stand as far as chamber music, or a concerto in a month or whatever. So, there are going to be things to look at and orchestra music that I don't know, parts that need re-learning, or the fourth part, where it was just almost automatic pilot because I've played all the repertoire. (Interview, 12/3/18)

He rarely studies a score in his preparations, and will occasionally consult a recording to learn context. "One of the worst feelings in the entire universe is all of a sudden, you're totally playing some cadenza that you didn't know you were going to be playing."

**Richard Deane.** As Acting Principal Horn of the New York Philharmonic, Deane has an extensive and detailed daily routine that enables him to perform at optimal levels. Regarding practice after this routine, he states:

I have over the last six years, had so much stuff on my plate all the time with the Philharmonic that I will take the 45 or 50 minutes that I have left [after the warm-up] and practice licks over and over and over again. Then there will always be a little bit of putting on a recording, putting on my headphones and imitating the feel of being onstage. Because it's so different when you actually get up onstage, as opposed to the practice room, I like to imitate that experience just a little bit every day. (Interview, 12/6/18)

His practice of the repertoire involves mental practice, listening, score and part study, and playing with recordings:

If I need to work on something I'm a little bit unfamiliar with, or if it's a really hard entrance, I'll focus on that. Notes are not the issue, I can play all those notes with no problem. It's the timing of everything, so I'll want to be really secure with what I'm doing before and what I'm doing during the solo; I don't leave

anything to chance. All the breathing, all the timing, all the listening and what I'm listening to, all those kinds of things are done without any arbitrary elements at all. (Interview, 12/6/18)

Exposed passages and solos receive extra attention:

I'll play the solo maybe ten times in a row with the recording, but not just the solo. I'll go back a couple minutes and just listen and pretend, and literally just visualize being onstage with exactly the breathing, exactly the set, exactly what I'm going to do, so once I get up there I've already done it, I've done it a couple of hundred times before we get to the first rehearsal. That helps me feel a lot more secure. (Interview, 12/6/18)

**Jeff Lang.** Unlike his colleagues in this study, Jeff takes a wider approach to his practice sessions. He intentionally avoids a routine:

I try to not fall into the same practicing rut out of necessity because of my job.... I like to practice in ways the problems fix themselves. There are always different ways to approach excerpts: playing down an octave, playing something that's slurred, articulated and playing something articulated, slurred. I'm always approaching stuff in different ways and hoping that practicing that way with technical issues or anything, that the problems work themselves out on their own without micromanaging. (Interview, 12/8/18)

Sometimes he practices the "standard way:"

You do your etudes and maybe a couple of excerpts and maybe throw in a solo thing...then there are times that you have to woodshed and learn a new part and just work out fingerings, transpositions, rhythms, it's a different kind of practicing. (Interview, 12/8/18)

Regarding the use of etudes, Lang stated that if he has "the time and the chops" to practice he will:

...sit down and play a lot of Pares Scales and a lot of Kopprasch, and I play a lot of Concone *Lyrical Studies for Trumpet or Horn*. I do a lot of scales and arpeggios on my own. I do a lot of isolating octaves. I'll just play octaves, all articulations, all dynamic levels through the range of the horn. That tends to really get my chops in position and everything working really well

At other times major orchestral parts need the most attention:

...there is just no real way, no matter how great of shape you're in if you're playing a Mahler Symphony, there is no real way to replicate that in the practice room unless you sit down and play the part and count the bars rest. (Interview, 12/8/18)

His last point, practicing a complete orchestral part and counting through all of the measures of rest, is unique among the participants of this study.

Occasionally I'll play along with a recording, [but] I actually prefer to do it counting the bars rest only because playing along with a recording is sometimes just annoying with pitch and rhythm and that kind of stuff. So, if I'm playing and I really want to be in shape for a big blow, a big symphony or something like that, I'll just sit down, put the music on the stand, and just play it from the first note to the last note and count the bars rest. (Interview, 12/8/18)

He notes that this approach takes large amounts of time and patience, but the benefit of this as an orchestral player is significant because, "when you can do that at home and get through the part, get to the last note and sound good, you're really ready, because playing in the orchestra is much easier."

**Thomas Jostlein.** Practice content for Jostlein is in part similar to the other participants in this study. Repertoire work for the orchestra or for other performances is a priority, often with recordings. His intent when he practices is to "challenge myself musically to address technical [issues]." While he focuses on his orchestral repertoire as needed, his practice content differs in that it contains more etude books, some of which are not written for horn. For example, he often uses the Rochut, *Melodious Etudes for Trombone* (1928), and the Milde, *Twenty-Five Studies for Bassoon* (1980), which he characterizes as a bassoonist's "Kopprasch of sorts." Additionally, he also uses the Bruckner Symphony horn parts:

Those are not too tricky technique-wise and yet they're often the hardest stuff we have to play because they're exposed. They go across the break range, they're often very low, often very sustained. But all that sustained playing is good for emphasizing the singing. (Interview, 12/11/18)

If learning new repertoire for the coming week, or re-visiting a work that he knows well, his approach is the same:

I treat it as if it's a brand-new piece for me. I want to have that sense of discovery, of improvisation, of being in the moment. First of all, I work on it with the drone, buzzing it, and then playing it on the horn, so going back and forth. I used to start off in a new piece: first thing is to get the recording, get the score, listen to it, figure it out and solo or whatever. I've since learned about myself that if I start knowing...this is a totally exposed solo, before I even start practicing it, then it inherently adds extra nervousness or stress or whatever to it.... So, I play each piece as an etude. (Interview, 12/11/18)

After he practices his parts as "etudes," he then listens to the work with the score and a pencil and marks the music as needed:

...am I playing with the oboe, is this a solo? Twenty-eight bars rest, I divide it up into segments Then, I perform the whole piece. I use the word "perform" because I'm not practicing, but I perform the piece with the recording on the loud speakers...at home, and then I'm good to go and I don't practice the piece anymore. (Interview, 12/11/18)

**Jennifer Montone.** Consistent with the other participants in this study, Montone's practice is largely focused on the orchestral repertoire, along with various other projects (solo and chamber music) that cycle into her schedule. Within this, she remains cognizant of healthy playing technique:

I always try and keep looking ahead to my next few months of repertoire, so I don't feel like I have to cram. At least half of my practice is for upcoming pieces for the orchestra or for other projects. Within that time, I love to break down the pieces into creative practice techniques; do things slurred or on the mouthpiece, or articulating subdivisions inside, or with different rhythms or articulations...anything I can do to strengthen the technical foundation underneath what I'm practicing. (Email, 3/24/19)

Due to her busy schedule, she emphasized her need to be efficient in her approach to her practice sessions:

Generally, if it's an orchestra piece, it's basically learning the orchestra piece and double-checking. I do a lot of listening to pieces, and I will do [that] during the day with my family or while I'm commuting somewhere...just listening to things so that I know exactly what I want it to sound like. Then, I can pick and choose what parts of it I actually have to practice a whole lot.... I usually try to pre-prioritize that part so I don't toast my face, and so I can get it prepared more smartly. (Interview, 12/14/18)

Consistent with most of the other participants, the use of recordings is an important aspect of her practice. “I also do a lot of listening to recordings of pieces I’m learning, with the part and the score, and playing along with them, to help with musical decision making.” For Montone, playing with recordings strengthens confidence, and increases awareness of the larger context of a given work:

I find it helpful, especially if I don’t know a piece exceptionally well, or if it’s a big enough part (like anything that’s eight horns. We have such a significant role I feel like I need to know what’s going on). So, I listen to recordings with a score, and then with my part and I’ll mark it. Then, I’ll play along with the recording and figure out how many horns are in whichever parts and do my homework. (Interview, 12/14/18)

Often, she will conclude her day with a brief routine. She finds this session helpful due to her busy professional schedule, and because the needs of her two small children tend to preclude earlier sessions: “I have a nighttime basics routine, and I also like to run through etudes, just to always have a clear sense of what are the strengths and weaknesses in my playing at any given moment.”

**James Smelser.** The content of Smelser’s practice sessions is similar to the other participants, although he does not use recordings. He noted the scarcity of available time, and his habit of approaching rehearsals with a practice mindset, a habit similar to Lang:

I view every opportunity to play horn as practicing in a rehearsal. You’re always working on something. You’re in a rehearsal; it’s routine; you’ve played the piece before, but you’re always working.... Like this day I’m going to play a lot more things on the F horn, or I’m going to pay closer attention to the starts of notes or the endings of notes, or I’m going to be listening extra carefully to my pitch and that sort of thing. So, I use the rehearsals for practicing the techniques of horn playing. (Interview, 12/19/18)

Outside of a rehearsal Smelser often uses other horn parts from the orchestral repertoire. For example, he will “play through Bruckner 4 if I know I have 45- or 50-minutes to practice, and I need to practice to stay in shape or get in shape.” If he needs to add more “weight, a little more bulk, a little more muscle” to his sound:

I'll play some Shostakovich 10.... I'll loop that, I'll turn it into repetitions. The first time is absolute fortissimo, one breath only in that passage, absolute fortissimo, and then three measures and three beats...then do it the second time absolute pianissimo. So, when you finish its "daa, rest, rest, rest," and then the second time. You'll do that ten or twelve times, and that takes a few minutes; that is a workout. I call that a high impact thing because you're playing absolute fortissimo, all out fortissimo, but it's still with good sound. (Interview, 12/19/18)

Another routine that Smelser will often do stems from his audition days, where endurance was a chief concern, particularly for the horn solos from Tchaikovsky Symphony No. 5 and Mendelssohn, *Nocturne from a Midsummer Night's Dream*. He now uses these in practice, playing them consecutively:

I will play this all back-to-back except for emptying your water, literally thirty seconds at the end of these two. I'll play Tchaikovsky Five solo, [the] solo from the Nocturne and that's one set. I'll go back and do it again, and I'll do four of these back-to-back. So, you've given yourself this unreasonable task that's nearly impossible and by the end it's not pretty; it's not pretty at all. The goal is to get through it, you must finish it. You have to figure out different ways to breathe, different pressure on the face, different ways to think about the music, occupy your mind so you're actually moving along and you're not just, "oh my gosh when am I going to get to the next breath...." That's very much a mental thing. (Interview, 12/19/18)

### **Specific Goals for Practice**

In their description of deliberate practice, Ericsson, Krampe, and Tesch-Romer (1993) underscored the importance of goal-directed, organized practice. All eight participants indicated that their practice sessions were goal-directed. Four of the eight specifically noted the need to maintain their playing level. Smelser stated that, "the purpose of the practice session is to just remain in shape or get in better shape." Montone noted that, "it's more important for me to get to a point where I feel comfortable and confident about being in shape." For that reason, every couple of months she will review fundamentals.

A couple of times a year I have to circle around to certain basics. If I notice certain physical or a certain basic or technical topic is falling out of my window, then I'll prioritize that for a week or two. [For example,] I'm going to work on

loud attacks or soft attacks or middle register, flexibility, or low articulation or whatever. (Interview, 12/14/18)

Lang offered similar thoughts: “sometimes I have to practice just to keep and maintain, to keep in shape.” He continued:

My fitness in my chops is really, really important because in a way I never know what will be on my stand.... So much of my practice is centered around maintaining the job, maintaining the chops and maintaining the endurance. So, that also keeps your playing in shape, and you keep improving and becoming a better player too, of course. It’s also a matter of self-preservation. (Interview, 12/8/18)

King also noted that a central goal of his practice is to maintain his horn playing fitness.

He stated that “If I have a pretty good idea, and I think I do, of how to play the instrument then it’s just a matter of trying to recreate it.” At first glance this seems simple, but he quickly added: “sometimes it couldn’t be easier, and sometimes you can’t find it with two hands and a flashlight.”

Four of the participants provided different responses regarding practice goals.

Snider focuses on the resonance of his tone:

I’m listening for a certain kind of sound that I’m trying to get back to if I’ve wandered away from that a little. So, I have in my ear a certain kind of resonance or clarity that sometimes gets beat out of my playing in the orchestra. So, I go back to restore that vibrancy. (Interview, 11/16/18)

For Deane, his practice goals are centered on specific techniques needed for the orchestral repertoire: “My specific goal is I’m going to work these licks out until I can get them as good as they can be.” He elaborated further:

Trills, extended techniques, I’ll focus on that a little bit outside and do some extra exercises. But usually honestly, there are so many licks, and when you’re playing lead in a big orchestra, there is so much repertoire, I’ve spent all my time playing the licks. The goal is if I run upon a problem, I might do an exercise. For instance, upward slurs have always been hard for me over my break. So, I’ll do some exercise specifically if there are some licks that need specific attention, some upward octave or an octave and the third, that kind of thing. (Interview, 12/6/18)



Sterrett noted that her specific practice goals are focused on repertoire preparation prior to a rehearsal:

I'll set something for myself: by the Saturday before the Tuesday rehearsal I'd really like to be able to play through this concerto with the recording, and get it through it cleanly, know all my cues, things like that. So, I'll set goals in terms of that. (Interview, 12/2/18)

Finally, Jostlein is very specific with setting practice goals and keeping a record of them:

I have been keeping a practice notebook, a journal since about 1992.... Before I play a note, I assign myself my entire day of practicing...and I check-off [each item] when I've played it with 100 percent commitment, and then I go on. The going on is very important, we don't want to repeat things just to repeat them. You want to be always in performance mode. I never keep track of how much time I spend on each segment.... For me, it's more important to check it off and then when I'm done...I put the horn away. That's very important too, not to noodle aimlessly, but to play with intent. (Interview, 12/11/18)

In his practicing, his goal is to "...establish what is right, establish what you want to sound like; don't worry about reacting, don't listen; be one hundred percent singing."

### **Practice: Light Weeks vs. Heavy Weeks**

Orchestral schedules directly influence practice time, duration, and content. The scheduled repertoire also directly influences the practice habits of these eight horn experts. For the purpose of this study, a "light week" was defined as an all-Mozart program, and "heavy week" was defined as an all-Mahler or an all-Bruckner program. All eight participants underscored the continually changing repertoire demands which, as King stated, are "always cyclical" between light and heavy weeks. All participants highlighted the need to prepare in advance for heavy weeks. Specific comments from each participant comparing light week practice with heavy week practice are listed in Table 3.

Table 3

*Practice: Light Weeks vs. Heavy Weeks*

Participant	Light Week	Heavy Week
Richard Deane	I'm used to shifting quickly so it's no big deal. There is absolutely nothing that I do differently.	If it's Alpine Symphony or Mahler 3 or something like that, you have to...be in the best shape you possibly can.... Maybe do an extra set, maybe do instead of four or five or six practice sessions during the week, you'll do eight.... So, it's a matter of just ramping up for two or three weeks before...you've got to ramp up the amount you practice.
Thomas Jostlein	I try to treat Mozart the same as Mahler in the sense of always playing with a beautiful singing sustained sound quality. Yes of course they're different sounds, they're different dynamics, but I try to achieve a variety of colors on the horn. This is, for me, the highest level of musical artistry.	The Mahler/Mozart issue: try to play everything with a lyrical approach, even triple-forte Mahler should be played very lyrically. Prior to Mahler or Bruckner, I definitely have to be playing for many hours just to get the endurance up before that week.
Richard King	If I'm playing a Mozart Symphony this week and then next week is a Bruckner Symphony, I have to be in shape for that, always thinking and planning ahead....	On a Mahler week...there is no practicing, none. You warm-up, go to work, make it through. Still, every time I play one of the big pieces, whichever big piece, I always have this nagging question in my mind on a Thursday night, "am I going to get through this thing?"
Jeff Lang	If it's a very light Mozart week then I'll just play in that style... if there is a week with high delicate playing, I would adjust my warm-up a little bit. I would warm-up a little higher and not play loud and low that much so the aperture doesn't get blown out too much.	Mahler 5 for me, is one of the easier things to do...you're just blowing the whole time, you get in the groove. Now, if you're playing a Mozart violin concerto and the first thing you do is you have to play high E's in the first measure when it's just you and couple of violins, that's a whole different situation....
Jennifer Montone	If I have a light week and I'm only playing on one thing or something and it's light...I'll be practicing other stuff to keep myself in shape...so that it's not shocking for my body if I have something heavy the next week.	For [heavy] weeks I have to play along with recordings quite a bit beforehand just to kind of play through a full movement or play through two movements and then play through three movements and kind of work myself up to it physically....

Table 3 (continued).

James Smelser	If you've been playing really, really heavy but you feel like your Mozart finesse isn't there, then I will just work on light little things like that.	Always, always looking ahead and planning how to do it.... Sometimes I'll go after a concert and do one of my routines for ten or fifteen minutes. If I think I'm not in the right type of shape or I want to be in a different type of shape I'll go after a concert and play a little bit.
Jason Snider	If the playing at work is really light [all Mozart] then I might be in more of a mood to practice at home.	When the playing gets really heavy at work, I just have an instinct not to beat my face up at home.
Leelance Sterrett	With Mozart I'm going to be doing more exercises, more things that are going to make me feel more facile on the horn and just getting into articulation. I would probably sit and do a lot more repeated pitches with the metronome or something like that.... If I'm going to play something classical, I really need to be feeling control of the release of the notes.	I'll be thinking about the sound I need to get, and from Mahler I need to get myself comfortable with just a larger box...something like Mahler and Strauss, the focus is more control, sustain of the lines, things like that.

### Practice: Tour Weeks

Since each of the six orchestras represented in this study perform on tour regularly, the question of how practice changes on tour was investigated. Responses range from not much practice on tour to practicing more on tour. Smelser noted that since the instruments are packed away much of the time, practice time on tour is limited. By contrast, King stated that, "I tend to practice more on tour because I have more time." Deane maintains his daily routine on tour, and noted that the New York Philharmonic horn section tends to be the primary occupant of the tour practice room. The resulting sense of community there is also favored by Sterrett. Additional comments from each participant about tour week practice are included in Table 4.

Table 4

*Practice: Tour Weeks*

Participant	Tour Week Practice
Richard Deane	No difference. The Philharmonic has a room at the hotel we can go to and practice. It's always the horn players down there with maybe a couple of trumpet players and maybe a trombone player. But it's mostly horns; it's eighty percent horns down there, so you get an idea of how hard the instrument is. No difference. I'll do my same warm-ups, octaves, and everything exactly the same.
Thomas Jostlein	My goal is always singing, so it's a matter of being sharp. I would not practice much at all on concert days, and just an hour on others to keep the chops in shape and test my commitment to singing. Maybe Mozart or Strauss concerto on off days?
Richard King	I tend to practice more on tour because I have more time, honestly. Unless we're traveling every day, I really enjoy being able to sit down and spend some time with the horn, with technique and stuff like that.
Jeff Lang	There are times when I'm on tour that I practice only to stay in shape. So, I'll sit in front of the TV with the mute in and just play scales and arpeggios, doodling, hardly listening to myself and practicing in front of the TV.
Jennifer Montone	If we're traveling, there won't be as much time for practice. But if you're traveling, you also have flights and jet-lag situations, or altitudes or something, so I have to baby my face more in terms of just making sure that it's working for me. Generally, I do super-fundamental type stuff, like a lot of Kopprasch and a lot of very basic stuff just to make sure it's all working okay. I don't tend to work on rep a whole lot on tour; just making sure that I'm able to be sounding okay and feeling okay when we play.
James Smelser	On tour, since you have very few rehearsals, you have to play. Think about that forty minutes in Bruckner Four: if your maximum output is just music from that concert (this is assuming you don't have any jet-lag and you slept and ate well), eventually you have no reserves, you have no extra strength. It's very physical; you have to train; you have to train five miles to run three.... I have a practice mute and I will practice on tour. I will do thirty or forty minutes during the day with the practice mute in the room, and then maybe a little bit before the concert depending on the concert, and sometimes after the concert back in the room with the practice mute.... It also depends if you're traveling the next day, because maybe that next day you really don't have a chance to practice until just before the concert. So, you'd better do something the night before you depart.
Jason Snider	I'm not able to practice as much on tour, as instruments are packed in the trunks a good deal of the time. If we have time in our schedule in between cities, we can bring our instruments with us and practice in the hotel in a provided space. Usually the repertoire is enough that I'm able to stay in shape with a good warmup before the soundcheck and concert. If I have time to practice, I like to do some etude work. I've been digitizing my etude collection on my iPad so I don't have to lug music around with me.

Table 4 (continued).

Leelanee Sterrett	I like touring—everybody likes touring in the orchestra because we’re playing the rep over and over again so it gives you a chance to maintain, but maybe also put the learning of the new music on the back-burner. I always bring my Verne Reynolds etude book on tour and various things that I feel like I never really have the time for.... In the tour practice room, we end up playing duets and trios and quartets. There’s a lot more back-and-forth, like an open forum as horn players: “what do you do, what are you doing tonight,” a lot of exchange of ideas, which is really fun.
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### **Maintaining and Improving Artistry and Musicianship**

One of the defining characteristics of expert musicians is their artistry and musicianship. As members of major American symphony orchestras, these eight expert horn players have mastered the technical demands of the instrument. Beyond this achievement, what sets them apart is their tone, their ability to bring a phrase to life, and their ability to create an affective impact in their listeners. Therefore, the question of how these experts maintain and advance their artistry and musicianship was investigated. All eight participants emphasized the critical importance of listening. Lang said, “Listening is absolutely essential, listening to great artists, great singers...Yo Yo Ma, Pablo Casals, the list is endless.” Jostlein stated, “I listen to great recordings over breakfast, nighttime it’s in the background....” Sterrett agreed, stating that artistry and musicianship is maintained and improved, “with a lot of listening...you just have to keep listening.” Three of the eight specified the influence of other horn experts, and six of the eight highlighted the influence of their orchestra colleagues.

