Developing a method for assessing the skilfulness and practice time of Upper Palaeolithic representative artists

by

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Abstract

Archaeologists have tended to approach Upper Palaeolithic art in the way that art historians and critics approach modern art—with a focus on meaning. While this approach has yielded interesting results, its dominance has led to the neglect of another important aspect of art—the skill required to produce it. Research on the acquisition of skill across a wide range of activities suggests that an individual’s level of skill in a given activity is primarily determined by the number of hours they have practiced that activity. I developed an experimental approach for the evaluation of skill in representative drawing, a common form of Upper Palaeolithic art. First, I devised a set of criteria that can be used to evaluate drawing skill. Then, I asked 30 subjects with varying amounts of experience to produce drawings and to provide an estimate of their hours of practice. Next, the subjects’ drawings were scored with the evaluation criteria. Lastly, I regressed the scores for the drawings on hours of practice. The results indicate a strong, significant relationship between drawing skill and number of hours of practice. The rate of the participant artists skill acquisition increased steadily in congruence with their increased practice time, until they reached approximately 10,000 hours, and their abilities plateaued. With this result and a reliable set of criteria for the evaluation of skill in drawing, I am prepared to move onto the second phase of this study, which is the evaluation of skill in representative UP art.

Keywords: Upper Palaeolithic; skill; drawing; representative art; modern humans; craft specialization
Dedication

This thesis is dedicated to my husband, Jake, who was cool with me quitting my job to study archaeology, and who supported me the whole way through.
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List of Acronyms

AMH    Anatomically Modern Human
UP     Upper Palaeolithic
Chapter 1.

Introduction

The objective of the project reported here was to develop a method of assessing the skilfulness of the individuals who produced the Upper Palaeolithic cave paintings of Europe.

The vast majority of Palaeolithic art dates to the Upper Palaeolithic (42-12 ka cal BP), with Lascaux and Chauvet in France and Altamira in Spain being the most famous sites. Recent estimates suggest that there may be more than 200 caves and rock shelters in Europe with UP paintings (Guthrie 2005). The greatest concentrations of these sites are in South-western France and northern Spain. However, other countries such as Germany, Portugal, Italy, Sicily, Serbia, and Romania have sites with cave paintings dating to the UP (ibid).

The UP cave paintings of Europe are one of the best known, if not the best known, types of prehistoric art, due to their visually striking, detailed depictions of Ice Age animals (Bahn 1997). Since the depicted animals are extinct, these cave paintings provide information about their appearance that we otherwise would not have (Guthrie 2005). The cave paintings also represent the first unambiguous evidence for artistic activity in the archaeological record.

The skill required to produce UP art has been argued to be “considerably sophisticated” (Bahn 1997) and “the work of a specialist” (Pettitt and Allistar 2007), although, as of yet, there is no empirical way of determining whether or not the art is the work of a specialist or a novice. The lack of focus on skill in UP art is unfortunate, because an understanding of the skill required to produce a painting would not only contribute to a better understanding of the paintings themselves, but may also provide valuable insight into UP life. If representative art can be evaluated in terms of the skill
level of the artist, hypothetically it is possible to identify the skill level of UP artists and to infer an approximate amount of practice that it took for UP artists to achieve their skill. If the practice time of UP artists can be inferred, then the skill level of UP art can potentially shed light on the time-budgets of UP artists, as well as the general economy and social organization of UP populations.

In cognitive psychology, there is a field of research that focuses entirely on the acquisition of skill across a wide range of activities. The research suggests that an individual’s skill level for a given activity is primarily determined by the number of hours devoted to practicing that activity (Ericsson et al. 2006). Thus far, research into the production of representative art suggests it is also a skill that is acquired through practice (Edwards 1999). Therefore, it should be possible to borrow the methods for measuring skill and practice from cognitive psychology to determine whether or not representative drawing is also a skill that is acquired through practice. If representative drawing skill is determined to be dependent on practice, the same methods for measuring skill and practice time of current representative art can be used to evaluate UP art.