**Other Horn Experts.** Snider noted that he is still inspired by the sound and artistry of Dennis Brain, the renowned British horn virtuoso of the mid-20<sup>th</sup> Century. This inspiration has roots in Snider’s earliest days of horn playing and is still present for him as a member of the Boston Symphony. He stated, “I’m just trying to imagine the best

sound that I can for the place that I'm in now and see if I can make that happen." He elaborated that as fourth horn of the Boston Symphony, an exact imitation of the Dennis Brain sound "would not fit." However, from this core inspiration he adjusts accordingly:

The kind of sound I need in any given situation might be different depending on the people I'm playing with. Of course, in the Boston Symphony on fourth horn there is a certain bracket that my sound needs to be in, even with variance when you're doing Ravel or Bruckner. But I've learned over time that there is a certain kind of resonance in sound that works in that hall. (Interview, 11/16/18)

Deane listed four horn experts who have had significant impact on his artistry and musicianship. Interestingly, three of the four, James Chambers, John Cerminaro, and Phil Myers, each served as Principal Horn of the New York Philharmonic:

I quickly learned in college that the people who listened the most were the ones that were the most successful. That correlation was there from the beginning for me. So, I started listening and bought as many records as I could...then listen and try to imitate: Myron Bloom, John Cerminaro, James Chambers, and Phil Myers, all those cats who we loved. Honestly, I think a lot of that just gets ingrained in your body. (Interview, 12/6/18)

King highlighted the influence of his horn section colleague Eli Epstein: "I had the great fortune of sitting next to Eli Epstein for about fifteen or seventeen years...Eli's goal was always: "I tried to play everything as beautifully as I could." King also mentioned the influence of the long-tenured second horn of the Philadelphia Orchestra, Randy Gardner:

Randy sounded good, always. Always played beautifully, always supported whichever person he played with, and whenever he had something by himself it always sounded gorgeous...he was an inspiration to me. It occurred to me if I was the luckiest guy in the world that I could sit next to somebody like Randy, and it turned out I kind of did with Eli. He was the same kind of humble, gentle expert. I always was really impressed with how Randy just seemed to play musically all the time, so beautifully. (Interview, 12/3/18)

**Orchestra Colleagues.** The influence of orchestra colleagues on artistry and musicianship on the horn experts in this study was prominent. Participants also underscored the influence of guest soloists. Sterrett's thoughts were typical of the six players who spoke of these influences:

I feel like we have such an unfair advantage, once you're in an orchestra you're just fed—you get so much. You hear pianists and violinists, you hear your colleagues in other sections playing the way they do, and you hear the soloists who come. It's almost not fair because you are just fed so many ideas. So, if you keep your ears open that's the most important thing; I listen a lot. (Interview, 12/2/18)

Echoing his colleague's thoughts, Deane noted the privilege of playing with so many accomplished musicians, and underscored their inspiration on him:

...not only in a moment, but you can also gain long-term ideas from the privilege of being able to play with other people who've made it their life-study to figure out how to express themselves on a piece of wood with a hole down the middle of it. You can just listen and it's a great source of inspiration to be sitting on that stage with them for sure. (Interview, 12/6/18)

Smelser agreed, and as second horn of the Chicago Symphony, added specific thoughts about the inspiration of second-chair players. His reply is similar to King's thoughts about Eli Epstein:

You listen to your colleagues. I learned so much from the second players. I always thought, Greg Smith [on] second clarinet, is, I don't take anything away from Larry Combs, but he is so much of the reason why they sounded good. Larry Combs sounded good because of the second player. Norman Schweikert, my gosh, the perfect second horn player for Dale Clevenger. Louise Dixon was second flute, so I learned a lot from these players. Our second trumpet, John Hagstrom was an amazing second trumpet player to Bud Herseth, through Bud's final years with the symphony, and then the transition to several different principals in the meantime since then. (Interview, 12/19/18)

Lang's respect for, and inspiration from his colleagues is also evident:

The wind players, my colleagues...I'm playing around people that are at the top, these [are] legendary players, so you're hearing this all the time...if you don't play musically you're just done, you're just not getting it.... It's very easy when you're sitting around some of our principal players, it's very easy to feel like the weak link. (Interview, 12/8/18)

Additionally, he highlighted the influence of the many guest soloists that visit regularly:

“...one of the real perks of playing in a big orchestra [is] that you hear the top, top level of playing, and so when you're surrounded by that it's hard to play unmusically.”

Montone echoed Lang's thoughts. "When you're in an orchestra like this you have lots of inspiration from the soloist or the other principal winds or the strings or whatever, so it's easy in that regard." She expanded on the influence of her colleagues:

I love the risk-taking that happens in this orchestra. It's very much a chamber music kind of mentality, a sense of everybody egging each other on with phrasing and challenging each other to grow softer or grow bigger...it feels very collaborative, which is pure joy. We're very lucky! (Interview, 12/14/18)

She also added a broader perspective, a larger mindset in which artistry and musicianship can grow. She emphasized the need to stay open musically and intellectually, to "find genius wherever you can, and then try to see what you can apply of that to your own playing." She elaborated:

...perceive yourself as a musical student, always looking for things that inspire you.... I love going to the Curtis concerts, or being with all these great chamber musicians. I try to listen to their rehearsals and listen to their concerts...how do they practice and how do they rehearse and how do they, when they turn-on their performance mindset and they're at their most creative, what does that look like? What decisions are they making? (Interview, 12/14/18)

### **Horn Specifics**

Specific topics of horn playing were investigated with each participant. These specific topics are common to all brass players, and were chosen as "horn specifics" because they are specifically identified in the writings of prominent horn players and pedagogues, all of whom are widely consulted in the field (Farkas, 1956; Schuller, 1962; Wekre, 1994; Reynolds, 1997; Gardner, 2014). These horn specifics are common areas of focus for horn teachers. The following discussion is organized by these specific topics: free-buzzing, mouthpiece buzzing, breathing, tone, flexibility, articulation, range, dynamics, and endurance.



## Free-buzzing

Free-buzzing is defined as buzzing the lips without the mouthpiece or horn. Each participant was asked if they use free-buzzing, and if so, what they do. Four of the eight participants do use free-buzzing, and four do not. Table 5 lists those who do, and their basic approach.

Table 5

### *Participants who use Free-Buzzing*

Participant	Approach
Jason Snider	I do, yes, a couple notes here and there. Generally, I do it when I feel like my lips are just not vibrating well...on the way to work sometimes if I don't have time to warm-up I might, and just that wakes my chops up and gets some air moving; it works.
Leelanee Sterrett	Yes, every day...I'll play a straight tone, and then I'll do extending patterns out from there; just neighbor notes and playing a third up and a third down.... I'm just trying to get some resonance going. I'm trying to feel where everything is in the mechanism on that particular day before I get a hunk of cold metal on my face.
Jennifer Montone	Yes, I usually free-buzz whatever it is I'm going to play. I use it kind of as a practice tool.... I've done some of the Jim Thompson buzzing basic stuff as well, and the "lips-mouthpiece-horn" of [Carmine] Caruso, I free-buzz that part too.
James Smelser	Some, but not as a routine, not any specific to practice. I'll do it because it's a good test for me to see really how in shape I am. If I can't buzz up to a G easily I'll feel like I'm not in very good shape....

Of the four participants who do not use free-buzzing, Deane and King answered simply, "no," and King added that he has never used it. Lang noted, "I think it's bad, I do not recommend it. I think it can damage your chops and I do not recommend it." Thomas agreed, adding, "I think its detrimental."

## Mouthpiece Buzzing

Five participants use mouthpiece buzzing to varying degrees, and three rarely do.

Table 6 lists those who use mouthpiece buzzing and their approach when using it.

Table 6

### *Participants who use Mouthpiece Buzzing*

Participant	Approach
Thomas Jostlein	Mostly simple melodies. Also, you can get a little funnel (Jo-Ral makes one for trumpets) that you put on your mouthpiece, I do that for low range. I'm less a fan of doing just big glissandos...it does not encourage singing; it encourages letting the opposite stuff in.
Leelanee Sterrett	[After free-buzzing,] I go to the mouthpiece and I use one of my extra lead pipe tuning bits for a little bit of extra resistance on the end of the mouthpiece, which I think is a really important aspect of mouthpiece buzzing.... Again, I go as high as is possible for me to maintain my actual embouchure aperture, the whole set-up of the horn playing. As soon as I feel myself changing things in a way that I wouldn't on the horn in order to get higher or get lower, that's my time to stop. I try to keep my mouthpiece buzzing exactly what I'd do on the horn.
Jennifer Montone	Yes, a lot of mouthpiece buzzing, and I tend to use it as a magnifying glass for improving smoothness and air-to-tongue ratio.
Jeff Lang	Yes, mouthpiece buzzing is great in moderation. Extended mouthpiece buzzing can be bad for your sound because the mouthpiece buzz is different when it's connected to the horn, where the buzz is much more subtle and less violent. For a lot of reasons mouthpiece buzzing is great...it does really tend to straighten out a lot of stuff. Too much of it is actually not great because it can do weird things for the sound since that buzz is not the buzz when it's connected to the horn.
Jason Snider	I do, and I go in and out of course. I will have periods where I haven't done it for weeks or months and then something doesn't feel right in my playing. The student that's always inside my brain says "hey, I think you know the answer," and then I go back and I work on it. Sure enough, over the course of a couple of days I'm thinking, "yeah I should probably do this more." But the mouthpiece buzzing I think is a great thing.

Deane stated that he does not use mouthpiece buzzing at all. Smelser said that he also does not, except "maybe in the car driving to something, just a little bit, but not as a

practice.” Similarly, King said, “I don’t buzz the mouthpiece unless I’m in the car on the way to a gig; I don’t do that as a matter of the procedure of warming up or playing.”

## **Breathing**

Gardner (2014) states that “air is the brass player’s fuel,” and that “proper air movement is the central physical component of great brass playing” (p. 19). Farkas (1956) states that the air column in horn playing is “our bow,” referencing the bow utilized by a violinist (p. 27). Despite the obvious importance of breathing in playing a wind instrument, only Montone works on breathing directly related to horn playing. Snider does breathing exercises only when necessary. Jostlein, Smelser, and Lang stated that their breathing is dictated by the music. Sterrett and Deane acknowledged the importance of breathing, but do not practice anything specific, and King highlighted his routine of aerobic exercise for improving his breathing for horn playing.

Montone is the most intentional with breathing practice related to horn playing:

I have a Yoga deck of cards that have some poses, but then they also have a bunch of breathing exercises on them. Then I love the *Breathing Gym*, that’s an amazing resource. So, I do that a lot and then my own [breathing exercises] for calming down purposes. I do nose breaths and humming exhales. (Interview, 12/14/18)

Snider practices breathing exercises as required. If his breathing is not as efficient or simple as it should be, or if stress or allergies are interfering, he will,

...take five minutes and use the breathing bag or I just practice some finger breaths, different things, over the course of several days usually that will relax [me] and then I feel better about it. In the meantime, I find if my breathing is tight, I just breathe over a longer period before a passage. I try not to think too much about breathing and just let it be natural, but sometimes it needs attention. (Interview, 11/16/18)

Sterrett reported that she intends to do more breathing exercises, and at one time did Adam Unsworth’s routine, which consisted of quick inhales and long exhales with a metronome. She is, however, acutely aware of her breathing habits:

I do think a lot about breathing because I find that air support in breathing is being in control, and that is basically the only way that I can play the way this horn section plays. You have to use your air and you have to find a way to relax into the support or you won't last a week trying to keep up with the volume, and not even the volume so much as the depth of the sound. So, I'm always thinking a lot about that, about how to breathe and stay full and keep the feeling of support. (Interview, 12/2/18)

The other five participants do not do any sort of breathing exercises specifically related to the horn. Jostlein pointed out that "You cannot expand your vital capacity; you can be in great physical shape so that when you take a breath you're not encumbered by excess weight," but nothing will expand your capacity. He added,

I let the music dictate what kind of breath I take and it's not ever constant.... I will sometimes take a huge breath if it's a long phrase coming up; I'll put a double quotation mark for my needs. I don't worry about what kind of a breath or what kind of an exhalation I take.... I will tell you that we are all master breathers from birth on. (Interview, 12/11/18)

Smelser said that he is confident with his "ability to phrase and breathe, but there are a lot of things I think about, and we all breathe differently." Commenting further he said,

I think you always breathe with the music, but not always in time; you're breathing with the phrase coming up, the phrase that you're hearing. But always there is one consistent thing, it's slow intake, just a relaxed intake...that is just natural for me. I will be the first in the section to breathe.... (Interview, 12/19/18)

King noted that he does a lot of aerobic exercise, but he does not do any specific breathing exercises for the horn. Deane also does not: "I think I've focused on it so much during the day that I just don't feel the need to do, but there is always room to make it better, always definitely room to make it better." Lang also does not do specific breathing exercises for horn, rather, "I just try to breathe naturally." He believes that the inhale is more important than the exhale and that brass players "do get hung-up sometimes on the quantity of air and doing things physically that are unnatural to breathe." He continued:

When it comes to breathing, every passage, every excerpt has just the right amount of air. Not too much, not too little, and sometimes people over-breathe and over-complicate this whole breathing thing. The horn lead pipe is small, the

mouthpiece is a tiny hole, so the actual amount of air that it takes to produce a note on the horn is not very much at all; in fact, it's very little. (Interview, 12/8/18)

Summing-up his thoughts on breathing, Lang noted:

What's important is the speed, the intensity, the evenness, the efficiency of the air, all those things are really important. Massive quantities of air are not, and supporting the wrong way sometimes just creates extra tension in the musicality and in the player that's not necessary. So, I think there are a lot of myths out there about the way brass players use air.... I think that incorrect breathing just creates an artificial sound that's not your own or it adds excess tension, those kinds of things. Just rely on the sound and rely on producing the best tone and your breathing will be right. If the tone is right the breathing is right. (Interview, 12/8/18)

## **Tone**

At one time, specific concepts of horn tone varied by country and were held with “a fierce devotion that one encounters otherwise only in religious controversies” (Schuller, 1962, p. 14). While concepts and traditions still exist, such lines are less distinct. Despite the challenge of describing horn tone, it is universally understood to be an essential, defining element of a horn player. Gardner (2014) suggests, “beautiful, rich, brilliant, heroic, and soulful” as possible descriptors of the unique characteristics of tone. He notes that high-quality tone “is pure—void of any grit, escaping air, distortion, or unwanted sounds” (p. 27). A brass player's tone, he continues, is “influenced to the greatest extent by the tone concept that lives in their mind,” far more than by the equipment they use (p. 27). Given the importance of tone, each participant was asked how they maintain and improve their horn tone. Keen listening, the use of vowel syllables (sounds), and a focus on vocal quality and resonance were common among the responses. As a means to improve tone, participants also highlighted the use of basics such as buzzing, long tones, and breathing. Representative responses from each horn player about how they maintain and improve their tone are listed in Table 7.

Table 7  
*Maintaining and Improving Horn Tone*

Participant	Response
Richard Deane	I think about it all the time. If the sound isn't right, I'll know I'm not doing things right. So, I don't do anything specific, it's just a pervasive effort to make it better.
Thomas Jostlein	[By my] reliance on the singing approach, and just challenging myself musically. I also use <i>Music Minus One</i> , which uses the art songs of Schubert, Schuman and Brahms. Those have the text and I am a native German speaker; it's second nature to me. So, working on colors through the vehicle of the art song is a great way to develop this.
Richard King	I warm-up backwards. When I start to play, after a couple of minutes if things sound good, I realize I'm on the right track, and if things don't, if I can't seem to get a clear sound and so forth, I have to regroup and try again more decisively, more committedly.... I talk and think a lot about vowel sounds...and, is it in the right spot? If it's not, then I play with it and move the pitch up and down and surround it, until I am thinking that it's in the right spot.
Jeff Lang	Just listening, sharp ears; listening very closely.... I do practice a lot of low horn, probably more than others.... If your tone is thin or it just doesn't sound good in your upper range, usually you can improve the tone by a good amount of low range practicing.... The other thing of course that benefits tone is playing F-horn a lot. I'm a traditional F-horn schooled player, so low range and F-horn are essential. But, having a good concept of sound is the most important thing and that is very hard to teach...concept is key to having a good tone.
Jennifer Montone	I do long-tone type things. I've learned that for me, if I have a good sense of taking good breaths and really engaging my support in my stomach on the inhales, then my sound generally has more range. I like to fool around with the vocal-ness that's inside the sound. I look at the nuts and bolts of it: the breathing, the support, the sustained physical end of it, the vocal-ness, and the send-off on the musical end. I go from bottom up and then the top down, and hit it from both angles.
James Smelser	I just listen all the time. I listen all the time in every rehearsal, every concert; that is the practice.... But I won't say, okay today is going to be an exercise on tone. If the tone isn't good it's usually because of some fatigue, some overplaying...always, just practice by listening when I play in the rehearsals and the concerts, always listening and adjusting and changing.
Jason Snider	I'm interested in resonance of tone so I'm always listening for a sound that sounds ringing and vibrant and has a color to it, and isn't grey.... I try not to think about the how or the why, I just listen for vibrancy because I know that when things are speaking well and there is a vibrant tone, playing the horn is fun and easier.... Usually when the sound is not right there is too much tension somewhere in my breathing, in my face, or somewhere I'm forcing something instead of letting it happen. If I have the time to practice well and in a relaxed fashion, I'm usually thinking about getting rid of tension or letting it go as much as possible.

Table 7 (continued).

Leelanee Sterrett	I personally believe that my mouthpiece buzzing contributes to maintaining richness and depth in tone production...I think my efforts to “fill up” the mouthpiece which as much sound/air as it can take translate well into doing that same thing on horn, which I consider to be the basis of producing a good tone. I also do long tones with a conscious ear to tone quality. I find that playing long tones over a range of dynamics, especially in trying to push the limits of extreme softs and louds, makes me focus on the core of the sound.... I will sometimes do a bit of pitch-bending on my long tones, or as a way to re-warm up when coming back to the horn after a break...I definitely think of “tone” and “resonance” as being entirely intertwined. Finally, playing along with recordings is an important way for me to practice blending with other instruments, which I consider a crucial part of “good tone.” In fact, I might even define a good tone on horn as one that can easily mesh with other sounds. A good sound should have a wide array of harmonics, which can be subtly manipulated by the player to either match the tones around, or project through without obliterating other instrumental tones.
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## Articulation

Schuller (1962) states that “in essence, tonguing is nothing more than a musical decoration of a note,” and that proper performance of the repertoire requires “the complete gamut of infinite and subtle gradations” of all articulation styles (p. 46). Reynolds (1997) concurs, noting that horn players must “develop a large assortment of attacking styles” (p. 29). Farkas (1956) describes this range of styles: “from the gentlest, most smooth attack, played pianissimo, to a literal explosion of sound” (p. 49). Each participant was asked about how they maintain and improve articulation. All work on articulations, but their approaches vary. Six of the participants are intentional about incorporating articulation work into their daily routine and/or practicing, two are less intentional.

**Intentional.** Deane performs an extensive routine each day that begins with a set of 13 slurred scales to address all three octaves of the horn, and then he repeats: “I go

back down to the low C and I do the exact same thing again, but with a fairly short tongue.” His awareness of articulation continues in all that he plays:

I’m so focused in on the shape of the note in articulation that again, it’s a constant thing for me.... I’m constantly working on the articulation, one hundred percent of the time. It’s a pervasive awareness of tone and articulation, its literally constant. (Interview, 12/6/18)

Similarly, Snider alternates tonguing and slurring in his routine from the Harold Meek (1947) book, “I slur the first phrase and then tongue the next one, and the next day I tongue and slur. I’m always alternating...thinking about a clear beginning to the note... does the tone stay the same on both sides?” Sterrett also alternates tonguing and slurring: “I have a combined slurred and articulation exercise that includes arpeggios and similar things, and then I do harmonic slurs and I articulate them, and I do the different dynamics.” In addition, she adds articulations to her long tones and scale patterns:

I like to do some isolated articulations at varying dynamic levels to experience the difference there.... I have some scale patterns that I like to do articulated, that are sort of more like a power exercise and those come from Doug Hill; it’s kind of [a] quick triplet through two octave scales. (Interview, 12/2/18)

She also works on multiple tonguing, again adding articulation to a harmonic series exercise. For example, she will begin on a single tone with multiple tonguing, “and then go into the harmonic exercises as a way to make multiple tonguing into something that’s very tied to the air and tied to the forward motion of air.” She uses this approach as a “way to wake things up and at least you’ve done it, you’ve touched on it in a day.”

Smelser noted that practice of articulations “is something I actually do.” He will start at middle C and descend an octave or more at various speeds:

I’ll play with absolute consistency of the length of the notes, the amount of staccato or accent, whatever it might be. Then I speed it up, all single tongue...chromatically down. Then I’ll go up from that that low C, up to middle C. The idea is that you’re really trying to time the speed of the tongue of course with the fingers, and to me that is the technical aspect of it. (Interview, 12/19/18)



After this, he will add a note to each, now playing pairs. Occasionally, he plays through the first thirteen or fourteen etudes in the Concone *Lyrical Studies for Trumpet or Horn* (1972), with a specific focus on exact and consistent articulations at each dynamic level from pianissimo through to the rare fortes. Montone thinks often about what kind of articulation she wants to use, and compares the range of possible articulations to an artist's palette. She uses the Kopprasch (1939) and Pares Scales (1952) books for her articulation practice:

...you can do all of them in the style of different composers and with different articulations: slurred and then legato, then accented, then staccato, and then double-checking that the air stays the same, along with the air-to-tongue ratio. So again, I like to think of it from the bottom up and then from the music down, and then double-check that they come together. (Interview, 12/14/18)

**Less Intentional.** In contrast, Lang and Jostlein are less intentional about the practice of articulation, but give it attention as needed. Lang noted that after 36 years of professional horn playing, repeated fast passages can be more challenging now. For this, he will practice some of the Kopprasch (1939) etudes:

I'll do stuff light and fast...I'll listen with a really sharp ear to the sound, and then try not to analyze to find out what's causing the deficiency or anything like that. I just practice until it clears up and until it really sounds good; I have no idea what I'm doing. (Interview, 12/8/18)

Jostlein's approach is completely focused on singing one note at a time. In that context, he practices various etudes for clear and consistent tonguing. One of his preferred books for this is Josef Schantl, *Grand Theoretical and Practical Method for Valve Horn* (1981).

### **Flexibility**

With a 4+ octave range, developing and maintaining flexibility on the horn is essential. Seven of the eight participants practice flexibility regularly, and one does not. Six of the seven who do practice flexibility, slur arpeggios and harmonics on the various valve combinations. The other works on flexibility in the context of etudes. Table 8

highlights the six horn players who practice flexibility using arpeggios and harmonics, with some of their specific comments.

Table 8

*Participants who Practice Flexibility Using Arpeggios and Harmonics*

Participant	Comments
Richard Deane	Yes, mostly in the form of harmonic series studies...if I feel like I need to be more flexible I'll expand that out to harmonics that are further apart. But, it's a fairly minimal amount of stuff just because I'm dealing with it constantly.
Richard King	Yes, arpeggios and fast-moving stuff. For a long time growing up, one of the things I did was I used the Farkas warm-ups to try to learn how to center notes...arpeggios and scales that are at least two octaves....
Jeff Lang	I do. I just put that into my practice routine: scales and arpeggios, and harmonics slurred.
Jennifer Montone	Slurred arpeggios, and I like the noodles; anything that's middle register and noodle-like. [I like] to be able to change notes without stopping the air, and ride the air and not over-move and over-bump a lot.
Jason Snider	In the Meek book there is a little flexibility study, I think it starts on a third space C and it's just do, sol, mi, sol, do, do; do, sol, mi, sol, do, do. Then just moving in half steps, or just an arpeggio up two octaves and down. I do the same thing: I slur the first phrase and then tongue the next one and the next day I tongue and slur; I'm always alternating.
Leelanee Sterrett	I've done the classic lip slur and every variation on that and every expansion of that. A lot of the things I do on the harmonic series I would consider my flexibility studies. I've got some new ones from the Biehlig German method that are nice ones that sort of skip around the possibilities. I've really been a fan of the ones stolen from the tuba flexibility exercise that has the skipped partials.... So, for me flexibility is a lot about manipulating the open harmonics and getting across two or three plus octaves on the horn using the air.

Jostlein stated that he works on flexibility in the context of etudes, such as those by Shantl (1981) and H.L Clarke (1984), and those he makes-up on his own. His approach is focused on the expression of music rather than the development of a specific technique, very similar to Dale Clevenger's famous phrase, "Musical thought dictates technique."

Jostlein elaborated further:

Don't worry about flexibility as a goal in itself because that inevitably leads to feel. Let the art form and expression of music guide the so-called technique. Once you try to assemble technique out of building blocks (lip trills, flexibility, etc.), you lose sight of the goal: singing one note at a time. (Email, 2/21/19)

Smelser stated that he does not practice flexibility specifically, although he hears his colleagues "doing glissandos and acrobatics and things like that." Instead, he believes:

...if you have done a basic warm-up, and if you're in shape and have the strength, those are the two things that you need. You need the strength and the air to play those high notes and you need to be not stiff.... (Interview, 12/18/19)

## **Range**

Farkas (1956) notes that the horn's 4+ octave range is one of its "most remarkable features," and that all horn players "should gain complete command" of three, if not four octaves (p. 57). Wekre (1994) states that, "One's high and low range does not appear by itself" (p. 62). Each of the eight horn players in this study include high and low range regularly in their practice, although their approaches differ. Four of the participants include range practice in their daily routines, three highlighted intentional work beyond a basic routine, and one player does both. The players who include range work in their routines will also do specific practice depending on repertoire needs.

**Range Practice in Daily Routine.** The horn players who practice high and low range as part of a daily routine appear to value the confidence that is produced through that type of conditioning. As fourth horn of the Boston Symphony, Snider noted that his

job maintains his low range, and added that since high and low range are in his warm up routine, he is confident that he is prepared:

It's just part of my daily routine [to play] both high and low...my warm-ups are designed to move me through the ranges of the instrument, so I don't think about it beyond that. That is what my warm-up is, to make sure that I like my tone in the different ranges of the instrument. That mostly gets me there, and I do have a few exercises I can pull out if I have a special occasion or, when I have to play with more power than usual; there are some things I can do. (Interview, 11/16/18)

In her position as Acting Associate Principal Horn of the New York Philharmonic, Sterrett noted the irony of needing a high range for her job while she does "not have a natural high range." To counter this, she stated that, "it is something that requires a lot of maintenance for me, kind of like use it or lose it." Therefore, she plays to the high range early in her practicing:

A lot of my warm up exercises go up into the high range right away. It's the first thing that you do after mouthpiece buzzing, you do diminished arpeggios and the first one goes from G below the staff up to a high B-flat within the first minute of playing; you're up at the top of the staff to not be afraid of it. (Interview, 12/2/18)

Low range is also part of her routine:

Most of my exercises go into the pedal range. That's really important to me. I'll do the James Stamp [2005] basic warm-up with some variation on it, but I'll do it in two different octaves so that I really get down to the absolute bottom of the range. I love lower playing...it is something that I really have to keep it in shape and it also doesn't come naturally to me.... In a way, it requires more conditioning for me than high range, so it's more of a finesse type of strength and control. (Interview, 12/2/18)

Richard Deane has the most extensive daily routine of the eight participants. The comprehensive nature of his routine covers both low and high range daily. Because of this, he does not practice anything in particular for his range needs since, "it's something that's addressed constantly as a part of day-to-day routines." His routine is designed to address three parameters across the entire range of the instrument:

1) Am I supporting what's going on in embouchure support? 2) Am I working on my resonance concepts, in other words what's going on with the inside of the

mouth? and 3) How is my breathing, how is my support there? All those things are addressed in terms of the whole range of the instrument, and you've pretty much covered everything. [If] you do all four octaves in thinking about those three things, you are good as far as I'm concerned. (Interview, 12/6/18)

When asked if he does anything specific for the upper range he quipped, "Just make sure that my second thumb valve for the high notes is in good operating condition!"

Jeff Lang also covers range in his warm up. After scales and arpeggios, one of his techniques is to isolate octaves, "jumping from the top to the bottom" in order to focus the embouchure in the right spot. Additionally, for high range, he plays with as little pressure as possible. Sometimes, he admitted, you have to "muscle" notes out in upper register. In a concert, for example, "in the heat of battle you've got to do whatever it takes, wrap your legs around the chair, whatever it takes!" But, for a baseline, it is best to use as little pressure as possible. He added: "I'll play very often in the orchestra in the first hour of rehearsal without the finger hook." Regarding low range, he believes that it starts with properly dropping the jaw, and then:

...keeping the corners firm, holding onto the mouthpiece, not letting things get loose and flabby. It takes a lot of strength in playing the low range, to hug the mouthpiece and really keep things at the corners very strong, lowering the jaw. Then again, I don't pivot in the low range either. Blow through the notes...and get out of your comfort zone. (Interview, 12/8/18)

As Associate Principal Horn of the Philadelphia Orchestra, Lang is primarily a high horn player, but he practices low range often. For example, he'll play etudes from the Kopprasch (1939) and Concone (1972) books down an octave. His reason for this is his concept of practicing opposites:

It's very important that you balance your practice. If you're working at a high range, you've got to work low range. If you're doing fast, then do slow; if you're doing lyrical stuff, then you should do staccato stuff. [If] you work on loud playing you've got to work on soft playing. (Interview, 12/8/18)

**Other Approaches.** King spent many years as Principal Horn of the Cleveland Orchestra. Regarding range, he highlighted the inspiration of his second hornist, Eli Epstein, who had a “five-octave middle register.” While King has always been comfortable with the high range, he noted that “playing efficiently in the high register and sustaining high notes like you would do as a first horn player didn’t come as easily as pecking-out notes in a Haydn Symphony.” He explains how he handled this situation:

I really had to examine how I felt about vowel sounds, and the vowel sounds that make things sit naturally in the high register. Once I learned where those neighborhoods were as far as the vowels, and Mr. Farkas explains it a lot better than I can, then it became like a larger middle register, just as an extension. (Interview, 12/3/18)

The vowels to which King refers are “oo” for lower notes and “ee” for upper notes (Farkas, 1956, p. 46-47). This concept is central to his success playing all registers in the horn range. Referring to the use of vowels, he concluded:

Anybody who plays like they’re playing naturally, they’re doing that. You can’t be playing a horn and it sounds great and it sounds easy, like Dennis Brain easy, and you’re not doing at least something. (Interview, 12/3/18)

Recently, King made the switch from Principal Horn to fourth horn, which gives him a unique perspective on range. Of this transition, he commented, “...it was a big mystery when I made the switch...there were some low horn articulations in the soft dynamic that didn’t speak” that he initially needed to slur. Regarding specific practice for the low range, he has played through the Hackleman (1990) low horn book, but his fitness for chamber music is key: “I care more about being fit for playing chamber music than I do about having some low horn note. I care much more about being a musician than about nailing things.”

Thomas Jostlein's approach to maintain and improve high range is based completely in repertoire, and his concept of a singing approach to horn is evident. To work on his high range, he stated:

I play it there. It sounds ridiculous but I have these complete horn parts for the Bach repertoire, the cantatas mostly, and those go super-duper high; I will choose one movement of that. Or how about this, I've got a great book of the oboe parts to the Bach Cantatas. If you play like oboe in F, there it lies beautifully. It goes up to occasional high C, but usually it goes up to A and B-flat and stays up there. So, letting the music just encourage the singing up there is the main thing. (Interview, 12/11/18)

The same approach also applies to his low register work: "just play it there." His focus on singing and musical phrases is paramount. At times he will use non-horn etude books, such as the Rochut, *Melodious Etudes for Trombone* (1928), or Blazhevich, *70 Etudes for Tuba* (2009), or Grigoriev, *78 Etudes for Tuba* (1983), but he also favors repertoire, particularly:

...playing Mozart concertos down one or even two octaves. It's so wonderful because then you're playing music that's familiar without the challenges of high range...you just think musically and it's in the pedal range.

As Principal Horn of the Philadelphia Orchestra, Montone often plays in the upper register, but she does have some specific exercises for that range:

Practice down the octaves, and I like glissing a lot, just the idea of glissing and catching the little partials going up. I like to do ascending intervals: a fifth, a fourth, a fifth, a sixth, a seventh, and an eighth with glissing. Basically, anything where you start from a place where you feel comfortable and healthy and then you go up into where it's slightly less comfortable. (Interview, 12/14/18)

Regarding low range she stated, "I have to work pretty hard on low range just to keep it even functional because it's not my fun suit." Similar to Jostlein, she will play familiar pieces in down an octave (or more), and similar to Lang, she experiments with dropping the jaw:

I usually take pieces that I love up high and play them down the octaves because then I know what I want them to sound like, and my body tends to figure it out....

I experiment with the air speed, slow versus fast, like a really deep belly kind of breath as opposed to a more direct kind of air. (Interview, 12/14/18)

As second horn of the Chicago Symphony, Smelser has responsibility to play in all registers. His work in the high range "...is based on how much wear and tear you have from the week." If he has repertoire in the upper range,

I will shift my playing and my practicing, I will shift that range up. I'll make sure in a warm-up to spend a little more time on those chromatic scales to the upper [range]. You make that the mindset; this is the type of horn player I am, I'm a high horn player.... I'm going to spend more time up there and I'll play, instead of playing Gliere *Nocturne* solo, I'll play Strauss *Andante* where it's hanging up high. (Interview, 12/19/18)

One of the techniques that he uses is to add demand to notes just below the upper-most that he will need: "under those conditions you're actually working much harder, as if you're playing much higher." He continues, "...if you're not able or don't want to play the highest note that you're trying to work on, try something lower, but more." This approach saves your face but enables the accumulation of strength to play higher.

Smelser will occasionally use etude books for high range work. He'll play the high studies from the Kopprasch (1939) book, but noted that "my problem or my difficulty or dislike of specific high horn studies is they are so virtuosic and so high, it's as if you already can do that or you have to be able to, to play it." His preference is for more conjunct, scalar studies that "are gradually sending you up high and then if you want you can play it louder or slower, tongued or slurred, you can change it a little bit." For low range practice, Smelser uses the Hermann Neuling (1964) *30 Special Etudes for Low Horn*. He focuses on the studies that are slower and have "less articulation and less technical [demands] where you're just really putting some weight on the low range." He noted that he does not play too many excerpts for low horn, except for Shostakovich 5 and the slow movement from the Shostakovich Violin Concerto.



## Dynamic Range

Citing the *Symphony in D minor* by Cesar Franck as an example, Farkas (1956) underscores that great dynamic range is required in orchestral horn playing (p. 64). Wekre (1994) notes that, “To play extremely loud, preferably with great sound, is physically very demanding” and that daily practice is necessary (p. 62). All eight horn players in this study work on dynamic contrast in their practicing, but their areas of focus differ. Three players focus more on soft playing, two focus on loud playing, and three focus on both.

**Focus on Soft.** Snider and Sterrett noted that playing in their respective orchestras maintains their loud playing. Snider remarked: “I don’t think about loud playing too much; we get enough opportunities in the orchestra to use it. Soft playing, I have to think about that a little bit more.” Similarly, Sterrett said, “I find that orchestral playing actually keeps my loud playing pretty well in shape and what I have to be mindful of is the soft playing.” They both use simple exercises to practice soft playing. Snider noted that any etude played softly serves this need. He reported that his home practice is mostly at the mezzo-forte level and softer, and his focus is on resonance. As for practicing loud, he said, “When I get to work and get on stage, that’s my chance to get in a few minutes just opening up; I don’t think my string colleagues like it.” Sterrett also uses exercises for soft practice, along with arpeggios:

...taking one of my exercises and deciding to do it at a softer range, a more controlled range. Or, I like to do arpeggios, kind of soft too, ascending up arpeggios, to really feel everything and just get into the air space. (Interview, 12/2/18)

She will also do long tones and harmonic slurs at various dynamic levels and differing articulations to expand her dynamic envelope. Her focus, regardless of dynamic level, is to maintain “the core of the sound.”

Similarly, Smelser believes that “everybody should practice soft playing,” although he admits that he does not always do that. His focus on soft practice “will be when we have to do it in the orchestra.” He explained further:

I’m blessed to have colleagues when it says soft, it’s soft. It’s not approximately soft, it’s extremely soft. So that is a practice each and every time.... I’m doing it in the rehearsal, in the setting, which actually adds another challenge because you have to play what’s before and after it. (Interview, 12/19/18)

He also emphasized that he focuses on soft playing in his teaching, frequently demonstrating for his students examples of soft playing for them to emulate.

**Focus on Loud.** Deane’s soft practice “tends to get addressed by my warm up,” but his loud playing needs to be practiced daily:

I find it’s very important to play very loud at least for a little bit every single day.... I think this is a Phil Myers idea, and it’s really a good idea, to blow as loud as you possibly can for a couple of minutes every day and in a non-stressed kind of way. In other words, don’t stress the embouchure too much, but just get used to really blowing a lot of air into the horn.

Lang stated that, “Soft playing has actually been one of those kinds of things that I haven’t had to work for. Soft playing has always been easy for me.” Consequently, when he practices dynamics there is a focus on loud playing. His approach to this is “to get out of your comfort zone, but always...blow through the horn and not at the horn...you want to sing, not yell.” The goal is to expand the edge of the envelope while thinking “big, loud, full and singing...it’s got to be quality sound.” As for soft playing, he will occasionally practice long tones “where you taper the sound and at the end it’s nothing.”

**Practice Both.** Jostlein replied that a wide dynamic range is one of his biggest challenges, so working on soft and loud playing is an integral part of his practice. For this, he chooses etudes, such as those early in the Kopprasch (1939) book. Once there, “let the music challenge you.” He explains:

One little tip that I use for crescendos, big crescendos, rather than thinking of an even crescendo where it's gradually turning the volume knob up and down, I try to play where I'm sustaining at a specific dynamic level. I will sustain piano and then sustain a stepwise ascent up to mezzo piano, mezzo forte, and then reverse it and hold it at the end.... Often, we think the big decrescendo without singing, and this encourages you to sustain the singing to the end. (Interview, 12/11/18)

Montone also practices both soft and loud. Her preference is using the interval studies in Carmine Caruso, *Musical Calisthenics for Brass* (1979): "I love the intervals that have the crescendo-decrescendos, and the loud-soft-loud, because that gets you through the register while doing different dynamics, which I find really helpful." She uses the same approach with arpeggios:

...through the range being loud and soft at different points, and to see if I can still be smooth and have decent sounds no matter where I put the crescendo and where I put the diminuendo. So, varying where you crescendo where you decrescendo, where you put the peak...if you do a variation on a basic exercise, then you listen differently and it keeps it new and challenging. (Interview, 12/14/18)

Reflecting a broader perspective, King noted that his ability has grown with experience. He was initially inspired by earlier Principal Horns of the Cleveland Orchestra:

My two predecessors in Cleveland were herculean horn players; they could both blow the walls in, Rick Solis and Myron Bloom. They played heroically like nobody's business...it was really beautiful and it really inspired me.

He knew that he was "not the best at" playing loud, and that if tried to emulate Solis and Bloom, the result would not be good. His solution was to emulate James Chambers, whose sound was "both large and lyrical." For the soft dynamic levels, he noted that the music directors in Cleveland tend to have the orchestra play quietly. Of this, he observed:

When a conductor puts up their hand because you're playing too loud and then you play less and it sounds awful because you're not playing with real sound anymore—you're just trying to play as soft as you can—then it sounds bad, and then it certainly is too loud because they don't want to hear that...it's like you're chasing your tail. (Interview, 12/3/18)

He summarized his approach to practicing and performing both ends of the dynamic range: “I try to play as beautifully as I can, and therefore you still have enough sound in your sounding that people can blend, and you can blend with other people and play in tune with other people.”

## **Endurance**

Farkas (1956) states that endurance is “vitally necessary to the professional” and that it “is not acquired easily or quickly” (p. 62). Gardner (2014) compares endurance in horn playing to endurance in athletics, both are by-products of “muscular efficiency and training that include periods of stress and recovery” (p. 103). All eight horn players in this study approach the practice of endurance in the same manner as that suggested by Farkas (1956) and Gardner (2014): by playing more. There is an awareness of upcoming repertoire, and the intention to add more time playing to improve endurance to be ready for upcoming performance demands. The responses of each are listed in Table 9.

Table 9

### *Practicing for Endurance*

<b>Participant</b>	<b>Response</b>
Richard Deane	I practice technically correctly all the time, so I’m addressing everything that needs to be addressed. But if the repertoire demands that I even push that a little bit more, then I’ll just do more of what I do every day. I’ll add another session for example; it’s literally just training for a marathon. It’s nothing super-specific, just more of it.
Thomas Jostlein	Just play. I don’t have the same endurance that Phil Meyers or Bill Vermeulen have, but I can get by enough. So basically, just by playing more. But I will say I don’t believe in the notion of once your lips are giving out at the practice session to keep going to build up the chops because then you’re encouraging bad playing. I would at that point take a little ten second break, or a twenty second break, and then pick up there again. Prior to Mahler and Bruckner, I definitely have to be playing for many hours just to get the endurance up before that week.

Table 9 (continued).

Richard King	It goes back to practicing for what you have coming up. Playing a Mozart Symphony this week and a Mahler Symphony next week for instance, if you don't get in shape for that then you're going to be in hot water big-time. For example, with the Strauss Second Concerto, I would hire a pianist to practice with me three times a week before [the concert] for an hour. I'd just play the piece with the piano, go get a drink of water and play the piece again. That way, I knew that under the strain of a performance if can play it twice and be relatively comfortable with it, that I can certainly play it once.
Jeff Lang	Putting time on the horn and getting that stuff in your face. I'll put those tunes up on the stand and play through it, the same mentality of playing through the symphony parts counting the bars rest. I'll play through the whole program just to make sure I've got it in my chops, that's really important. So much of my practice is centered around maintaining the job, you know, maintaining the chops and just maintaining the endurance. I also like to use the Singer book, <i>Pares Scales</i> , and the Dufrense routine. Of course, long tones are a must. But I especially like to do about 15-20 minutes of Kopprasch with no stopping at all for endurance. This works great for me.
Jennifer Montone	Playing along with recordings.... Sometimes I'll take pieces apart, like if it's a big endurance piece like Gliere, or Strauss 2, or <i>Adagio and Allegro</i> . I'll take it apart and build it up with very good, healthy, production quality. I'll play it down the octave and then up the octave to a certain part. Then I'll add two lines to it, and then do that plus the hardest part, and then work backwards that way. I try to go for music quality first, and then build the endurance around it. Also, doing a lot of slurred and then tongued. Then, if it's not sounding healthy, I'll go for longer articulation just to make sure the air isn't stopping. Usually the thing that gets in the way for me with endurance is if the air is stopping, or if I'm not centering the notes or sustaining them enough and using the big muscles.
James Smelser	If I feel like I need a little more weight, a little more bulk, a little more muscle, I'll play some Shostakovich 10. I'll loop that, I'll turn it into repetitions: the first time is absolute fortissimo, one breath only in that passage, absolute fortissimo... and then do it the second time absolute pianissimo. [Also,] I will play back-to-back, except for emptying your water, the Tchaikovsky 5 solo, and the solo from the Nocturne [Mendelssohn, <i>Midsummer Night's Dream</i> ], and that's one set. I'll go back and I'll do it again, and I'll do four of these back-to-back.... The goal is to get through it, you must finish it. You have to figure out different ways to breathe, different pressure on the face, different ways to think about the music, occupy your mind so you're actually moving along and you're not just like, oh my gosh when am I going to get to the next breath. That's very much a mental thing...that's something I'll do actually fairly often.

Table 9 (continued).

Jason Snider	I do have to think about endurance depending upon the piece. In the orchestra I rarely have to worry about endurance on fourth horn. If I'm playing well there is usually enough, if I can have ten- or twenty-seconds in between passages, that's enough and I relax my face and I let my breath out. I've learned to try to relax when I'm not actually playing. But if I'm doing the Brahms Trio, or a recital which I try to do fairly regularly, you have to work on endurance and efficiency.
Leelanee Sterrett	I work on it especially if I've had a couple of light weeks in a row. For example, if I have Shostakovich 7 coming up, I will pull-out etudes and things like that. ...I'll play through one of the later Kopprasch etudes, or the Alfonse books 4 and 5. I have to be careful, after some light weeks or I'm only playing a half program, or something like that. I have to get myself back in shape, maybe push it to the edge a little bit and wear myself out.

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### **Non-Horn Practices**

Factors beyond the practice room and rehearsal hall that might contribute to the maintenance and advancement of expertise among these horn players were also investigated. The findings of this portion of the study are detailed in the following discussion, and are organized by the following headings: vacations and breaks, procedures to return from vacation, the use of focus and/or relaxation techniques, physical activity, and the presence of a growth mindset.

#### **Vacations and Breaks**

Each horn player in this study indicated that they do take a vacation away from the horn every year. These vacation periods range from a few days to four weeks, typically during their respective orchestra's summer break, and sometimes during a Christmas holiday break. Short breaks of a day or two are less common. The return to playing is different for each player, but each indicated that a period of time is necessary, as well as a degree of patience, since nothing will be comfortable. Table 10 lists vacation length for each player.