Inferring the skill level of UP artists by observing modern representative artists is possible because the cognitive and methodical aspects of producing representative art are the same today as they were in the UP (Edwards 1975, 1999; Eisner 2008; Fayena-Tawil 2011; Kleiner and Myanma 2006; Kleiner 2010; Konstam 1978). For example Figure 1 is an image of some of the drawings from one of the earliest and most famous UP art sites, Chauvet cave. Apart from the fact that the drawings are on a cave wall, there are no other aspects that indicate they were drawn more than 30,000 years ago, and not in the present.
The objective of this study is to develop a method of measuring the skill level and practice time of representative artists today, so that the same method can be used to infer the skill level and practice time of the individuals who produced the UP cave paintings. Research into the production of representative art indicates that representative art is learned and produced by the acquisition and execution of a set of sub-skills (Edwards 1999). In this study, those skills became the foundation of the scoring criteria for evaluating skill, referred to as the “evaluation criteria”. When tested with trial evaluators, reliability tests indicate that the evaluation criteria are able to produce consistent responses by several evaluators, and the evaluation criteria were deemed sufficient for the evaluation of skill in drawing. Next, volunteers with varying degrees of drawing experience produced three drawings in different time intervals and completed surveys outlining their practice history. The drawings produced by the volunteers were then assessed with the evaluation criteria. Subsequently, the scores were regressed on the participants’ total practice time, and this information was used to develop a model that allows practice time to be inferred from a piece of representative art.
Chapter 2. Background

2.1. UP art: an overview

Cave art is one of the most noteworthy features of the UP, as there are numerous sites with beautiful representations of prehistoric wildlife, which modern people would otherwise never see. This combination of antiquity and beauty has made certain UP art sites world famous and has ignited an interdisciplinary interest in prehistory. In archaeology, the study of UP art has grown to become its own sub-discipline that produces two general areas of inquiry. The first area is defined by the use of empirical analyses of UP art, and the second area consists of theoretical hypotheses related to the meaning or purpose of UP art. Therefore, the archaeological discussion section presented in this thesis will be divided into two parts, accordingly.

2.1.1. The UP

The UP is a period that dates to 42,000 – 12,000 cal BP. It is referred to as the ‘Upper’ Palaeolithic because it is the third and final time period of the European Palaeolithic, after the Lower and Middle Palaeolithic. The UP is usually divided into five overlapping archaeological cultures: the Aurignacian (42-28 ka cal BP), the Gravettian (30,000 – 20,000 BP), the Solutrean (21,000 – 17,000 BP), the Magdalenian (20,000 – 14,000 BP), and the Azilian (18,000 – 12,000 BP) (Bahn 1997).

UP material culture was made by anatomically modern humans (AMHs). AMHs evolved 195,000 years ago in Africa and migrated to Europe by 43,000 years ago, near the beginning of the UP (Hingham et al. 2001). Europe was originally inhabited by another hominin, H. neanderthalensis, who went extinct by approximately 32,000 BP, approximately 9,000 years after the arrival of AMH’s (43,000 BP)
Thus far, the impact AMHs had on the extinction of Neanderthals is hotly debated (Finlayson 2004; Klein 2000; Mellars 2005, 2011; Mithen 1996).

The environment in Europe during the UP is often characterized by the effects of the Last Glacial Maximum (LGM), a climatological event caused by glaciation and the onset of very cold and dry weather, that extended into mainland Europe from 26,000 cal BP to about 20,000 cal BP, (Guthrie 2005). It produced freezing temperatures of -20 to -40 degrees Celsius that lasted nearly the entire duration of the UP (van Andel and Davies et. al. 2003). The European landscape during the UP has been described as tundra, a permafrost semi-arid desert inhabited by grasses and large grazing animals (Guthrie 2006; vanAndel and Tzedaskis 1996).

In the past decade, however, research has emerged suggesting that (most) humans in the UP were less subject to the extreme harsh conditions of the LGM than was previously thought. Recent research indicates that that the periglacial regions (areas surrounding the glacial ice sheets) of South-western Europe were much more habitable than initially thought. Oxygen isotope ratios recovered from the GISP2 (Greenland Ice Sheet Project 2) indicate that the South-western Europe was a much warmer -4 to 8 degrees C, comparable to the temperatures of modern day South-western Europe (Stuvier and Grootes 2000). Similarly, pollen analyses indicate that South-western Europe contained dense forests that were bordered by park tundra, a less-dense plant community that consisted of trees and bushes (Figure 2) (ibid). Additionally, faunal remains indicate that a diverse range of animal species occupied these South-western Europe regions (van Andel and Tzedaskis 1996). Since most AMH UP sites are found in the forested and park tundra periglacial regions of South-western Europe (Figure 2), it can be inferred that people in the UP were largely able to avoid the harshest conditions of the LGM.
Figure 2. An illustration of the distribution of flora and archaeological sites in Western Europe during the UP (van Andel and Tzedaskis 1996; Guthrie 2006).