Table 10

*Vacation Time Each Year*

<b>Participant</b>	<b>Vacation Length</b>
Richard Deane	4 weeks
Thomas Jostlein	1-2 days, sometimes 1 week
Richard King	2 weeks, twice a year
Jeff Lang	2 or 3 weeks
Jennifer Montone	More than 2 days, but less than 1 week, at least once per year
James Smelser	3 weeks
Jason Snider	1 or 2 weeks, sometimes twice per year
Leelanee Sterrett	1 week in summer; a couple of days at other times

**Short Breaks.** Occasionally a player will take a day or two off within the season, but this is rare. Deane stated that the intensity of his work is constant and therefore, “during the season I very rarely take any time off.” Despite the temptation for a brief break, missing a day was uniformly determined as making things harder. Lang’s thoughts are an example: “it’s harder to take off one day than to take off weeks.... When I’m in the groove I usually don’t take it off; it’s just easier.” In these circumstances, maintaining fitness is easier than relaxing and re-building the fitness level. Lang elaborated further:

If I take a day off, I need two days off at the minimum. I need that next day to ramp up again, otherwise I can hurt my chops. So, it’s easier and quite frankly on the really busy weeks, it’s easier for me to just go ahead and practice on the day off than to not practice. (Interview, 12/8/18)

Jostlein echoed Lang's thoughts: "I might take one or two days off, but it takes me a while to really build up again." Regarding his habit of continuing practice during short breaks in the orchestra schedule, Smelser agreed:

I don't want to have to go through the agony of starting at square one because you have to work from zero up to a certain level and then maintain it. It's better, even if you drop a little bit, to maintain that and add to it; it's less overall work. (Interview, 12/19/18)

**Vacations.** For this reason, Jostlein rarely takes even a full week vacation at any point in the year. At most, his vacation might reach a week in length. Similarly, Montone said that she will "take a couple of breaks during the year if I have some time off," but only for a couple of days, and for less than a week. Her reason is the same as Jostlein's, "...it's too hard to get back in." Vacation length for each player is determined by what each needs to do to "get back in," and by what repertoire is upcoming upon return.

Two participants offered additional thoughts about vacation periods. Regarding the benefit of time away from the horn, King stated,

I think physically it certainly helps, but mentally I need some time away, and some time not thinking about what the next thing is and what I have to do today, or what I have to do tomorrow. That's important to me...what are your hobbies, what do you like to do, how do you relax, those things are all very important. Nobody teaches you that at school, nobody. (Interview, 12/3/18)

Similarly, Snider underscored the healing that can occur during a break, and trusting your ability as a horn player:

Muscularly there is some relaxation and healing that happens. But I think more important is [that] mentally you have to have some faith in your ability that you don't have to practice every day and every moment in order to be a good player. I think it is a chance every time you take off to re-establish trust in yourself. I find that to be a beautiful thing. (Interview, 11/16/18)

### **Procedures to Return from Vacation**

Each participant reported that they need a period of time to return to their typical playing level. Length of time away and upcoming repertoire determined when work



would resume. While Montone and Jostlein take very little time away from horn playing because of the inherent challenges of returning to form, others take time away and navigate those challenges. Table 11 highlights each player's approach. The findings indicate that for these experts, the process of resuming practice is uncomfortable and needs to be handled with care. No matter when you return, Deane stated, "you're not going to be able to do what you did before; the horn is too fractious." Other players agreed. Sterrett said, "I'll kind of know that it's going to feel terrible. I end up with sort of blank spots in my range, suddenly it's slow and there are holes in my range that I have to be patient with." Smelser stated, "It's going to be painful and agonizing no matter what." King provided more detailed insight into returning from a vacation period:

Most of the time I got this one-day grace period where I sounded amazing, and then the second day or later in the first day, it would be like somebody pulled the rug out from under me and I couldn't play anything at all. Here I am for the first fifteen minutes, "wow!" and then all of a sudden, "No, that's just a teaser. At first this was really disconcerting, when all of a sudden, I could hardly play anything. But then, as a matter of experience just like anything else, take it easy." (Interview, 12/3/18)

Table 11

*Procedure for Returning from Vacation*

Participant	Procedure for Return
Richard Deane	I'll need seven to ten days to get back into shape before the first service.... I'll start with whatever my body allows and usually it's only fifteen minutes at a time. So, I'll do fifteen, take a couple of hours and do fifteen again, and gradually work up more endurance; that's when I'll play the etudes and work my way up. As we get closer, I'll start working on the rep and start playing with recordings to get myself back in the groove. But usually to start, it's just scales and arpeggios and real simple stuff just to get back in shape.
Thomas Jostlein	[After a rare vacation,] play stuff that's easy; I do also play my little natural horn studies. They're basically simple melodies on the natural horn just to get you to sing.
Richard King	It's important to know what you need to do next and to know that you have to start at a certain time. So, I would pick a date on the calendar, say Friday the 10th, that's when I'm playing again, and that was a hard rule...that would be anywhere between five and fifteen days. [Then,] play twenty minutes twice the first day, and twenty, thirty minutes through three times the next day or whatever; really break it up and be very patient about it and know that I'm not that far away from where I was.
Jeff Lang	If I come back and try to play even maybe fifteen minutes, that's way too long. I work up to it very, very, very slowly, dividing it maybe between a morning and afternoon and evening session.... Keeping in mind it's a great opportunity when you do that to get your basics back in shape and to really be mindful of your chops and your air and all of that good stuff...it's really a great chance to reset your playing. But then eventually, I'll get up to an hour of playing and then I'm pretty much good to go. It's the loud playing that I've got to be careful with.
Jennifer Montone	It depends on what I'm coming back to. If it's something big and heavy, then I have to start a lot earlier, if it's not too bad [heavy], I can ease into it.... I'll probably give myself a week or two before coming back into it...[so] that I'm ready and I'm okay and I'm in shape again. So, it usually doesn't seem to be as much of a physical problem as it is just a comfort level.
James Smelser	I will get back in shape in one week, sometimes less. Sometimes I will get back in shape in four days. The first day back might only be twenty minutes of playing, but the goal is always control. It's not random, everything is very, very controlled and consistent, like the articulations and sound...when the quality goes that's about the time to stop. I will do the Concone <i>Lyrical Studies</i> and I will play through as many as I can, and my goal is to try to get through eight, basically nonstop. Then that might be the only thing I play that day because now that's it, it's all you can do. I might come back later in the day and just noodle around a little bit, but just like any other time, you need to rest between the workout and the next level.

Table 11 (continued).

Jason Snider	I find that the Harold Meek routine is very gentle and any routine that you know and you've done a lot, of course it's going to be a quicker way to get back. I can take three weeks off and come back and sound mostly the same, I would just get tired faster. Maybe some things would be not as coordinated, but I can pretty much re-coordinate things in my warm-up session.
Leelanee Sterrett	I'll do my buzzing and sort of check-in with that and I'll kind of know that it's going to feel terrible. [Last] summer when I came back from some time off, I did quite a lot of low playing, that's where the holes in my range were.... I kept things low, kept things moderate, with the idea of feeling good and flexible over my problem areas. [The intent was] to go where it was hard and try to make it feel good, and then know the rest of the strength would come back. That really works for me, so I'll do that again in the future

### Focus and/or Relaxation Techniques

Focus or relaxation techniques were broadly defined as any form of meditation, visualization, or yoga. The findings indicate that three participants practice all three techniques, one participant practices yoga, visualization, and positive affirmations, and three use meditation as needed. One participant does not use any techniques to aid in focus or relaxation. Lang stated simply, “No, never gotten so much into that.... I never got into any of those kinds of rituals.”

The three participants who reported using all three techniques responded enthusiastically. Montone said, “All of the above, all the time, it's amazing, it's really good stuff for me,” and Deane stated simply, “Yes, all of them.” Similarly, Jostlein stated, “I love all that stuff,” and elaborated further:

When playing the horn, I'm meditating on the music, it's my mantra. So, ideally being present, and it's so hard in this iPhone time that we're in. I'm as guilty as anyone of looking at it for an hour and then, where did the time go? So, I don't choose meditation separately, I try to involve it; it's my life essentially.  
(Interview, 12/11/18)

Sterrett noted that she is doing “...a lot of yoga, which I think has a lot of benefits too, although I haven't found that maybe the mental benefits crossed over super-easily. It's going to take a little bit more intentional practice than I had hoped.” She also practices

visualization at times, and is a firm believer in the use of positive affirmations as a pre-performance tool. Regarding positive affirmations she stated,

I found it really works to have a mantra or have something positive that I say repetitively to myself in order to drown out the inside voices that tend to come in, like getting ready to play something and say: “you’ve got this girl, you can do it.” So, the inner voice, making a choice to be in charge of your inner voice, that is something I still work with. (Interview, 12/2/18)

Two participants reported using meditation at certain times when needed. Snider stated that he uses the meditation in the Kenny Werner book, *Effortless Mastery* (1996). “If I’m feeling uptight about my playing sometimes, I’ll pull that out. There is a little 5-minute [meditation] you can do before a practice session, and I find that that’s very helpful.” King also uses meditation, and did so particularly during his transition from Principal Horn to fourth horn:

I had a few rough years when I moved away from first horn...performance anxiety became an issue and meditation helped. I did it pretty religiously. But what helps me more than anything is aerobic exercise. Not even specifically for the aerobic exercise, but going for a run; I just let thoughts process. That really helps me. (Interview, 12/3/18)

Smelser does not do yoga but does use his “own version of meditation,” which is perhaps better described as a small ritual or routine that helps him focus:

I brush my teeth and wash my hands and face before a rehearsal or a concert. When I dry my face and I’m covering it, I’ll just take a breath and blow it out, and then its: “okay, down to work!” (Interview, 12/19/18)

This focus technique is amplified by a deep awareness of, and respect for the many great musicians of the Chicago Symphony who have preceded him. He explains:

When I walk on stage I remember all of the people in front of me and I just turn a switch. Sometimes literally, with my bell on my lap in the concert, the conductor comes out and I just move my hand, like you’re turning the ignition in your car: this is it, you’re in full speed. It’s those two things every time I walk on stage. (Interview, 12/19/18)

## Physical Activity

As an aid to maintaining their expertise, each participant was asked if they are physically active or work-out regularly, and if so, how it affects their horn playing. The findings indicate that all eight participants value physical activity and believe that it contributes positively to their horn playing.

Six participants engage in physical activity occasionally, and two do so daily. Snider reported that he has been “in and out of physical activity for the last couple of years.” He has found that scheduling time with a personal trainer results in regular work outs, and is “a gift I give myself” when he is able. Deane prefers swimming, but only does so one or two times per week, and added, “but I should do more.” Smelser stated that he works out “in spurts,” and is particularly motivated on vacation where he uses the health club at the hotel, where he does “some light weights for your shoulders and your arms, and some light running.” Sterrett has run in several New York City Marathons. She noted that running was something that really helped her horn playing. She does practice yoga, but the loss of regular running has been noticeable: “I don’t manage the peaks and valleys in terms of my heart rate and my adrenaline response quite as well without serious cardio.” Montone also practices yoga, and will bike to work, but beyond that she said, “I run around raising my children.” Jostlein does not do a regular workout routine, but he plays tennis as often as possible, indoor or outdoor.

Two participants engage in physical activity regularly. King stated, “what helps me more than anything is aerobic exercise, particularly going for a run.” He will also bike ride and swim, and participate in triathlons. The most intentional of the eight horn players about daily physical activity is Lang:

In the morning it’s upper body, sit-ups, pushups, pull-ups and curls, and then cardio later on in the day, but not every day. I try to get in at least three or four

days of cardio a week. If it's warm out that will be bike riding or running, and if it's not warm, we've got a treadmill and a trainer inside. (Interview, 12/8/18)

**Benefits to Horn Playing.** There was wide agreement that physical activity helps horn playing. Lang stated enthusiastically that regular physical activity “absolutely benefits the playing.” Snider believes that physical activity is the best way to “balance out the mental stress of playing the horn.” He commented further:

When I'm going for a run, I'm not thinking anything about the horn. I might think about a concert or something like that, but I'm not worried about how to play the horn. I find that shutting off that part of the brain for a while is good. (Interview, 11/16/18)

Similarly, King stated that aerobic activity helps quiet the mind, and he can “let thoughts process.” Deane noted that swimming “makes me a much better horn player...it makes me feel great to play the horn.” Sterrett agreed, and highlighted the positive effects of running:

When I'm in good physical shape, I feel better about the horn. Running was something really, really great to actually feel that my resting heart rate was lower, and it helped me process the adrenaline a lot better. I'm noticing that now as I'm not doing it anymore. (Interview, 12/2/18)

### **Growth Mindset**

In 1986, Harvard psychologist Carol Dweck first identified the concepts of growth mindset and fixed mindset in a study about the nature of intelligence, and how they impact learning. Dweck (2016) defines a fixed mindset as one in which you believe that your abilities are fixed, or are “carved in stone” (p. 6). On the other hand, a growth mindset is one in which you believe that your abilities can “change and grow through application and experience” (p. 7). All eight participants in this study indicated a clear growth mindset. Despite their expertise and their level of professional attainment, intentional work for improvement persists. King provides an example:

I would look at people like Phil Myers [former Principal Horn, New York Philharmonic] and think well, he's got it all figured out, he knows what he's doing so he's done, or Dale [Clevenger, former Principal Horn, Chicago Symphony]. I realize now that it couldn't be further from the truth. I ended up practicing more than I ever had toward the end of my time [as Principal Horn of the Cleveland Orchestra]. (Interview, 12/3/18)

Table 12 lists each player based on years of professional experience, and their comments about a growth mindset.

Table 12

*Growth Mindset*

Participant	Years Pro	Growth Mindset
Leelance Sterrett	9	Never being content with what you do...that being a musician, your work will never be done and you have to be okay with that. You're never going to arrive where you want to be. The growth mindset, it's the idea that practicing, warming up, everything has to come from actually being curious about the horn...I'm still finding the path.
Jennifer Montone	21	You want to grow throughout your whole career. How are going to do that, what are the weak points, what do you hear that other people can do that you can't do anymore? Or, how can you grow, and why can he do that and play it beautifully that way, or why can that violinist play like that, and how can you figure out how to do that kind of thing?
Jason Snider	23	Sometimes I am just maintaining, but I don't get that much gratification out of that. When I'm not growing and I don't have a goal in my playing, I don't find it as fulfilling.
Thomas Jostlein	24	Always grow, but musically so. I don't believe in a level maintenance; you either improve or decline.
James Smelser	28	There is always more, a higher level of thinking and beauty that you can go for. I really like noticing yourself getting better, feeling that you're getting more comfortable with something or you're actually achieving something at this point. You're still learning, you're still improving at this point; that's a great feeling.
Richard King	30	I polish things all the time, and if I didn't then certain things would sort of go away, clear articulation, beautiful slurs, whatever it is you're trying to accomplish. There are always things that creep into your playing, like a stutter, or suddenly you can't play in the middle register very well, then you've got to go back to school a little bit and figure out what's going on.

Table 12 (continued).

Richard Deane	33	I love it and I don't want to let people down, and I also have this insidious desire to get better. I'm just obsessed with getting better and trying to figure stuff out, and figure out why I'm doing it. Always, always, always, the number one thing is trying to get better, trying to fix that problem.
Jeff Lang	36	I'm practicing to stay a good horn player and I am constantly improving. [Also,] I've got to make sure that I maintain some areas that do start to get more difficult as you get older.

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Of people possessing a growth mindset Dweck (2016) stated,

People with the growth mindset believe in something very different. For them, even geniuses have to work very hard for their achievement...they admire effort, for no matter what your ability is, effort is what ignites that ability and turns it into accomplishment" (p. 41).

Consistent with Dweck's comment, the findings of this study indicate that expertise in horn playing is not a point of arrival after which one can simply coast and maintain their skills. As Deane stated clearly, "that's not the way it is. Unfortunately, the work gets even harder; the level, the work, never goes away, never."



## **Chapter 5 – Discussion**

### **Introduction**

The purpose of this study was to examine the habits and practices of eight expert French horn players representing six major American symphony orchestras. The study focused on the players' warm up procedures, practice procedures, method for practicing specific areas of horn technique, and non-horn practices that might contribute to horn playing expertise. A major factor in this study is the professional success achieved by each participant. Each horn player has earned tenure in their respective orchestra, each is held in high regard by the horn playing community, and each orchestra represented is considered among the finest in this country. Additionally, each participant holds a teaching position in higher education and/or regularly gives master classes and clinics at conferences and universities. Each is therefore accustomed to describing their processes and articulating their approach to horn playing. This minimized a common challenge of studying experts identified by Chi (2006) and Harnum (2013), namely, that because so much of their knowledge is tacit, ingrained, and autonomous, experts often have great difficulty articulating their processes. With minor exception, this did not seem to be an issue in this study. Each participant was articulate and enthusiastic about their processes and their participation in this study, and each was curious about learning about the habits of their peers. The conversational nature of each interview, rather than a strict, formal question-answer format, resulted in an open exchange of concepts, ideas, and approaches. The average length of each interview was 90 minutes.

### **The Question of Experts and Expertise**

While much of the study of experts has focused on the acquisition of expertise and the characteristics of experts (see chapter 2), the intent of this study was to explore

what experts do, if anything, to maintain and advance their expertise once they have achieved recognition as an expert. Researchers investigating experts and expertise are immediately challenged by the term itself: what defines an expert? An expert has been defined as “one who has acquired special skill in or knowledge of a particular subject” (*Webster’s New Collegiate Dictionary*, 1979, p. 400), or as one who “has gained special skills or knowledge representing mastery of a particular subject through experience and instruction” (Ericsson, 2014, p. 508).

But what are those special skills, and by what measure is mastery defined? Montero (2016) underscores the challenge of providing answers: “...there is very little agreement among the expertise scientists about who exactly counts as an expert and what exactly expert action is” (p. 4). Those who study the characteristics of experts have found that experts perform with minimal awareness of their actions (Dreyfus, 2004; Fitts and Posner, 1967), have spent many years in their domain (Chi, 1988), and have earned peer recognition within a particular domain (Carroll, 1994). The question of what defines an expert was not addressed by this study. For the present purpose, the definition of a French horn expert was determined by each participant’s membership in a major American symphony orchestra. Such membership is determined by an extended and highly competitive audition process.

### **Overview**

The findings of this study underscore many of the major assumptions and procedures in horn pedagogy and practice. Warm-ups are vitally important, not simply to prepare for a day’s practice, but for overall horn health. While variability of scheduling and content are preferred by most of these participants, initial contact with the horn is careful, thoughtful, and context-specific. During periods of intense playing, such as an

all-Mahler or all-Bruckner week, the warm up is often the only playing that occurs away from the orchestra.

Practice sessions for these professional musicians do occur, and are also variable in terms of scheduling and length of time. Interestingly, this directly contradicts a major assumption of Hallam (1995), who believed that full-time professional orchestra wind players did not have time to practice. Practice sessions among these participants are goal-directed, and content is focused primarily on orchestral repertoire, and on being prepared and in-shape for the heavy weeks. These players also indicated that often, the orchestra rehearsals themselves are good opportunities to refine and improve their habits and techniques of horn playing.

The specific areas of horn technique that are detailed in the horn pedagogy literature are continually and intentionally practiced by these eight horn experts. It is clear that these areas of technique and skill are not taken for granted, but rather, are attended to regularly. While approaches vary based on perceived personal strengths, current conditioning, and the responsibilities of the orchestral chairs that they hold, practice in these specific areas is pervasive and intentional. Among these participants, tone, articulation, flexibility, and endurance seem to receive particular attention. Practice on range and dynamics will often be opposite of the responsibilities of their orchestral chair and the current repertoire. For example, if one is a low horn player, upper range is practiced more, and the converse is also true. Similarly, if the current repertoire being rehearsed is largely at the louder dynamic levels, softer dynamics will receive attention in practice sessions. These findings underscore the importance of maintaining the concept of balanced practice, and of remaining fit and prepared to play in all registers, styles, and dynamic ranges.

Among the most surprising findings of the study was the lack of practice of breathing exercises specific to the horn. While all players clearly understood the importance of good breathing habits, only one participant works specifically on this area of horn technique. Given the rather significant attention that breathing receives in the pedagogy literature, and in teaching practice, this finding was not expected. Another unexpected, but significant finding was the use of recordings for repertoire preparation. This was not limited to listening for larger musical contexts, or for learning a certain conductor's potential interpretation. Rather, the majority of these players play their parts along with a recording. This serves as a synthesis of all previous practice and preparation, and as a test of one's readiness for rehearsal and performance with the orchestra. While it might be expected that younger and less experienced players will occasionally practice with recordings, the fact that these expert professionals also do so, underscores the value of this technique for performance preparation.

Finally, among all of the facets and responsibilities of maintaining and advancing expertise in horn playing, one of the most important is artistry and musicianship. All of the players in this study emphasized the importance of keen and discerning listening, and of constantly being aware of even the most minute and subtle of changes tone, balance, articulation, tempo, and any variety of musical elements which contribute to musical interpretation and meaning. This is an active, constant, literally note-by-note awareness, of hearing and reacting, and of accommodating and adding to the larger musical interpretation of the conductor and the orchestra in "real" time. The influence of orchestra colleagues and visiting guest soloists is significant in this area, and points to the critical importance of teaching listening skills to music students.

The following discussion expands on these points, and is organized by the interview protocol (see Appendix C) and the two emergent findings. Given the recognized expertise of each of the participants in this study, the discussion is amplified by direct quotes from the players themselves as appropriate. Additionally, references will be made to relevant related research and pedagogy literature. Limitations of the study, implications for the field of music education, and suggestions for future research are also included.

### **The Major Findings**

If expertise is the result of nature or nurture, and/or a unique and fortunate combination of these and other possible factors, what happens when one has achieved professional recognition as an expert? Is there a sense of arrival, a sense that one can now simply “ride the wave” of genetic good fortune and/or countless hours of deliberate practice? Is expertise an endpoint? The major finding of this study is that the maintenance and advancement of expertise for these expert French horn players is intentional and is actively pursued each day. This is consistent with the findings of Breiter and Scardamalia (1993) and Sosniak (2006) who describe expertise as a process or continuum rather than an endpoint, and it is consistent with other studies of the habits of expert brass players (Trusheim, 1987; Harnum, 2013). While each of the eight participants has earned a chair in an elite American orchestra, thereby achieving a recognized level of expertise, each is regularly, actively, and intentionally engaged in the maintenance and improvement of their horn playing. Additionally, in the midst of regularly attending to the disciplines of their craft and embracing the inherent challenges of the art form, the majority of the horn players expressed a strong sense of gratitude for where they are, what they do, and for the many outstanding colleagues with whom they are fortunate to work. In the words of

James Smelser, second horn of the Chicago Symphony for many years, “I don’t take anything for granted...it’s amazing that I get to do this.”

Finally, the findings of this study are consistent with what is found in the horn pedagogy literature. The habits and practices of these eight horn experts confirm the recommendations of Farkas (1956), Schuller (1962), Wekre (1994), Reynolds (1997), Hill (2001), Rider (2006), Morrell (2014), and Gardner (2014). This degree of consistency suggests that these authors are reliable sources for aspiring horn professionals, horn teachers, and music educators in their quest to learn more about horn pedagogy and performance.

### **Motivation to Practice**

What motivates experts to practice? Harnum (2013) states that “without motivation, practice simply wouldn’t happen” (p. 331). All eight horn experts in this study indicated strong motivation to practice, and all cited both internal motivation (sounding good, improving ability), and external motivation (upcoming performance, maintaining the expected level of excellence). This fact contradicts Hallam’s (1995) findings where only 5 of 22 professional musicians cited both internal and external motivation to practice. During the conversations on this topic, the horn players in this study typically mentioned internal motivators before external ones: “I really like noticing yourself getting better” (Smelser), “I’m a perfectionist. I will freely admit that and I want it to be great” (Deane), “it just feels so much better and so much more enjoyable when you’ve done your homework” (Sterrett), and most succinctly, King is motivated by “the joy of being in shape.” As expected, the external motivation of having music prepared for a rehearsal or performance was uniformly noted by all. What was not expected was that the motivation to practice among these horn experts extended further to honoring their

colleagues, their orchestra, the chairs that they hold, and the explicit drive to maintain the standard of excellence for which their respective orchestras are known. These motivators were not after-thoughts or distant secondary factors, but rather, were among the primary sources of motivation for these expert horn players.

### **Growth Mindset**

Harnum (2013) found that professional musicians appear to hold “mastery-oriented motivations” (p. 332), or what Dweck (2016) calls a growth mindset. Research indicates that such a mindset fuels internal motivation, propels learning, and enables the grit and persistence necessary for high achievement (Harnum, 2013; Dweck, 2007, 2016; Duckworth, 2016; Smith 2005). Consistent with this research, the findings from this study indicate that all eight horn players, while already having achieved expert status within the profession, possess this growth mindset. This mindset seems to broaden and deepen the motivation to practice, and this was evident regardless of years of experience. Sterrett, with nine years of professional experience emphasized, “Never being content with what you do...your work will never be done.” On the other end of the spectrum Deane, with 33 years of experience stated, “I have this insidious drive to get better,” and Lang, the most experienced player in this sample with 36 years noted, “I am constantly improving.” Lang also admitted that some areas of playing do begin to get more difficult with age. Attending to these areas has further added to his internal motivation to practice.

### **Warm up**

The findings from this study demonstrate the value and importance of a warm up. This is consistent with research in music practice which indicates that warm up procedures are used by most musicians prior to nearly every playing session (Jorgensen, 2004; Hallam, 1995; Harnum, 2013; Hill, 2013). These findings also indicate that

variability of the warm up is preferred, and this is consistent with the research in professional practice (Hallam, 1995; Harnum, 2013; Trusheim, 1987), and with the horn pedagogy literature (Farkas, 1956; Reynolds, 1997; Wekre, 1994; Gardner, 2014).

### **Back to Basics**

For each participant, the warm up routine is based on upcoming demands of the day and the degree of fatigue from previous days; the warm up is context-specific. In the warm ups of these eight horn experts there is an emphasis on initiating the buzz with relative ease and with virtually no mouthpiece pressure. Breath attacks (no articulation), “soft, easy buzzing” (Montone), notes that “speak and respond quickly” (Snider), and feeling “the softness of the transition between the notes and the quality of the sound” (Smelser) were highlighted. The responses indicate a preference for a warm up that begins in the middle register, defined as written C4 through G4, and that expands in both directions. Four players use free buzzing, and five use mouthpiece buzzing before moving to the horn itself. The majority of participants start with chromatic or diatonic patterns expanding in both directions. Scales and arpeggios with differing articulations and dynamics are added. Favored among two participants as part of their warm ups are conjunct, diatonic and chromatic line-based melodies called, “noodles” or “snakes,” which are similar to the *Flow Studies* by Vincent Cichowicz (2013), and the H. L. Clarke, *Technical Studies for the Cornet* (1984). The emphasis on, and awareness of the most fundamental elements vibration, sound, resonance, flow, and line among these horn experts is an important finding. Despite their years of experience and the level of expertise attained, these players return to foundational concepts routinely. These findings are similar to Harnum’s (2013) findings with classical musicians, and they confirm the



recommendations found in the horn pedagogy literature (Farkas, 1956; Reynolds, 1997; Wekre, 1994; Gardner, 2014).

### **Assessment and Repair**

The warm up is also used as a period of assessment and repair. Given the demanding performance schedules that these players maintain, this seems to be a critical element in their practice habits. While the need to prepare for what is to be played on a given day is a clear objective, the warm up is also used to assess embouchure responsiveness, which then dictates what is practiced next. King stated that, “I see how it feels and how it sounds, and if it’s going well, I sort of proceed onto arpeggios and things like that.” Lang’s warm up “tells me how my chops are doing...tells me if the note comes easily, then that tells me something. If I’m a little stiff and beat-up from the day before and it doesn’t come, that’s fine” and he adjusts his warm up accordingly. Similarly, Snider uses his warm up to “see how the air and the chops are responding, because if that’s gotten blown-out in the orchestra; that’s the first thing to fix for me.” As he warms up, Deane is “searching for a feeling, and re-emphasizing pathways,” and Smelser is restoring the “softness of the transition between notes and the quality of sound.” This period of assessment is important for determining if practice is needed for repair and healing, and determines how the next rehearsal is approached. Maintaining horn health and readiness for the next service are high priorities. For the majority of these eight horn experts, the warm up period serves multiple purposes: assessment, repair, and recovery as needed, restoring flexibility and responsiveness, and initiating air flow to prepare for the coming day. This is consistent with Reynolds (1997), who noted that one of the primary reasons for a warm up is “to repair damage caused by over-work.” (p. 27).

## Something Different

Among the participants in this study, there was one exception to the warm up habits discussed above. Jostlein stated, “I don’t warm up except for getting my mind on music.” His approach, rooted in the teachings of the former Chicago Symphony tubist Arnold Jacobs, is to “flood your brain with musical thoughts” so that the goal is firmly established in the mind. From here, he will buzz simple melodies with a focus on mentally singing, intentionally avoiding concern about technical aspects. He readily admits, “I’m different,” and the result is a deeply musical approach that completely avoids the “paralysis by analysis” condition that has impacted many brass players. In his interview, Jostlein did not discuss the basics mentioned by his colleagues. One might speculate that this is evidence of an expert whose habits are so ingrained and autonomous that he has difficulty articulating his processes. On the contrary, he is entirely committed to this singing approach. He believes that the horn is a “mirror of your thoughts” and that training the horn in your head by listening to great soloists enables the horn in your hands to sing. He imagines the sound he wants before he plays, and then the singing and buzzing further activate the desired product (Jostlein, 2004). The degree to which mental imagery and aural modeling influence these horn experts was not investigated in this study, but it has been shown to play a significant role with other elite orchestral brass experts (Trusheim, 1987). This concept continues to be advocated by brass performers today (Harnum, 2013; Loubriel, 2012), and is recommended in the horn pedagogy literature (Reynolds, 1997; Gardner, 2014). It is also consistent with studies in mental rehearsal (Connolly & Williamon, 2004; Freymuth, 1993; Stanton, 1994).

## **Performance Warm up**

Prior to a performance an abbreviated warm up seems to be favored, and this is true even if there has been a rehearsal earlier in the day. The purpose of the pre-performance warm up is to “check and see where you are” (Smelser) and to “make sure that I still feel okay” (Montone). Again, flexibility of content is preferred, and will include “random doodling” (Lang), “noodle-type things” (Sterrett), and “lines and melodies” (Smelser). Lightly touching passages and/or solos that are about to be performed is also common. The pre-performance warm-up also serves to restore focus and concentration and to “get in the zone and in the right place musically” (Montone). These findings confirm the pre-concert recommendations of Reynolds (1997). The importance of a warm up period prior to a performance or practice session remains important for expert horn players, despite their extensive experience. While the ability to “play cold” was something that two players mentioned as a valuable skill, no participant advocated this approach as a standard practice. A warm up procedure of varying types appears to be an essential component for these expert horn players prior to practice, rehearsal, and performance.

## **Practice**

### **Scheduling**

The scheduling of practice sessions is dictated by orchestra schedules and by current and upcoming repertoire, in addition to other responsibilities. The need to be sensitive to over-all playing demands and upcoming repertoire determines both when a practice session is scheduled, and the duration of that session. During periods of demanding repertoire (i.e., works by Mahler and Bruckner), very little practice occurs. In these cases, a warm-up is sufficient, along with remaining mindful of good playing habits

during orchestra rehearsals. More broadly, flexibility in practice scheduling is common and occurs in small segments between students, after teaching, after rehearsal, after a concert, and sometimes on stage during an intermission.

Often, practice sessions are scheduled on light days (one orchestra service or less). Montone and Jostlein typically schedule these sessions at night around the needs of their families, while King prefers late morning. The average length of time for these sessions was 75-90 minutes, consistent with Harnum's (2013) findings with Western classical musicians. While research indicates that as a student musician's expertise develops, practice time also increases (Byo & Cassidy, 2008; Ericsson, Krampe, & Tesch-Romer, 1993; Jørgensen & Hallam, 2009), these findings indicate professional musicians' practice time is less than that of advanced students. The varying orchestral demands are likely a reason for this, as each player spends a considerable amount of time playing, but it may also be that expert professional musicians are better able to assess their needs and therefore practice more efficiently (Harnum, 2013).

## **Content**

The findings of this study indicate that current and upcoming orchestra repertoire is the primary area of focus in a practice session. While previous research in practice structure and content indicates a focus on technique and then repertoire after a warm up (Jorgensen, 2004; Jorgensen & Hallam, 2009; Hallam, 1995), these findings indicate a strong emphasis on repertoire following warm up. All players indicated the necessity of looking ahead and being prepared for the varying demands that the repertoire presents, whether it be learning new repertoire or re-visiting a well-known work. Practicing "in small chunks" and "around licks that are tough" (Sterrett), or approaching each work as "a brand-new piece" (Jostlein) were common themes. Creative approaches such as

playing on the mouthpiece, slurring everything, tonguing everything, articulating underlying subdivisions, and playing parts down an octave seem to be useful and common practices.

An interesting finding was the pervasive use of recordings for repertoire preparation. While recordings provide valuable information about how a particular passage fits into the larger orchestral whole, they also inform musical decision-making as various horn parts are learned and prepared. Additionally, they enable practice as “a trial run” (Sterrett), the ability to “imitate the feel of being on stage” (Deane), and to “perform the whole piece” (Jostlein) prior to a rehearsal or performance. Performing with the recording is typically undertaken after listening to a work, listening with the full score, and after parts have been marked and practiced. Practicing with recordings seems to increase confidence and solidify previous study and preparation. It also contributes to erasing the line between practice and performance, which was an important finding with the brass players in Harnums’s (2013) study. While not every player employs recordings in this manner, further study might explore the degree of efficacy of this approach, and the potential impact on practice efficiency.

Beyond the repertoire on the orchestral schedule, practice sessions will often include repertoire for chamber music or various solo projects, although two participants specifically noted that they do not simply “play through Strauss again” (King). This finding was not surprising, but what was interesting is that three of the participants specifically use other repertoire as part of their practice. The horn parts for the Bruckner Symphonies were specifically noted for achieving and maintaining top conditioning because “they’re exposed, they go across the break range, they’re often very low, often very sustained” (Jostlein). Looping excerpts from Shostakovich 10, and playing the horn

solos from Tchaikovsky Symphony 5 and Mendelssohn *Midsummer Night's Dream* back-to-back were also noted, as well as movements from the Bach Cello Suites. The use of other repertoire appears to be an efficient way to remain in “orchestral shape,” provide variety in practice content, and continually hone skill in musical phrasing and intent.

Practice content among these eight horn experts is occasionally augmented with various horn etude books (see Appendix F). Given the level of expertise of these players and their busy performance schedules, this finding was not expected, but it is consistent with studies of other professional musicians (Hallam, 1995; Harnum, 2013; Sloboda et al., 1996; Jorgensen, 1998). This finding is also consistent with Reynolds (1997) who asserted that etudes are never finished and can be used “throughout one’s playing career for diagnosis and rehabilitation of the fundamental techniques” (p. 51). Among the participants in this study, etudes are used to “beef up” areas of playing needing additional attention (Snider), to address “things that creep under your playing” (King), and to explore nuance and color (Montone). The use of etude books occurs also during the return from a vacation, and are used on tour for general conditioning and endurance. While repertoire preparation receives primary attention in a practice session, the use of etudes to supplement and augment conditioning for these experts is noteworthy. Given the widespread use of etude books by horn teachers across the country, it is interesting and reassuring that these etude books are used by horn experts who continue to derive musical and technical benefit from them as they work to maintain and improve their expertise.

### **Specific Goals**

Since time for practice is limited by busy orchestra schedules and often by teaching responsibilities, practice sessions are not entered into lightly or haphazardly.

The findings indicate that each session is goal-directed, although there is great diversity in what those specific goals might be. Broadly, the goal is to “remain in shape or get in better shape” (Smelser), but specific goals range from assessment and repair to reestablishing or restoring resonance, to building endurance for upcoming repertoire, to learning new music and working out tough passages, tricky transpositions, or unusual rhythms. The most meticulous goal-setter in this study was Jostlein, who for nearly 30 years has kept a practice journal. For each session he assigns himself the specifics of what needs to be practiced, and then checks-off each item upon completion. When the list is done he puts his horn away noting that it is “very important too not to just noodle aimlessly, but play with intent.” While available time is a factor, the desire to be efficient and practice as needed for optimal preparation and embouchure health is also a primary motivator.

A major influence on practice goals, content, and duration for these eight horn experts is the cyclical nature of the demands of the orchestral repertoire. Each participant was asked about differences in preparation for “light weeks” (i.e., an all-Mozart program) and “heavy weeks” (i.e., all-Bruckner or all-Mahler program). Preparation for the heavy weeks requires at least a few weeks, and in some cases, the preparation begins months in advance. Changes in sound, duration of lines, articulation, endurance, range, and dynamics all receive attention. Despite their expertise, the findings indicate that these horn players are intentional about honing the many important details that enable the fullest artistic expression of the various compositions that they perform. While this was expected, there were a few surprises. Deane and Jostlein approach all-Mozart weeks and all-Mahler weeks in as similar a manner as possible. While adding more practice time for the heavy weeks, they rely on their inherent musicianship to complete the necessary

differences. Perhaps this is because of their many years of experience, or the intention to simplify approaches, or possibly it is due to the general nature of experts to be unaware of their processes. The most surprising finding was Lang's response that Mozart is more challenging than Mahler. For him, performing Mahler is "getting in the groove" and "blowing down" the symphony. Using the example of the high E's in the first horn part of a Mozart violin concerto, he underscored the challenges of range and texture inherent in Mozart, stating succinctly, "that's a whole different situation." Mozart may not demand the more continuous playing or volume levels common in music of the later Romantic era, but the challenges are unique and significant. It might be preferable to view the "light weeks" as simply different, without implication that they are easier. As Reynolds (1997) noted, "Mozart wrote music of charm and wit for an instrument of limitation and hazard" (p. 164). The modern instrument has far less limitation, but still retains a fair amount of hazard.

### **Artistry and Musicianship**

Renowned music education philosopher Bennett Reimer observed that musicians face countless decisions "about the sounds themselves and how to most effectively produce and shape them" (Reimer, 2003, p. 113). Exceptional skill and technical proficiency are necessary and are clearly evident at expert levels, but they are not sufficient in the interpretation and performance of music. Beyond technical mastery, what distinguishes expert musicians is their ability to control and manipulate the infinite nuances of tone and sound, to be aware of and understand a composer's concept and intent, and to make countless aesthetic decisions influencing musical interpretation. Of all the fundamentals required for expert horn playing, Farkas (1992) called musicianship the most vital. "Musicianship is... a matter of knowing, or doing things in moderation,



neither too little or too much; a little finesse when called for, boldness in the proper place, and always uppermost, the playing of music, not notes.” (Farkas, 1992, p. 128). Given this critical aspect of expert horn playing, the question of how these eight participants maintain and advance their artistry and musicianship was investigated. The unanimous finding was listening. The majority of participants spoke of the direct influence of, and inspiration received from their orchestra colleagues. Sterrett spoke of this as “an unfair advantage,” Montone stated, “we’re very lucky,” and Deane called it a privilege. Interestingly, this listening was not confined to the other members of their respective horn sections. Rather, there was an emphasis on the inspiration derived from the musicians from other sections. This larger spirit of collaboration, what Montone called “a chamber music mentality, a sense of everybody kind of egging each other on,” was common. In this environment, while “it’s very easy to feel like the weak link,” when you are surrounded with top-level playing, “it’s hard to play unmusically” (Lang). The influence of visiting soloists was also highlighted, as was the inspiration of other horn experts, and performing chamber music and other outside projects. Listening to great artists, to great recordings while doing other things, and being open to inspiration wherever it might be found were also noted. “You just have to keep listening” (Sterrett) and as you do, “a lot of that gets ingrained in your body” (Deane). These findings are further evidence of the growth mindset of these experts, and are consistent with research in aural imagery in expert professional brass players (Trusheim, 1987). Given the clear importance of listening’s impact on artistry and musicianship, these findings are a potent reminder that exposing horn students to quality recordings and performances, and helping them to develop discernment in listening should be an integral part of any horn curriculum.

### **Horn Specifics**

The horn pedagogy literature typically separates the various elements of horn playing into specific topics (Farkas, 1956; Schuller, 1962; Wekre, 1994; Reynolds, 1997; Hill, 2001; Rider, 2006; Gardner, 2014; Morrell, 2014). While these topics are present in the pedagogy of other instruments, they are here referred to as “horn specifics” for the sake of simplicity. Since the purpose of this study was to investigate the practices and habits of expert horn players, each of these specific areas was investigated. The specific topics were: buzzing (free and mouthpiece), breathing, tone, flexibility, articulation, range (high and low), dynamics, and endurance.

#### **Buzzing**

Buzzing as a part of brass practice and pedagogy is fairly common, though not universal. The findings of this study indicate that three participants use little or no mouthpiece buzzing, while the other five do so to varying degrees. Typically, mouthpiece buzzing awakens the aperture, establishes the vibration, and underscores the necessity of a free-flowing air stream. Buzzing can also be used to help focus on singing melodies without the constraints or distraction of the horn itself, as Jostlein does, or as a “magnifying glass” for improving basic technique (Montone). The five participants who use mouthpiece buzzing recognize that it can “straighten out a lot of stuff” (Lang), but there are limitations. Too much mouthpiece buzzing can cause issues because “that buzz is not the buzz when it’s connected to the horn” (Lang). Sterrett uses extra tuning bits when she buzzes to avoid bad habits and more closely approximate the resistance of the horn, and Jostlein will add a little funnel to aid the low range. Buzzing for long periods, extremes of range, or large glissandos are not recommended. As Sterrett stated, “I try to keep my mouthpiece buzzing exactly what I’d do on the horn in theory.” Mouthpiece

buzzing is helpful in moderation, to remind, re-establish, or restore basic procedures of vibration and resonance, and to encourage mentally singing and a focus on the product rather than the process.

The concept of free-buzzing, defined as buzzing the lips without the aid of the mouthpiece or horn, has been more controversial among brass performers and teachers. This fact is evident among the participants in this study, four of whom use this technique, and four of whom do not. Two of those who do not use free-buzzing stated clearly that they think it is detrimental. Of the four who do use it, two do so sparingly, more as a way to initiate the vibration or assess basic conditioning. Sterrett will do a bit more, but her focus is on establishing the resonance and feeling “where everything is in the mechanism on that particular day before I get a hunk of cold metal on my face.” Montone uses free-buzzing the most extensively, “I usually free-buzz whatever it is I’m going to play.” This is perhaps to be expected as this is the approach of her teacher, now colleague, at the Juilliard School, Julie Landsman. Given the variety of opinion regarding free-buzzing in the larger brass community, these findings were expected, and they suggest that the use of free-buzzing by music educators and horn teachers should be done so sparingly and with care, if at all.

### **Breathing**

Given the critical importance of breathing in French horn playing, one of the surprising findings in this study was the fact that only Montone practices breathing for her horn playing. In addition to breathing exercises to calm and focus, and the use of certain yoga poses, Montone uses the Breathing Gym (Pilafian & Sheridan, 2002) to increase airflow and efficiency and reduce stress. The other participants, while understanding the importance of breathing in horn playing, and having a clear awareness

of it when they play, do not do specific breathing exercises to aid their playing. Jostlein noted that “You cannot expand your vital capacity” but you can be in great physical shape. This importance of physical fitness as a contributing factor to breathing on horn was noted by a number of the participants. Other common themes were simply letting the music dictate the breathing and breathing as naturally as possible. These themes seemed to be the ones that were most prevalent among these participants.

That breathing as a specific and important technique in horn playing is not directly practiced by the majority of these horn experts was surprising, especially since it has been given so much attention in the horn pedagogy literature. Farkas (1956) devotes an entire chapter to the mechanics of breathing, and Reynolds (1997) offers a highly detailed approach to practicing breathing using a metronome. However, consistent with the horn experts in this study, Gardner (2014) states that “No area of brass technique has been over-analyzed more, and made far too complicated, than the simple act of breathing” (p. 19). Breathing in horn playing is obviously important, but as Lang stated, “I think there are a lot of myths out there about the way brass players use their air.” There is a belief that massive quantities of air are required, and many teach their students to take large inhales. Lang pointed out that this can lead to extra tension. Instead, “what’s important is the speed, the intensity, the evenness, the efficiency of the air, all those things are really, really important.”

While teaching horn students the importance of breathing and helping them to develop good breathing habits, these findings suggest that breathing naturally and musically, and keeping suggestions simple, should guide instruction. Perhaps the lack of specific breathing practice by these horn experts is evidence of a characteristic of experts found across other domains: that their knowledge and skill is tacit, and so ingrained and

autonomous, that they are either unaware of, or have difficulty articulating their processes (Chi, 2006; Harnum, 2013). Or, perhaps the expertise is even more inherent, as Jostlein concluded, “we are all master breathers from birth on.”

### **Tone**

One of the major findings of this study is the importance of tone to each player, and the prominence that it has in their thinking and practicing. While this was not surprising, it was interesting to discover differences and similarities in how this is manifested. Listening was directly mentioned or strongly inferred by all participants. This included listening to one’s own tone to maximize vibrancy and resonance, and listening to match and blend with others and adjusting as necessary. Another common emphasis was thinking about vowels and colors, having a singing approach, and a focus on the “vocal-ness that’s inside the sound” (Montone). Awareness of, and optimizing tone is constant. As Deane noted, “I think about it all the time.” Specific techniques for working on tone were mentioned: mouthpiece buzzing (Sterrett), good breathing (Montone), releasing tension (Snider), playing art songs of Schubert, Schuman, and Brahms (Jostlein), and playing in the low range and playing on the F horn (Lang).

Having a good concept of horn tone was also noted. Gardner (2014) stated that “a brass player’s tone is influenced to the greatest extent by the tone concept that lives in their mind,” and that to develop this, one needs to “listen deeply to many fine performers over a long period of time” (p. 27). Each player reported the influence of other expert horn players as inspiration for their sound. The list of these horn models included Dennis Brain, Hermann Baumann, Barry Tuckwell, Lowell Greer, John Cerminaro, Jerry Peel, James Chambers, Dale Clevenger, Eli Epstein, Randy Gardner, Radovan Vlatkovic, Edwin Sayre, Julie Landsman, Frank Brouk, and Gail Williams, among others. These

findings suggest that horn teachers should make recordings of expert horn players available to their students. Since listening is crucial to optimal horn tone, teachers need to help students develop and hone this skill so that they can grow in aural perception and discernment and have a clear example of the goal.

### **Articulation**

Rider (2006) states that “theoretically we would want to have an almost infinite gradation of tonguing, from long to short, that we could use as needed for the interpretation of music...” (p. 95). An interesting finding in this study is the intentional inclusion of articulation work in the practice sessions of these horn players. Similar to the importance of tone, articulation receives constant attention. Alternating tongued and slurred scales, arpeggios, or harmonic-series patterns is common, and then progressing to the use of an etude book, such as Pares Scales (1952), Kopprasch (1939), or Concone (1972), and followed occasionally by multiple-tonguing exercises as needed. Montone compares the style range of possible articulations to an artist’s palette, and will play an etude in the style of different composers, emphasizing distinction, clarity, and consistency of air. Beginnings and endings of notes, and the “shape of the note in articulation” (Deane) are all involved. The variation of styles, and the maintenance and refinement of the ability to create those styles, needs to be practiced regularly. Additionally, this appears to change over time. Lang noted that with age, “articulation does slow down,” particularly in fast technical passages.

### **Flexibility**

Another convincing finding in this study is the importance of practicing flexibility regularly. Seven of the eight horn players list this as one of their areas of focus in their practice, similar to the findings in tone and articulation. The 4+ octave range of the horn,

and its ability to sound the notes of the naturally occurring harmonic series from the second partial through to the 16<sup>th</sup> and beyond, necessitates flexibility practice. Additionally, the horn players in this study perform on either double or triple horns, further adding opportunity for flexibility exercises, which is why six participants specifically cited the use of harmonic slurs. Using harmonic series slurs provides experience with the natural horn, and also has the benefit of developing “inside-the-mouthpiece muscle control” and “paves the way for lip trills and upper range flexibility” (Rider, 2006, p. 130). Moving through adjacent partials that are close together, centering pitches and changing notes as you “ride the air and not over-move and over-bump a lot” (Montone) seems to be a common approach. For more flexibility, skipping adjacent partials and expanding to those that are further apart can be used. Deane will do this as needed, as will Sterrett, who noted that she is “a fan of the ones stolen from the tuba flexibility exercise that has the skipped partials.”

Another natural progression after the adjacent harmonics is slurring scales and arpeggios. Deane is the most diligent with this type of progression, and prefers fully diminished arpeggios because “the intervals between notes are all the same, promoting a feel of evenly graduated flexibility” (Deane, 2017, p. 54). The objective is that of progressively working with notes that are further apart while maintaining “the same feel of ease and closeness” that was established previously (Rider, 2006, p. 138). Often, slurring is alternated with the same exercise articulated, thereby enabling the practice of two essential components of performance with great efficiency.

While the majority of these participants maintain and advance their flexibility skills with specific exercises, one participant uses a different approach. Jostlein’s emphasis on musical thought and singing inspires his flexibility practice within the

context of specific etudes. One of Jostlein's concerns is that in attempting "to assemble technique out of building blocks (lip trills, flexibility, etc.), you lose sight of the goal: singing one note at a time." However, horn teachers and music educators will likely see the need to separate concepts for younger players to establish necessary performance skills. Moving rapidly to musical examples and excerpts that employ these new and developing skills is not only logical, it also encourages the development of musical phrasing and sound that is at the heart of the art form itself. Perhaps a combination of the practices employed by these experts might be the best choice for teachers and younger players.

### **Range**

The large 4+ octave range of the horn is one of its more unique features. In earlier times, horn players could "become more or less specialists in either upper or lower registers" (Farkas, 1956, p. 57). While this is no longer true, even in 1956 Farkas advised against such specialization (p. 57), and these eight horn experts agree with Farkas. The importance of proficiency throughout the entire horn range was underscored by all of the participants in this study, and it is a skill that they continue to hone regularly. While specific practices for high and low register used by these eight horn experts were detailed in chapter 4, a number of themes emerged.

By virtue of the specific chair that each player holds, certain areas of the horn range are maintained by playing in their respective orchestras. For example, Snider plays fourth horn in the Boston Symphony so his low range is well-rehearsed. On the other end of the spectrum, Montone and Lang regularly play upper range in the Philadelphia Orchestra, so in their practice sessions there will be intentional work in the low register. Sterrett, as Acting Associate Principal of the New York Philharmonic, plays mostly in the



upper register, which she finds particularly ironic since she “does not have a natural high range.” Two practice habits emerged: practice both high and low range every day, and closely related, the concept of balanced practice.

Five participants highlighted the importance of playing both high and low every day, perhaps most clearly illustrated by Deane’s comprehensive routine. Practicing in both ranges obviously maintains skill and fluency in all areas, as Sterrett quipped, “use it or lose it.” The emphasis in this approach is to either work on an area that is not natural, as Sterrett does, or to practice the range that is opposite of the majority of the repertoire that is played in the orchestra, as Montone and Lang highlighted. These findings underscore the importance of Farkas’ advice against range specialization, and suggest that horn teachers should emphasize the practice in, and development of both ranges equally.

Closely related is the concept of balanced practice, which was alluded to by all of the players in this study. Balanced practice is practicing opposites in all specific areas of horn playing: range, dynamics, articulations, and tempo in particular. Deane and Snider have daily routines which are designed to be balanced and to cover opposites. King makes perhaps the clearest statement of the importance of balanced practice:

If you play low, go home and practice high. If you play loud, go home and practice soft. You have to do the opposite thing otherwise it’s gone. If you only play assistant and only have to play loud stuff, you’re going to play a Mozart quintet and it’s going to be awful. You’re going to suffer through that because you don’t do that habitually, so you’ve got to do the opposite things. As horn players we have a tremendous register and tremendous dynamic variation; you have to be a complete player. (Interview, 12/3/18)

The concept of balanced practice was also specifically underscored by Lang, who is entirely consistent with King: “If you’re working in a high range, you’ve got to also work in a low range. If you’re doing fast practice, do slow practice. If you’re doing lyrical

work, you should also do staccato work.” It is interesting to note that these two players each have more than 30 years of professional experience, are two of the most experienced players in this study, and they are making exactly the same point. Given the horn’s enormous range and expansive expressive capability, balanced practice is an important responsibility, and perhaps more so given the evidence of the practices of these experienced expert horn players. These are important findings for instrumental music teachers and horn instructors since teaching students how to practice is a primary responsibility. If the concept of practicing opposites can be woven into the tasks of a practice session, it is highly likely that a more complete player will begin to emerge.

A few specific procedures for range practice emerged in these findings that are important and worthy of consideration for younger players and horn teachers. The concept of “glissing” takes advantage of the many close harmonics that are inherent to the instrument. Glissing is when the player chooses a fingering and slurs up an octave or more without changing the fingering and playing through all available pitches. Montone uses this, “I like glissing a lot, the idea of glissing and catching the little partials going up.” This technique is the same as Deane’s “Smears,” which is the final element of his daily routine (Deane, 2009, p. 64). Glissing is often practiced with the concept of vowel changes aligned with note changes from low to high: “Ahh to Eeh” (Deane, 2009, p. 64), or “Aw” to “a long E as in the word ‘eat’” (Gardner, 2014, p. 71), and “oo-ee” (Farkas, 1956, p. 47). The use of vowels to assist in range with good tone was specifically noted by King and Deane. As this procedure for range practice is both effective and recommended by these horn experts, it is likely that it would be effective for range development and maintenance in horn students and younger players.

One procedure that emerged which would likely would prove very useful to teachers and younger players was playing familiar music down an octave. The advantage of practicing familiar pieces down an octave is that the player knows what the melody is, thereby enabling more focus on the intended result, “you just think musically” (Jostlein). Montone will play high pieces that she loves down an octave “because then I know what I want them to sound like and my body tends to figure it out.” Jostlein will play a Mozart concerto down an octave, and Lang will play familiar etudes down an octave. This is a simple and musical approach to range development and maintenance. It also implies that low range is not necessarily a separate area requiring a distinct and unique set of drills and exercises, but rather an extension of what is already known. It is also a clear example of the initial responses of both Jostlein and Smelser when asked about how they practice range: “Just play it there.”

The concept of creating a larger middle register also emerged. This finding is consistent with Gardner (2014) who notes that, “the heart of every brass player’s technique is their middle register. It is the foundation on which excellence throughout the entire range is built” (p. 71). Typically, student horn players are most comfortable in the middle register. From here, the pedagogical approach would be to slowly and gradually expand in both directions. King noted that this was his approach, inspired by his Cleveland Orchestra colleague Eli Epstein who had a “five-octave middle register.” Montone also favors this approach: “anything where you start from a place where you feel comfortable and healthy and then you go up into where it’s slightly less comfortable.” This is also consistent with an approach that Smelser prefers. Occasionally he will practice etudes that are scalar and conjunct that are “gradually sending you up high and then if you want, you can play it louder or slower, tongued or slurred, you can

kind of change it a little bit.” As a pedagogical approach, this perspective can be most helpful. Rather than working from the belief that developing a particular register is “hard” or is a challenging separate project (common perspectives of students), the focus is on carefully and persistently expanding what is mastered and is already an established strength. As Gardner (2014) states, “Rome was not built in a day and neither is an efficient high register. Confront and break through barriers in baby steps” (p. 74). This perspective can make a world of difference for all players, particularly younger ones.

### **Dynamics**

Dynamic control and contrast are characteristics of expert musicians, and as expected, these eight horn experts are intentional about maintaining and honing these skills. Practice approaches vary and resemble the findings in the range category. For a number of the participants in this study, playing in their respective orchestras maintains their skill in playing a particular dynamic. Snider and Sterrett observed that their orchestral work maintains their skills in performing at loud dynamic levels, while Smelser and King noted that their skill at soft dynamic levels is greatly aided by playing with their colleagues. As Smelser stated, “I’m blessed to have colleagues when it says soft, it’s soft. It’s not approximately soft, it’s extremely soft.” Away from their respective orchestras, these players will focus dynamic practice on the opposite: Snider and Sterrett on soft playing, and Smelser and King on louder playing. This recalls the concept of balanced practice, or working on opposites to be a complete player. As if to underscore this point, for Jostlein and Montone, soft and loud playing are integral to their practice sessions; they practice both. For Lang, soft playing has always been easy, so loud playing receives attention in his practice sessions. Again, the concept of balanced practice is clear, as is the intent to be efficient with available time. Regarding loud playing two

important points were highlighted: “blow through the horn and not at the horn” (Lang), and a focus on large, lyrical, beautiful playing (King). This is consistent with Farkas (1956), who states succinctly, “Do not forget musicianship in endeavoring to show phenomenal command of volume” (p. 64). Dynamic contrast is not simply about the many differences between loud and soft, but also about maintaining a full, rich, resonant tone at all levels.

While skill in dynamic contrast would be expected of expert musicians, the attention given to this by these players underscores the necessity of including it in practice routines. For student horn players, developing this specific skill is often omitted in favor of range, flexibility, articulation, or other more immediate preparation needs. Rider (2006) wonders how many horn players are using the “tremendous dynamic range” that is possible on the horn (p. 62), implying that this skill tends to be underdeveloped. The important finding here is that dynamic contrast is practiced regularly by these expert horn players, as it is clearly a critical component of the full range of artistic expression. For horn teachers and developing horn players, dynamic contrast and control need to be an integral part of a balanced practice plan. Future study of the practice of dynamic contrast and control by horn experts might investigate more specific strategies employed by these players to maintain and advance these skills.

### **Endurance**

An important and unanimous finding in this study was how expert horn players maintain or improve endurance: “by playing more” (Jostlein). While this finding was expected, what was interesting is the fact that all players are keenly aware of their endurance levels and are constantly looking ahead to upcoming repertoire in order to be in shape and prepared. The cyclical demands of the repertoire make this a necessity.

When a “heavy week” (i.e., all-Bruckner or all-Mahler) is upcoming, which will demand more continuous playing with a different sound and a wider range of dynamic levels, each player is ramping-up in preparation. Typically, this occurs at least two weeks or more in advance. While playing more is how endurance is maintained and improved, specific approaches vary. Deane adds to his detailed routine, “I’ll just do more of what I do every day,” while Lang has a preference for “15-20 minutes of Kopprasch with no stopping.” King, using the Strauss Second Horn Concerto as an example, will practice playing the entire piece twice, with only a short break between. Montone will take demanding works apart and gradually add more lines. She also will play along with recordings. Regardless of differences in approach, the goal is the same: to play more, to be in shape and prepared, and “maybe push it to the edge a little bit and wear myself out” (Sterrett). These findings are entirely consistent with the pedagogy literature. Farkas (1956) states that endurance is developed “by gradually increasing practice time day by day” (p. 63). Rider (2006) suggests that after adding a few minutes each day, “expand the length and range of the pieces you play over a period of days” (p. 173). Gardner (2014) recommends to “systematically increase the amount of time and strenuousness” of practice sessions each day (p. 104).

The approaches to improving endurance used by Smelser were particularly interesting. One is alternating between “low impact and high impact.” For example, he will practice alternating the first movement and the slow movement of the Brahms Horn Trio. Another method is playing Shostakovich 10 and looping repetitions, the first time absolute fortissimo, taking a breath, then absolute pianissimo. While improving endurance he is also practicing dynamic contrast. Another approach that he favors stems from his audition days, “where if you saw Tchaikovsky 5 or even worse, the Nocturne

[from Mendelssohn *A Midsummer Night's Dream*] on the list your chief concern was getting through it" rather than "making this the most beautiful you can make it."

Consequently, he now practices these two excerpts fairly often, back-to-back four times, with a 30-second break between sets to empty water:

The goal is to get through it, you must finish it. You have to figure out different ways to breathe, different pressure on the face, different ways to think about the music, occupy your mind so you're actually moving along and you're not just like, oh my gosh when am I going to get to the next breath. That's very much a mental thing...if you start the Tchaikovsky you must finish the Mendelssohn, you can't stop halfway. (Interview, 12/19/18)

Most horn players would certainly find this challenging, and this is part of his intent. "I think you help yourself by challenging yourself...be tough but be fair." Interestingly, these same two excerpts are suggested by Farkas (1956) for practicing endurance, though he does not specify playing them back-to-back. Consistent with the other specific areas of horn technique investigated in this study, endurance is actively monitored and practiced by these horn experts. Smelser's last method notwithstanding, there is a consistent intent to maintain high musical standards: "I'll go from music quality first, and then build the endurance around it" (Montone), and to maintain horn health, "I don't believe in the notion of once your lips are giving out at the practice session, to keep going to build up the chops" (Jostlein).

### **Non-Horn Practices**

Recognizing that life as a professional musician is "fraught with physical, emotional, and mental demands" researchers are beginning to examine these areas more closely (Wynn Parry, 2004, p. 56). In recent decades there has been a growing interest in what has been described as "applied music research" (Williamon, 2004). Simply defined, this is a multidisciplinary approach that investigates additional ways that musicians might consider in order to improve their performance skills and manage high levels of stress.

Another author has called this “performance enhancement,” the premise of which is that musicians who “achieve greater control over their mental and physical states can often surpass expectations of their potential as artists” (Ritterman, 2004). Research in these areas includes physical fitness and managing physical demands, relaxation techniques, and mental training, and their potential benefit to performers. While each of these topics could be a separate study, the intent of the final portion of this study was to explore select non-horn practices to determine if or how these might contribute to the maintenance or advancement of expertise for these horn players.

### **Vacations**

For both physical and mental reasons, all of the participants do take time away from horn playing, and typically this occurs during their respective orchestra’s summer break. While this finding was expected, what was not expected was the wide variation in the length of vacation periods. Ranging from less than a week up to 4 weeks, these vacation periods are determined by individual preference and by the repertoire that begins the new season. It was interesting to note the initial reactions to the question of vacations: “Oh yeah, as much as I can manage, absolutely!” (Deane), “Oh absolutely!” (Lang), “We have four weeks off in the summer and I routinely take three of those off; I won’t even touch the horn” (Smelser), and “Yes, I do!” (King). By contrast, Jostlein and Montone take very little time off because of the challenge of returning to top form. They both stated that a couple of days off are good for them, but resuming their conditioning is important, and is easier if the time away is shorter. Given the demanding performance schedules that both of these players maintain, the brevity of their vacation periods was surprising.



Each participant was also asked about their process for returning to playing after a vacation. The responses here were among the most interesting of the entire study. While a period of ramping-up to return to form was expected, the descriptions of this return by most players were fascinating. Despite their years of experience, and their recognized level of expertise, the road back is not easy. King's description is most vivid:

Most of the time I got this one-day grace period where I sounded amazing and then the second day, or later in the first day, it would be like somebody pulled the rug out from under me and I couldn't play anything at all. Here I am for the first fifteen minutes, "wow," and then all of a sudden, "no, that's just a teaser."  
(Interview, 12/3/18)

Lang echoed King, "if I am taking a long break and then I come back and try to play even fifteen minutes, that's way too long." Similarly, Smelser stated that his first day might only be 20 minutes of playing and noted that, "it's going to be painful and agonizing no matter what," and Sterrett observed that she'll begin with buzzing and "know that it's going to feel terrible." These findings were both surprising, and oddly, reassuring. If the experts experience this vivid and uncomfortable sense of starting over, of feeling and sounding far less than their usual levels, then students and younger players can rest in the idea that all is normal when they experience similar things after a break from their playing. These findings also provide clear illustrations of why Jostlein and Montone prefer much shorter breaks.

Given these circumstances, the return to playing is carefully considered and patiently pursued. Those taking longer breaks know exactly how much time is needed, and calculate their starting day working backwards from the first service, and with the demands of upcoming repertoire clearly in mind. For King, that is "anywhere from 5-15 days," for Deane it is 7-10 days, and for Smelser it is 4-7 days. The road back is slow but steady. Initial sessions are short, perhaps 10 to 15 minutes, "whatever my body allows"

(Deane), and often multiple sessions in a day; within a week an hour of playing is fully restored. Lang noted that this is a “great opportunity to get your basics back in shape.” Once the basics have been re-established, there is a preference for conjunct, relatively simple etudes, such as, Concone (1972) and Shoemaker (1971), or the easier studies in Kopprasch (1939), and then finally repertoire. While restoring conditioning and preparing to return to service, nothing is random, there is a focus on quality and consistency; “when the quality goes, that’s about the time to stop” (Smelser). The implications for younger players and horn teachers are many. While time away from the horn is important, the return will not be comfortable and will take time. Initial sessions should be short, can be multiplied, and should always retain a focus on quality and consistency.

### **Physical Activity**

Not surprisingly, all participants indicated the value of physical activity. While six of the eight lamented the inconsistency of their physical activity due to busy performing and teaching schedules, there was a clear preference for some form of cardiovascular or aerobic exercise, typically running, cycling, or swimming. Responses about the value and benefit of these activities were clear and frequently enthusiastic. Deane stated that “swimming makes me a much better horn player...it makes me feel great to play the horn.” Similarly, Sterrett noted that “when I’m in good physical shape, I feel better about the horn” and Snider added, “physical activity is the best way to balance out the stress of playing the horn.” Further underscoring the value of exercise to horn playing, Sterrett compared her years as a runner in the New York City Marathon with those since she has stopped participating. Running lowered her resting heart rate and helped her to better process adrenaline while performing with the orchestra, a difference that she notices since she stopped participating. Lang maintains a daily routine that

includes upper body exercises and cardio, all of which he views as an essential component to maintaining his playing expertise.

These findings clearly indicate the direct benefit of physical activity to horn playing, and seem to underscore Taylor and Wasley (2004), who stated that “the connections between physical exercise, personal well-being, and performance are easy to overlook” (p. 163). In fact, research indicates that people who are more fit demonstrate lower cardiovascular response to psychological and physical stressors (Sothmann et al., 1996). The experience of these participants seems to confirm this research. This benefit is not limited to a stronger sense of physical well-being, but also extends to mental well-being including the reduction of anxiety, and the improvement of mood, cognitive function, and self-confidence. These benefits were noted by the participants, and are consistent with research in these areas (Taylor & Wasley, 2004; Sothman et al., 1996; Fox, 1997, 2000; Boutcher, 2000). Future study might focus on specific types of physical activity and how they might directly benefit horn players. While a chosen activity and its intensity will necessarily be a personal decision based on a number of factors, it might be that certain activities are particularly beneficial. The results of this study clearly indicate that regular physical activity contributes to optimal horn performance for these eight experts.

### **Focus, Relaxation, Mindfulness**

With the exception of one participant, all players employ some form of focus or relaxation techniques to some degree. Typically, this would be some form of yoga, meditation, visualization, or positive affirmations, or in the case of three players, “all of the above, all the time” (Montone). Others will use these techniques sparingly or as needed. The benefit of these practices includes lower performance anxiety, deeper, more

relaxed breathing, and a stronger sense of present-mindedness. Relaxation techniques result in a “positive state of being” that enhances learning, recall, sleep, and energy levels (Connolly & Williamon, 2004). Future study might explore these concepts specific to horn practice, perhaps in combination with the positive effects of physical activity previously noted. Clearly, these elite horn players have experienced the benefit of working on mental skills along with musical skills.

### **Limitations**

This study has several limitations related to the use of case study design and to the study of experts. A major benefit of case study design is that it enables examination of specific phenomena within the context of its use. Since the primary research question was how expert French horn players maintain their expertise, case study design was chosen because it is anchored in real-world situations; it would likely yield rich descriptions and explanations of specific practices, and it could potentially illuminate, confirm, or expand teaching approaches for those who teach French horn. Case study “allows investigators to focus on a ‘case’ and retain a holistic and real-world perspective” (Yin, 2014, p. 4). While these benefits are clearly evident in the findings of this study, there are also limitations.

One of the primary limitations of case study methodology is the difficulty of generalizing from a single case study (Yin, 2014; Flyvbjerg, 2006). The findings from this study provide rich descriptions of the habits and practices of these eight horn experts, but they do not necessarily describe or imply that the practices of horn experts in other major symphonies, or horn experts not currently in a major symphony, are the same. The findings also cannot be generalized to expert musicians in other sections of the orchestra, including other brass instruments. The choice to use a single case with multiple

embedded units (Yin, 2014, “Type 2” design) was intended to minimize, however slightly, the generalization limitation of a single case study. Including eight subjects (embedded units) from major symphonies in two different areas of the country was intended to provide a broad but manageable perspective, while at the same time investigating expert horn practice with some depth in its real-world setting. This is what Yin (2014) describes as exploring “specific phenomenon in operational detail” (p. 55), while at the same time obtaining a snap shot with a wide-angle lens. The use of eight participants (embedded units) helped avoid undue abstraction, as did the exploration of the “horn specifics” with each participant. This also minimized what Yin calls “slippage” (p. 55), a common problem with holistic case study design where the entire focus of the study could inadvertently shift. Despite these precautions, the findings of this study cannot be generalized to a larger population.

Another limitation of this study design is the fact that only one interview was conducted. While a substantial amount of time was spent with each participant, yielding rich descriptions of their habits and practices, these findings most accurately describe their practices at the time that the interviews occurred. While most participants either indicated or implied that their practices are largely consistent over time, this cannot be assumed. A second and third interview, spaced across a specific time interval (i.e., one year) would provide a more accurate picture of the practices of these experts.

A common concern with case study design is a lack of rigor and the absence of systematic procedures (Yin, 2009). While every effort has been made to retain a high level of rigor, consistency, and professionalism in the design of the questions and in the collection and analysis of the data, imperfection and inconsistency are nevertheless inherent when the researcher serves as the “instrument” for data collection. In particular,

steps were taken to ensure that time did not interfere with procedures in this study. Significant effort was made to interview each participant within the space of one month, using an identical protocol and note taking procedure. The coding and analysis phases were also conducted within a specified time period. Again, the intent was the concept of proximity to enable better focus and consistency.

The issue of researcher bias is another concern of case study design. This is perhaps especially true in an interview-based study in which the researcher is actively interacting with each participant. Adding to this challenge is the insider/outsider dichotomy inherent in qualitative research (Greene, 2014; Chavez, 2008; Breen, 2007). In addition to my role as the researcher (outsider), I am also a horn player with many years of experience (insider). The advantage is the rich context of understanding from which I interacted with each participant. This enabled acceptance, openness, and a greater willingness to share experiences and perspectives from each horn player. The disadvantage is the very real possibility of confirmation bias at various stages within the study. While every effort was made to maintain “the space between” insider and outsider (horn player and researcher; Dwyer & Buckle, 2009), it is possible that details were missed, overlooked, or assumed. Additionally, Yin (2014) states that case study data collection is not simply the act of recording data, but the ability “to *interpret* the information as it is being collected and to know immediately, for instance, if several sources of information contradict one another and lead to the need for additional evidence—much like a good detective” (p. 76, italics original). As an insider, one’s ability to be a good detective is increased, but this also raises the possibility of confirmation bias. To counter these issues, the words of the participants themselves were directly quoted in answer to specific questions, and were used throughout larger discourses as

much as possible. While every effort was made during data collection, coding, and analysis to retain an objective outsider perspective, the insider was always present.

Finally, there are unique challenges to studying experts. Researchers who study experts have noted that because so much of an expert's knowledge is tacit, ingrained, and autonomous, experts often have great difficulty articulating their processes (Chi, 2006; Harnum, 2013). Others have noted that with some experts, as their expertise increases, they lose awareness of what they do and how they do it (Kidd & Welbank, 1984). Since each participant in this study has done a significant amount of teaching, and most have presented master classes and workshops, articulating processes did not seem to be a major issue. However, particularly in the "horn specifics" section of the study, the details of process were not always clear. For example, the responses to practicing dynamics were centered on what is practiced with very few hints or tips on how one achieves a full, resonant fortissimo or pianissimo. By contrast, comments about endurance practice and range practice included a number of specific techniques and recommendations. Whether this inconsistency in response is related to the inherent challenge of studying experts, or is simply a result of faulty questioning, is unknown. There are indeed expert brass players who "just do it" without much awareness of how, and some who are hesitant to explore those details due to a latent fear of "paralysis by analysis." Jostlein in particular, was reluctant to separate his horn playing into specifics, preferring to maintain a completely musical, product-oriented approach centered on mentally singing. Others possess the ingrained autonomous skill that Lang indicated when describing his practice of pianissimo playing: "soft playing has actually been one of those kinds of things that I haven't had to work for." Consequently, he rarely practices it, and explains his process only in the broadest of terms. While rich and vivid explanations of various techniques

and practices were obtained throughout the majority of this study, there were a few areas lacking in practical clarity.

### **Implications for Music Education**

In addition to investigating the principal research question of how expert French horn players maintain their expertise, a secondary intent of this study was to help bridge the gap between the highest levels of expert performance and the common practices of pedagogy. In their research on experts, Bereiter and Scardamalia (1986) stated that “experts are not merely better at doing the same thing that others do; they do things differently” (p. 16). Studying their habits and practices is therefore an essential first step, and this was the primary intent of this study. If horn experts have certain procedures, have developed certain habits, and follow specific practices that help maintain and advance their playing expertise, these are at least the beginnings of the things that “they do differently” and are worthy of consideration for those who teach and study horn.

### **The Motivation to Practice**

Confirming Sosniak (2006), who stated that expertise is a continuum and not an endpoint, the eight horn experts in this study practice regularly, with intent, and do so within busy schedules. While this was an expected finding, the motivation to practice proved both interesting and important. The eight horn experts in this study reported both internal and external motivation for their practice. Given the importance of motivation as a precursor to practice, music educators can cultivate internal motivation by the manner in which instruction is delivered, by the setting of challenging but achievable goals, and by creating a positive learning environment that maintains high expectations, and within which it is also safe to make mistakes. The external motivation to prepare for an upcoming performance is present with each of these experts, and is obvious for teachers



and student musicians. The results of this study suggest that nurturing internal motivation helps fuel external motivation, which leads to more efficient and effective practice. This is consistent with previous research that recommends that teachers create learning environments that are warm, encouraging, friendly, and enriching (Woody, 2001).

Each of the eight horn experts in this study possess a clear growth mindset, defined as believing that your abilities can “change and grow through application and experience” (Dweck, 2016, p. 7). This belief positively influences the motivation to practice. As students achieve specified benchmarks, educators should celebrate the progress, then raise the standard. As Smelser stated, “There is always more, a higher level of thinking and beauty that you can go for.” Sterrett noted that a growth mindset and the motivation to practice come from being “curious about the horn.” Horn teachers should spark and reinforce this curiosity. These findings are a reminder that teachers need to teach students to love the process, to encourage them to embrace the inherent challenges, and to cultivate the perspective of continual growth and discovery. Consistent with Woody (2001), teachers should establish and reinforce the belief that focused, committed work will yield achievement.

### **Emergent Themes for Teaching Practice**

Given the central importance of practice to the maintenance and advancement of expertise, the findings of this study suggest that music educators should place a high priority on teaching their students *how* to practice and not simply on what to practice. A warm up routine that addresses basic concepts of breathing, buzzing, and resonance, and prepares for the demands of the day, is important and recommended. This might include simple middle register melodies and scales, before expanding to greater demands of register, technique, and repertoire as appropriate. While the eight horn experts in this

study prefer a variable warm up routine, younger students might need one that is rather strict initially, but that could be changed after a period of time. A simple, well-designed, intentional warm up strengthens the foundations of horn playing, focuses the mind, prepares the physical components of playing, and creates and reinforces essential habits for long-term horn health.

Practice content after a warm up will vary to a large degree for every player. For the horn players in this study, there was a strong focus on current and upcoming repertoire. Practice sessions are not long (generally 60-90 minutes at most), but they are intentionally scheduled, and there is a plan. Deane uses a strict routine each day for conditioning that covers every aspect of his performing needs, then practices repertoire as necessary. Jostlein keeps a practice journal and assigns himself specific tasks before he practices. There was a strong sense from a number of players that they do not play “just to play,” but there is always a clear intent. Music educators can help their students develop practice plans that enable efficient and productive practice sessions, even within the busy schedules that many students maintain. Goal-oriented practice design has been shown to be a primary contributor to productive practice and musical achievement (Lehmann, 1997; Barry, 1992; Sloboda et al., 1996).

Practice sessions should be balanced. Practicing a loud excerpt or etude is balanced with something soft. Slurring scales or arpeggios is balanced with those that are played staccato. Starting scales on the lowest note is balanced with starting them on the top note the next day. Working on upper range is balanced by playing in the lower range. It is not necessary that each session contains these opposites, but rather, that they are addressed within a reasonably short span of time. If a rehearsal or lesson contains a lot of loud playing, the next playing session should emphasize soft playing. As King noted,

“You have to do the opposite thing otherwise it’s gone.” As we teach our students how to practice, it is important to include the concept of practicing opposites in order to develop balanced players.

One of the more important findings in this study was the degree to which these eight horn players use recordings. General listening to music while commuting or doing other things was found to be an aid in maintaining and advancing artistry and musicianship, and certainly this could also be a significant benefit to music students. More specifically, recordings are used to learn the larger work being rehearsed, beyond just the horn parts. Recordings are also used to “test” one’s preparation of the individual part by playing along with the recording. For the horn players in this study, playing with recordings provides valuable context, aids in musical decision making, and develops confidence and endurance. Given the ease with which professional recordings can be accessed or purchased, this approach to practice should be used liberally by music educators and horn teachers. In addition to the benefits noted, listening can also help develop musicianship and tone, and can heighten the motivation to practice.

The use of specific repertoire to develop certain skills in playing was one of the surprising findings in this study, and is potentially very useful for teachers. The approach to endurance training that Smelser uses, to play the horn solo from the Tchaikovsky 5<sup>th</sup> Symphony back-to-back with the horn solo from the Mendelssohn Nocturne from *A Midsummer Night’s Dream*, four times, is perhaps most notable. Rather than choose an extended etude written for the purpose of endurance, he has chosen to use famous horn solos from the repertoire, each well-known for its endurance challenge, and each commonly required for orchestral auditions. For horn students, this approach will not

only develop endurance, but it will also promote the learning of important orchestral excerpts and aid in the development of musicianship and phrasing.

The use of French horn etude books continues into the highest levels of horn expertise (see Appendix F for list preferred books by the participants in this study). The “old standards” such as Kopprasch, Maxime-Alphonse, and Gallay continue to be used. These are not relics from a different century, or simply stepping stones into the profession. Rather, the horn experts in this study use them to address certain areas of playing that need extra attention, as a means of returning to form after a vacation, or simply for a break from orchestral music. Horn teachers can emphasize to their students that these books serve both a present and future purpose. Additionally, lesser-known books, such as Ward Fearn, *Exercises for Flexible Horn Playing* (1965) and Karl Biehlig, *Kompedium der Horntechnik* (2000) are also being used, as are books written for other instruments, such as Rochut, *Melodious Etudes for Trombone* (1928), Milde, *25 Studies for Bassoon* (1980), and Marcel Moyse, *Studies and Technical Exercises for Flute* (2005). Teachers can use these as the experts in this study do: to focus on specific effects, techniques, range, and styles. The amount and variety of resources available to horn teachers and students is substantial.

### **Additional Implications**

An unexpected finding in this study was the critical importance of listening. The development of keen and discerning listening skills is a major component of music education, and one that is too easily over-looked. Instrumental music teachers in particular have the responsibility to teach and develop motor skills specific to a wide variety of wind and percussion instruments. In an already limited teaching and rehearsal schedule, often burdened by civic and community performance expectations, developing

listening skills is easily omitted. The results of this study serve as a reminder that listening skills are central to the art form itself, and to the ability to maintain and advance one's musicianship. For both horn students and professionals, the presence of clear aural examples of desired sound will certainly contribute to more skilled performance. The horn experts in this study underscored the influence that they received from other horn experts in their growth and development as professionals. Certainly, horn students can derive the same benefits. It is the responsibility of teachers to provide access to exemplary models of playing and to teach students increasing levels of discernment in listening skill.

One of the most surprising findings in this study was the experience of returning to horn playing after a vacation period. Despite their level of expertise and the many years that they have played at such high levels, for these horn experts the return from vacation is not easy. Many participants noted the discomfort, "I'll kind of know that it's going to feel terrible" (Sterrett), and "It's going to be painful and agonizing no matter what" (Smelser), are representative of the experiences noted in the study. The return to playing is therefore undertaken carefully, in smaller segments of time, and typically keeping things low and moderate. As this is the experience for these experts, teachers can assume that students will have similar reactions to their return from a break. Teachers can ensure a successful, healthy, and relatively quick return to form for their students by establishing a patient and moderate sequence of playing, emphasizing good playing habits, quality tone, and attention to basic phrasing. Quality and consistency should be emphasized, as Smelser noted, "when the quality goes, that's about the time to stop." Vacations are important, as these top players demonstrate, but the return to playing needs to be managed carefully.

Finally, since the investigation of the specifics of horn technique was based on the topics discussed by highly regarded horn pedagogues, it is important to note that the findings of this study confirm both the importance of the specific topics themselves among these eight horn experts, and also the many suggestions offered by these authors for practice. The horn pedagogue-authors consulted were Farkas (1956), Schuller (1962), Wekre, (1994), Reynolds (1997), Rider (2006), and Gardner (2014). The findings of this study are in large agreement with these authors, which indicates that the specific topics—buzzing, breathing, tone, flexibility, articulations, range, dynamics, and endurance—are indeed essential components for horn players to develop and master. Music educators who teach horn can therefore be confident in consulting these authors for more information about each topic, and for practice suggestions to use with their students.

### **Recommendations for Future Research**

The findings of this study confirm the value of studying the habits and practices of experts that previous research has indicated (Bereiter & Scardamalia, 1986; Sosniak, 2006; Ochse, 1990; Sloboda, 1991b; Woody, 2001). Noted expertise researcher Anders Ericsson observed that studying “the training techniques and performance limits of experts who have spent their entire life striving to maximize their performance” is perhaps “the most effective training to achieve the highest attainable levels” (Ericsson, 2018a, p. 17). Research investigating the habits and practices of horn experts is a rich resource for those who teach and study the instrument, and should be continued. Additionally, consistent with the findings of Trusheim (1987), the distinguished performers in this study were articulate, informed, and very willing to participate. Future research will likely be fruitful, enlightening, fascinating, and enjoyable.

In order to confirm or expand upon these findings, future research might extend this study with the same participants and conduct additional interviews at various intervals in the future. This would be similar to Yin's (2014) longitudinal case study design, and would provide a clearer picture of the habits and practices of these experts. It would be interesting to see if certain habits change substantially, and if so, why. While the results would be of great interest to the participants themselves, they could also help further refine the practices of horn teachers and students, and perhaps guide the trajectories of future researchers in this area.

Future research could follow the same design and interview protocol of this study and expand the participant pool to major American symphony orchestra horn players in other parts of the country. The bounds of this case study limited the investigation to orchestras in the Northeast and Midwest. It would be interesting to expand this to other geographic regions and their major orchestras to see if the horn experts there have similar habits and practices. Results might indicate the presence of certain regional differences, or there might emerge a variety of common practices that could prove important for both teachers and students. The results from more horn experts from more elite orchestras would certainly provide a clearer more detailed picture of the habits and practices of major symphony horn experts. Additionally, it would be interesting to extend the same study design and protocol to the horn experts in elite orchestras in other parts of the world to discover both similarities and differences.

Particularly interesting to the larger study and practice of brass pedagogy, this study could be replicated with each of the other brass instruments. Future researchers could investigate expert trumpet, trombone, and tuba players from elite American symphony orchestras to see if their habits and practices are similar to each other, and the

degree to which they are consistent with, or contradict, the recommendations of the pedagogues and authors for each instrument. Other studies involving expert symphony orchestra brass players from the different instrument families (Trusheim, 1987; Harnum, 2013) found large areas of consistency among the participants of their studies regardless of instrument. It would be interesting to see if broad similarities exist with this type of study, and whether a larger, over-arching set of practices emerges that is common to all members of the brass family. It would also be fascinating to discover if there are any differences in the habits and practices of players that are unique to each instrument. The results of such studies could confirm, amend, and clarify teaching and practice for each instrument in the brass family.

Similarly, this study design could be replicated with expert musicians from the string, woodwind, and percussion sections of elite symphony orchestras. While discovering similarities and differences in the habits and practices of musicians across the orchestra, likely producing interesting results, a principal goal would be to inform the pedagogy of the various instruments. Sloboda (1991) stated that one of the primary reasons for studying expertise is practical, since it is “desirable for certain manifestations of expertise to be more widespread than they are, we want to know what we can do to assist people to acquire them” (p. 156). The larger concept, therefore, would be to help bridge the gap between expert professional practice and the common procedures of pedagogy in all instrument areas.

Another avenue for future research might be to extend the framework utilized by Hallam (1995) in her study of the practice habits of professional musicians. In her study, Hallam interviewed 22 professional musicians representing a broad range of orchestral instruments. Her sample intentionally omitted full-time symphony orchestra players



“because of the limited time they have available to practice” (p. 5). The findings of the present study indicate that full-time horn players from the six orchestras represented do indeed practice. Given this finding, future research with full-time orchestra musicians might follow Hallam’s design and investigate the orientation to practice (technical, musical, or both), and the relationship between orientation to practice and approach to interpretation. The findings of this research would highlight differences between full-time symphony players and free-lance professional players, if any, and could suggest additional practice procedures that might make teaching and learning more efficient and effective.

Finally, future research investigating the habits and practices of expert horn players might investigate how experts plan their practice sessions, thereby extending the work of Jorgensen (2004) and Jorgensen and Hallam (2009) from students to professionals. Future study might also examine specific behaviors such as how repetition is used, how errors are identified and corrected, the length of phrases and sections practiced (“chunking”), the use of a metronome, the use of a drone, and memorization techniques. This would extend similar studies in these areas with other instrumentalists (Gruson, 1988; Williamon & Valentine, 2000; Duke, Simmons, & Cash, 2009). In 2011, Miksa proposed a theory of effective and efficient practice that is centered on five primary variables: choice, intentionality, action, achievement outcome, and rest and recovery. While largely intended as an instructional theory, future research might investigate whether and how these variables are present in the practice sessions of experts. Additional research might also replicate Trusheim (1987) and examine the use of mental imagery among horn experts to investigate whether and how this influences how they practice. Lastly, further study could explore the use of metacognitive thinking and

analysis by experts in an effort to gain a glimpse into the internal processes that guide practice sessions. This approach would be similar to Wise, James, and Rink (2017) who used practice diaries and video-recall interviews to investigate how musicians practice interpretation, and it would be similar to research on grandmaster chess champions conducted by De Groot (1946/1978), where participants expressed their thoughts verbally when assessing a chess position and contemplating next moves. While these types of studies would indeed be fascinating, the time necessary to conduct such research might prove to be a limiting factor, given the busy schedules that elite symphony orchestra musicians maintain.

### **Conclusions**

The purpose of this study was to investigate the habits and practices of eight expert French horn players in six major American symphony orchestras. The study focused on the players' warm up procedures, practice procedures, method for practicing specific areas of horn technique, and non-horn activities that might contribute to horn playing expertise. The findings indicate that practice is intentional, takes place regularly, and is directly influenced by current and upcoming repertoire. The findings also indicate that a warm up routine is important, and that the specific areas of horn technique highlighted by the major authors of horn pedagogy books, are actively practiced by these horn experts. Additionally, physical activity, specifically aerobic exercise, is beneficial on many levels, not the least of which is stress management. Time away from the rigors of practice and performance is also important, but the return to playing needs to be handled with patience and care.

Given the demonstrated importance of practice by these experts, the findings imply that teaching students how to practice is essential. This might begin with a teaching

environment that engenders and nurtures the internal motivation to spend goal-directed time in practice, and one that enables goal-setting, evaluative processes, and the development of positive self-reflection and strength-building habits. The use of recordings to provide a larger musical context, vivid aural examples, and to help motivate musical practice sessions is recommended. Given the ubiquity of digital technology, and the availability of many fine recordings, teachers should take full advantage of these resources and integrate them into the teaching and learning process.

Finally, the value of direct influence from experts is clearly underscored. Too often, the challenges, demands, and minutiae of teaching can obscure the ultimate goal of developing musically sensitive musicians who possess excellent tone, and who are capable of delivering exceptional, aesthetically-rich performances. Exposing our students to expert playing, either in person or through recordings, makes the goal much more vivid, and imbues the path to excellence with profound clarity and positive energy. While certain technical skills need to be taught and mastered, we need to remember that we teach an aural art form. The shortest distance to the clearest form of the goal is an expert. In the same manner that apprentices learned from master craftsmen in centuries past, music teachers would better serve their students by interacting with, and exposing students to the sounds, habits, and procedures of expert musicians. These interactions will not only broaden and deepen our students' imagination and experience, they will also expand and energize the practice of teaching itself.

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## Appendix A: Formal Invitation

### Formal Invitation to Participants (email)

November 2, 2018

Dear X,

As you may recall, I am a doctoral student in music education at Rutgers University and you have indicated your willingness to participate in my dissertation research. My study is an investigation of the practices of experts and will focus on expertise in French horn performance in major professional symphony orchestras. More specifically, this is a descriptive case study in which I will interview current horn players from six American symphony orchestras, three from the Northeast and three from the Midwest.

My purpose in writing to you is to formally ask if you would be willing to participate in my study. If so, please read the attached consent letter carefully. If you choose to participate, we will have an interview via Skype/Facetime lasting approximately 60-75 minutes, scheduled at your convenience. The interview will be audio recorded and transcribed, a copy of which will then be sent to you for your review to ensure that your thoughts have been captured accurately. Your participation is completely voluntary, and you may withdraw at any time. While your name and orchestra affiliation will be known, I do not anticipate any risk greater than normal life. All information obtained will be kept strictly secure on a password-protected computer. The results of this study will be used for a D.M.A. dissertation.

Your participation will complete the perfect list of participants in my study. Please reply to this email to confirm your participation. I look forward to your reply.

Thanks,

David Martin  
Doctoral student, Music Education  
Rutgers, The State University of New Jersey  
Mason Gross School of the Arts

## Appendix B: Consent Letter

## CONSENT TO TAKE PART IN A RESEARCH STUDY

TITLE OF STUDY: Professional Horn Practice: A Case Study Examining the Practices, Procedures, Techniques, and Habits of Expert Professional Symphony Orchestra French Horn Players

Principal Investigator: David Martin

DATE:

Dear X,

You are invited to participate in a research study that is being conducted by David Martin, a doctoral student in music education at the Rutgers University Mason Gross School of the Arts. The purpose of the research is to investigate the practices and habits of expert professional symphony orchestra French horn players in the United States. You are being invited to participate because I believe that you fit this description.

This informed consent form provides information about a research study and what will be asked of you if you choose to take part in it. If you have any questions now or during the study, if you choose to take part in it, you should feel free to ask them and should expect to be given answers you completely understand. It is your choice whether to take part in the research. Your alternative to taking part is not to take part in the research.

A total of eight subjects will participate in this study. If you choose to participate, you will be asked to participate in an interview via Skype/Facetime, or by phone. The interview will last approximately one hour. You will be asked questions about your warm-up and practice procedures, and non-horn practices that contribute to your horn playing expertise. Should emergent issues arise during the interview or the initial analysis, a possible second interview or email dialog may be needed for clarification. You will be given an opportunity to review the write-up of the interview to correct, clarify, or omit any information you choose. There is no cost to participate in this study, nor will you be paid for your participation.

This research is confidential. All efforts will be made to keep your personal information in your research record confidential, but total confidentiality cannot be guaranteed. Confidential means that the research records will include some information about you (your name and your orchestra affiliation) and this information will be stored in such a manner that some linkage between your identity and the response in the research exists. Please note that we will keep this information confidential by limiting individual's access to the research data and keeping it in a secure, password protected location.

The dissertation committee and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as required by law. All study data will be kept until the completion of the study, and then will be destroyed after that time.

The benefits of taking part in this study may be improvement to the teaching practices of instrumental music teachers in music education, the improvement of the practice procedures of aspiring horn professionals, and contribution to the study of music practice and the field of expertise. However, you may receive no direct benefit from taking part in this study.

There is no anticipation of any risk greater than normal life. Participation in this study is voluntary. You may choose not to participate, and you may withdraw at any time during the study without penalty to you. There is no circumstance under which your contributions will be removed from the project involuntarily. In addition, you may choose not to answer any questions with which you are not comfortable. You may also withdraw your consent to use the data collected about you, but this must be done in writing to David Martin ([dmartin987@gmail.com](mailto:dmartin987@gmail.com)).

During the course of the study, you will be updated about any new information that may affect whether you are willing to continue taking part in the study. If new information is learned that may affect you after the study or your follow-up is completed, you will be contacted.

If you have any questions about the study, taking part in this study or the study procedures, or wish to withdraw from the study, you may contact me directly at [dmartin987@gmail.com](mailto:dmartin987@gmail.com), or by phone: 973-670-5366.

You may also contact my faculty advisor, Dr. William Berz, at [wberz@mgsa.rutgers.edu](mailto:wberz@mgsa.rutgers.edu), or by phone, 732-932-8860.

If you have questions about your rights as a research subject, please contact an IRB administrator at Rutgers University, Arts and Sciences IRB:

Institutional Review Board  
Rutgers University, The State University of New Jersey  
Liberty Plaza / Suite 3200  
335 George Street, 3<sup>rd</sup> Floor  
New Brunswick, NJ 08901  
Phone: 732-235-2866  
Email: [human-subjects@ored.rutgers.edu](mailto:human-subjects@ored.rutgers.edu)

Please retain a copy of this form for your records. By participating in the above stated procedures, then you agree to participation in this study.

### Audio/Visual Addendum to Consent Form

You have agreed to participate in a research study entitled, *Professional Horn Practice: A Case Study Examining the Practices, Procedures, Techniques, and Habits of Expert Professional Symphony Orchestra French Horn Players* that is being conducted by David Martin, who is a doctoral student in music education in the Music Department at Rutgers University. The purpose of this form is to ask your permission to audiotape (record) your interview as part of this research study. If you do not agree to be recorded, you will not be able to participate in the study.

The recording will be transcribed and sent to you for any adjustments, alterations, or amendments as you deem necessary. The transcription will then be used by the researcher for analysis. The recording will include identifiers, specifically, your name and orchestra affiliation. The recording will be stored in a password protected file on the researcher's computer. The recordings will be kept until the completion of the study, after which they will be destroyed.

The recording will include interview questions and any spoken responses you give. If you say anything that you believe at any point may be unintentional or harmful and/or damage your reputation, then you can ask that certain text be removed from the dataset/transcripts, OR, you can do this yourself when the transcript is sent to you for review.

This research is confidential. Confidential means that the research records will include some information about you and this information will be stored in such a manner that some linkage between your identity and the response in the research exists. Specifically, this will include your name and orchestra affiliation. Please note that we will keep this information confidential by limiting individual's access to the research data and keeping it in a secure location.

The researcher, the dissertation committee, and the Institutional Review Board at Rutgers University are the only parties that will be allowed to see the data, except as may be required by law.

There are no foreseeable risks to participation in this study.

Participation in this study is voluntary. You may choose not to participate, and you may withdraw at any time during the study procedures without any penalty to you. In addition, you may choose not to answer any questions with which you are not comfortable.

If you have any questions about the study or study procedures, you may contact myself, David Martin, at [dmartin987@gmail.com](mailto:dmartin987@gmail.com) or 973-670-5366. You may also contact my faculty advisor, Dr. William Berz, at [wberz@mgsa.rutgers.edu](mailto:wberz@mgsa.rutgers.edu) or 732-932-8860.

Please retain a copy of this form for your records. By participating in the above stated procedures, then you agree to participation in the above stated procedures, including recording the interview. The investigator will not use the recording for any other reason than that/those stated in the consent form without your permission.

If you have any questions about your rights as a research subject, please contact an IRB Administrator at the Rutgers University, Arts and Sciences IRB:

Institutional Review Board  
Rutgers University, the State University of New Jersey  
Liberty Plaza / Suite 3200  
335 George Street, 3<sup>rd</sup> Floor  
New Brunswick, NJ 08901  
Phone: 732-235-2866  
Email: [human-subjects@ored.rutgers.edu](mailto:human-subjects@ored.rutgers.edu)

## Appendix C: Interview Protocol

### Opening Script

Thank you for spending some time with me today to share your thoughts about how you maintain your horn playing expertise. The purpose of this study is to investigate the habits, practices, and procedures of expert American professional symphony orchestra French horn players. The goal is to learn what the experts do, and then to consider how or if these findings might improve the horn pedagogy of instrumental music teachers, enhance the practice procedures of horn students and aspiring professionals, and enlarge the body of research in both music practice and in the study of expertise.

After a few initial questions about your start on horn, I'd like to explore the ways in which you maintain and advance your expertise as a professional horn player, including practice routines, warm-up procedures, and the habits and practices you employ to maintain specific elements of horn playing. I have prepared questions to ask you, but I also welcome emergent themes and questions as our discussion unfolds. At the end of the interview, please feel free to add additional pertinent information that I might have missed or ask any questions about this study. The interview is being recorded. If you want to talk off the record, you can ask me to stop the recording and I will do so. The recorded interview will be transcribed and you will receive a copy to review. Finally, you can choose not to answer any question. Do you have any questions?

### Initial questions

1. How old were you when you started playing horn?
2. When did you start considering your horn playing a serious endeavor?

3. Who was your primary inspiration? What horn performers/teachers have most influenced your performance and pedagogy?
4. How long have you played horn professionally as a primary source of income?
5. How long have you played in the \_\_\_\_\_ symphony orchestra?

### **Practice Procedure – Maintaining Expertise**

1. Please tell me how you practice.
  - a. What do you do when you practice?
    - i. Specific routine? Please outline a typical session.
  - b. How long are your practice sessions?
  - c. Do you have a preferred time of day for your practice?
  - d. Do you have specific goals each time you practice? Such as...
  - e. How do you schedule practice to coordinate with orchestra services?
  - f. How do you modify the amount and nature of your practice sessions in relation to the changing demands of the repertoire? For example, how does your practice differ during an all-Mozart week compared with an all-Mahler week, or a tour week versus a home week?
2. How do you maintain your artistry and musicianship?
3. Do you practice scales regularly? Why?
4. Do you practice technical studies? If so, which books do you favor?
5. What are your primary motivations for regular practice?
  - a. Internal (sounding good, improving ability, enjoyment)
  - b. External (upcoming performance, recording, audition; learning new repertoire)

- c. Has your motivation to practice changed compared with your student years? If so, how?

### **Warm-up Procedure**

- 6. Can you tell me more about your warm-up routine: What, specifically, do you do?
  - a. Has it remained the same
  - b. If it changes, how, and why?
  - c. Is it the same during demanding performance periods?
  - d. Is it the same prior to performances?
    - i. If not, how does it change?

### **Horn Specifics**

*[The following questions are based on the specifics identified by noted horn performers and pedagogues: Gardner, 2014; Reynolds, 1997; Wekre, 1994; Farkas, 1956.]*

- 7. Do you do free-buzzing? If so, what do you do?
- 8. Do you do mouthpiece buzzing? If so, what do you do?
- 9. What is your approach to breathing on horn?
- 10. What do you do to maintain and improving tone?
- 11. Do you practice flexibility studies? If so, what do you do?
- 12. What do you do to maintain and improve articulations?
- 13. What do you do to maintain and improve your high range?
- 14. What do you do to maintain and improve your low range?
- 15. What is your approach to maintaining and improving dynamic range?
- 16. How do you work on endurance?



**Pre-service Routines**

1. What is your pre-service routine?
  - a. How early do you arrive prior to a rehearsal?
  - b. What is your pre-rehearsal routine at the rehearsal hall?
  - c. How early do you arrive prior to a performance?
  - d. What is your pre-performance routine at the concert hall?
  - e. What non-horn habits help prepare you for a rehearsal
  - f. What non-horn habits help prepare you for a performance?

**Non-horn Practices, Habits, or Activities**

1. Do you take vacations away from the horn? If so, for how long?
  - a. What is your procedure to return to horn playing after a vacation?
2. Do you practice meditation, visualization, yoga, or other techniques to improve focus?
3. Are you physically active or do you work-out regularly? If so, what do you do and how does this help your horn playing?
4. Are there certain foods or drinks that negatively impact your playing, if so, what are they?
5. What are the most important non-horn habits that help you maintain your horn playing expertise?

**Concluding Questions**

6. Is there anything that you would like to add, or anything that we didn't discuss, that contributes to your horn playing expertise?
7. Do you have any additional questions for me?

### Concluding Script

Thank you very much for sharing your thoughts and experiences on maintaining your horn playing expertise. I appreciate your willingness to share your ideas and practices, and to help me understand how expert professional horn players maintain and advance their expertise. Once this interview is transcribed, a copy will be sent to you for your review. Please feel free to clarify, amend, add, or delete anything in the transcript. If I have need for clarification or a brief follow-up question, what is the best way to reach you, email or phone?

Again, thank you! Your participation in this study is most appreciated!

## Appendix D: Code Table

Category	Sub category	Meaning
Practice Procedure		
	Schedule coordinated with orchestra services	Any statement describing how practice is scheduled with orchestra responsibilities
	Routine	Any statement associated with practice routine design
	Length of session	Any statement associated with duration of practice session
	Time of day	Any statement indicating time of day
	Specific goals	Any statements about the establishment specific goals prior to a practice session
	Practice routine change	Any statements indicating how practice routine changes during different repertoire weeks and/or tour vs. home
	Scales	Any statements about how or if scales are practiced regularly
	Technical studies	Any statements indicating the practice of technical studies, and preferred books
	Motivation to practice-Internal	Any statements describing internal motivation to practice
	Motivation to practice-External	Any statements describing external motivation to practice
Warm-up Procedure		
	Warm-up routine design	Any statement describing warm-up routine structure
	Remain the same?	Yes/no/partially.
	If it changes, how?	Any description of how the warm-up routine changes
	The same prior to performances	Yes/no/partially
	If different, how?	Any description of how warm-up is different prior to performances

	The same during demanding performance schedule?	Yes/no/partially
	If different, how?	Any description of how warm-up is different during demand performance periods
Category	Sub category	Meaning
Horn Specifics		
	Free buzzing?	If yes, any description of free buzzing exercises
	Mouthpiece buzzing?	If yes, any description of mouthpiece buzzing practice
	Breathing	Any description of how breathing is approached and/or practiced
	Tone	Any description about how horn tone is maintained and improved
	Flexibility	Any description of how flexibility is maintained and improved
	Articulation	Any description of how articulations are practiced, including multiple articulations
	High range	Any description of how high range is maintained or improved
	Low range	Any description of how low range is maintained or improved
	Dynamics	Any description of how the range of soft, medium, and loud dynamics are maintained or improved.
	Endurance	Any description of how endurance is practiced
Pre-service routines		
	Arrival prior to rehearsal	Any description of how much time is preferred on-site before rehearsal
	Pre-rehearsal routine at concert hall	Any description of the routine followed at the hall prior to a rehearsal

	Arrival prior to performance	Any description of how much time is preferred on-site before performance
	Pre-performance routine at the concert hall	Any description of routine that is followed at the hall prior to a performance
Category	Sub category	Meaning
Pre-service routines		
	Non-horn habits to prepare for rehearsal	Any description of non-horn habits that help prepare for rehearsal
	Non-horn habits to prepare for performance	Any description of non-horn habits that help prepare for performance
Non-horn practices or activities		
	Vacations away from horn playing?	If yes, any description of time away from horn (length of time)
	Returning from vacation periods	Any description of how horn practice is resumed
	Relaxation and/or focus techniques	Any description of techniques used to improve focus and relaxation, such as meditation, yoga, visualization, breathing exercises
	Physical activity	Any description of regular physical activity and how it aids horn playing
	Food and/or drink	Any description of foods or drinks that negatively impact horn playing
	Important habits	Any description of the most important habits that help maintain horn playing expertise

## Appendix E: IRB Approval

**Rutgers University eIRB: Study Approved**

eIRB@ored.rutgers.edu <eIRB@ored.rutgers.edu>  
 Reply-To: eIRB@ored.rutgers.edu  
 To: wberz@mgsa.rutgers.edu, dlm137@rutgers.edu  
 Cc: hanosma@rutgers.edu

Fri, Sep 7, 2018 at 2:19 PM



**RUTGERS**  
eIRB

**Arts & Sciences IRB -  
New Brunswick**  
 335 George Street  
 Suite 3100, 3rd Floor  
 New Brunswick, NJ 08901  
 Phone: 732-235-2866

**Health Sciences IRB -  
New Brunswick/Piscataway**  
 335 George Street  
 Suite 3100, 3rd Floor  
 New Brunswick, NJ 08901  
 Phone: 732-235-9806

**Health Sciences IRB -  
Newark**  
 65 Bergen Street  
 Suite 511, 5th Floor  
 Newark, NJ 07107  
 Phone: 973-972-3608

**DHHS Federal Wide Assurance Identifier:**  
 FWA00003913

**IRB Chair Person:** Beverly Tepper

**IRB Director:** Michelle Watkinson

**Effective Date:** 9/7/2018

**Approval Date:** 9/4/2018

**Expiration Date:** 9/3/2019

### eIRB Notice of Approval for Initial Submission # Pro2018001656

#### STUDY PROFILE

**Study ID:** Pro2018001656

**Title:** Professional Horn Practice: A Case Study Examining the Practices, Procedures, Techniques, and Habits of Expert Professional Symphony Orchestra French Horn Players

**Principal Investigator:** David Martin      **Study Coordinator:** William Berz

**Co-Investigator(s):** William Berz      **Other Study Staff:** William Berz

**Sponsor:** N/A      **Approval Cycle:** Twelve Months

**Risk Determination:** Minimal Risk      **Device Determination:** Not Applicable

**Review Type:** Expedited      **Expedited Category:** (5)  
(6)      **Exempt Category:** N/A  
(7)

**Subjects:** 8      **Specimens:** N/A      **Records:** N/A

9/28/2018

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## CURRENT SUBMISSION STATUS

<b>Submission Type:</b>	Research Protocol/Study	<b>Submission Status:</b>	Approved
<b>Approval Date:</b>	9/4/2018	<b>Expiration Date:</b>	9/3/2019
<b>Pregnancy Code:</b>	No Pregnant Women as Subjects	<b>Pediatric Code:</b>	No Children As Subjects
		<b>Prisoner Code:</b>	No Prisoners As Subjects
<b>Protocol:</b>	Research Protocol (HRP-503b) v12.1.16v4_0.docx	<b>Consent:</b>	Consent 8 21
		<b>Other Materials:</b>	Recruitment Email.docx INTERVIEW PROTOCOL.docx

## \* Study Performance Sites:

Other Rutgers Site      Music Building [81 George Street New Brunswick, NJ 08901](#)

## ALL APPROVED INVESTIGATOR(S) MUST COMPLY WITH THE FOLLOWING:

1. Conduct the research in accordance with the protocol, applicable laws and regulations, and the principles of research ethics as set forth in the Belmont Report.
2. **Continuing Review:** Approval is valid until the protocol expiration date shown above. To avoid lapses in approval, submit a continuation application at least eight weeks before the study expiration date.
3. **Expiration of IRB Approval:** If IRB approval expires, effective the date of expiration and until the continuing review approval is issued: **All research activities must stop unless the IRB finds that it is in the best interest of individual subjects to continue. (This determination shall be based on a separate written request from the PI to the IRB.) No new subjects may be enrolled and no samples/charts/surveys may be collected, reviewed, and/or analyzed.**
4. **Amendments/Modifications/Revisions:** If you wish to change any aspect of this study, including but not limited to, study procedures, consent form(s), investigators, advertisements, the protocol document, investigator drug brochure, or accrual goals, you are required to obtain IRB review and approval prior to implementation of these changes unless necessary to eliminate apparent immediate hazards to subjects.
5. **Unanticipated Problems:** Unanticipated problems involving risk to subjects or others must be reported to the IRB Office (45 CFR 46, 21 CFR 312, 812) as required, in the appropriate time as specified in the attachment online at: <https://orra.rutgers.edu/hssp>
6. **Protocol Deviations and Violations:** Deviations from/violations of the approved study protocol must be reported to the IRB Office (45 CFR 46, 21 CFR 312, 812) as required, in the appropriate time as specified in the attachment online at: <https://orra.rutgers.edu/hssp>
7. **Consent/Assent:** The IRB has reviewed and approved the consent and/or assent process, waiver and/or alteration described in this protocol as required by 45 CFR 46 and 21 CFR 50, 56, (if FDA regulated research). Only the versions of the documents included in the approved process may be used to document informed consent and/or assent of study

9/28/2018

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subjects; each subject must receive a copy of the approved form(s); and a copy of each signed form must be filed in a secure place in the subject's medical/patient/research record.

8. **Completion of Study:** Notify the IRB when your study has been stopped for any reason. Neither study closure by the sponsor or the investigator removes the obligation for submission of timely continuing review application or final report.

9. The Investigator(s) did not participate in the review, discussion, or vote of this protocol.

10. **Letter Comments:** **There are no additional comments.**

**CONFIDENTIALITY NOTICE:** This email communication may contain private, confidential, or legally privileged information intended for the sole use of the designated and/or duly authorized recipients(s). If you are not the intended recipient or have received this email in error, please notify the sender immediately by email and permanently delete all copies of this email including all attachments without reading them. If you are the intended recipient, secure the contents in a manner that conforms to all applicable state and/or federal requirements related to privacy and confidentiality of such information.

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Study,PI Name:

Study.Co-Investigators:



## Appendix F: Preferred Etude Books

<b>Participant</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
Richard Deane	Kopprasch	60 Studies for Horn, Books 1-2	International
	Kling	40 Characteristic Etudes	Southern Music
	Maxime-Alphonse	200 Studies for Horn, Books 1-6	Leduc
	Gallay	22 Studies	International
Thomas Jostlein	Rochut	Melodious Etudes for Trombone	Carl Fischer
	Milde	25 studies for Bassoon	Kalmus
	Maxime-Alphonse	200 Studies for Horn, Books 1-6	Leduc
	Kopprasch	60 Studies for Horn, Books 1-2	International
	Schantl	Grand Theoretical/Practical Method	Wind Music
Richard King	Gallay	12 Studies for Horn	International
	Kling	40 Characteristic Etudes	Southern Music
	Muller	34 Studies	International
	Schuller	Studies for Unaccompanied Horn	Oxford
Jeff Lang	Kopprasch	60 Studies for Horn, Books 1-2	International
	Pares	Scales for French Horn	Rub.-Hal Leonard
	Concone	Lyrical Studies	The Brass Press
	Shoemaker	Legato Studies for French Horn	Alfred Music
	Brahms	10 Horn Studies	Kalmus
	Gallay	12 Studies for 2 <sup>nd</sup> Horn	International
	Singer	Embouchure building for French Horn	Alfred
	Fearn	Exercises for Flexible Horn Playing	Theodore Presser
		Lyrical Studies	The Brass Press
Jennifer Montone	Kopprasch	60 Studies for Horn, Books 1-2	International
	Maxime-Alphonse	200 Studies for Horn, Books 1-6	Leduc
	Gallay	12 Studies for 2 <sup>nd</sup> Horn	International
	Hackelman	34 Characteristic Studies-Low Horn	Editions Bim
	Rochut	Melodious Etudes for Trombone	Carl Fischer
	Moyse	20 Studies for the Flute	Leduc
James Smelser	Neuling	18 Low Horn Studies	Hans Pizka
	Brahms	Horn Studies	Hans Pizka
	Fearn	Exercises for Flexible Horn Playing	Theodore Presser
	Maxime-Alphonse	200 Studies for Horn, Books 1-6	Leduc
	Concone	Lyrical Studies	The Brass Press
	Shoemaker	Legato Studies for French Horn	Alfred Music
Jason Snider	Barboteu	20 Concert Etudes for Horn	Choudens
	Belloli	8 Studies for Horn Solo	International
	Muller	34 Studies	International
	Kopprasch	60 Studies for Horn, Books 1-2	International
	Maxime-Alphonse	200 Studies for Horn, Books 1-6	Leduc
Leelanee Sterrett	Concone	Lyrical Studies	The Brass Press
	Maxime-Alphonse	200 Studies for Horn, Books 1-6	Leduc
	Borgdoni	Melodious Etudes for Horn	Carl Fischer
	Reynolds	48 Etudes for Horn	G. Schirmer
	Gallay	12 Studies for 2 <sup>nd</sup> Horn	International
	Gallay	Unmeasured Preludes	Southern
	Biehlig	Kompendium der Horntechnik	Breitkopf & Hartel