Though H. neanderthalensis developed a unique material culture, it appears to be less complex than that developed by the AMHs who ultimately replaced the Neanderthals. (Guthrie 2006; Nowell 2013; White 1992). There are some aspects of Neanderthal material culture, (such and the use of ochre and beads), that resemble AMH material culture, but it is not known whether these aspects were derived from AMHs or Neanderthals.

While AMH material culture in the UP is more complex than that of the Neanderthals, it was also considerably more complex and ubiquitous than Middle Palaeolithic material culture. In fact, there was such an explosion in the innovation and occurrence of UP material remains, that the Middle to Upper Palaeolithic transition is often referred to as the “UP revolution”. Innovations unique to the UP include the flute, oil lamp, drill, rope, spear thrower, harpoon, sewing needle, and representative art (Guthrie 2005; Halverson 1991; Shea 2003; White et al. 1982). Innovations related to lithics include bladelettes, burins, hafted point tools, and scrapers. There was also a new reliance on osseous materials such as bone, antler and ivory, for tools and art (Guthrie 2005, Halverson 1991). Some technologies, such as blade tools, microlithic technology, bone tools, specialized hunting tools, beads, engraving, sculpture, and ochre use, actually appear in the archaeological record at least 40-50 kya before the
Middle/Upper Palaeolithic transition (McBrearty and Brooks 2000). However, archaeologists generally maintain that there is such an increase in the quantity and rate of innovation of AMH material culture that some type of socioeconomic ‘revolution’ must have occurred (Bahn 1997, 1998; Guthrie 2005; Nowell 2006, 2010).

2.1.2. The spatial and temporal distribution of UP cave paintings

UP art is categorized based on its form, function, and/or style (Bahn 1997; Guthrie 2005). Form is defined as the visible shape and configuration of something (Barber 2005). In the UP, art is either two-dimensional (2D) or three-dimensional (3D). 2D UP art is drawn, painted, or etched onto relatively flat surfaces, such as cave walls and plaquettes. 3D UP art is sculpted or carved, such as a portable figurine or a sculpted frieze. The terms portable and parietal are archaeological in nature. Parietal art, such as cave painting, is a part of a site’s features, and cannot be moved, as it is largely found on the walls of caves and rock shelters. Portable art is transportable and usually consists of 3D sculpture and carving, but also includes clay plaquettes with 2D engravings (Bahn 1997). Art is also described in reference to its style, which is either representational or abstract. Representational art is defined as the depiction of something easily recognized in nature, while abstract art is the opposite of representational art and lacks representational qualities (Barber 2005). Representational and abstract art can either be 2D or 3D in their form, and parietal or portable in their function.

UP art is found all over western Eurasia. However, it is predominantly located in Europe, where it is found in every modern country with the exception of Holland and Poland (Bahn 1998). The greatest concentrations of UP art sites are in South-western France and northern Spain, but there are also well known UP art sites in Germany, the Netherlands, Russia, and Africa (ibid). To date, there are upwards 350 sites in Europe with UP art (Guthrie 2005).

UP art is remarkably preserved considering its antiquity. The long-term preservation of the materials commonly associated with UP art is so unlikely that the recovered art is argued to represent a very small percentage – less than 1% – of what
would have existed (Guthrie 2005). Taphonomically, UP portable art is like any other
UP artifact. Portable art made of bone, antler and horn can survive in the ground
under favourable conditions, but art made of other organic materials, such as wood,
would not survive. The preservation of UP parietal art is a little more fortuitous.
Engraved parietal art is etched into stone, so it’s primary taphonomic concern is
weathering. As such, UP engravings are generally found in areas that were protected
from environmental damage, such as rock shelters and caves (Bahn 1997). However,
paintings and drawings are often composed of organic materials, such as charcoal
and ochre paint (ochre minerals mixed with an organic binder), that are subject to
microbial decomposition as well as weathering. In most cases microbial
decomposition was avoided because the landmass of South-western Europe is
composed of limestone. Limestone is naturally alkaline and prevents the
decomposition of organic materials on its surface (Guthrie 2005). As such, the
nonorganic components of the paint and charcoal remained on the surface of the
limestone for long enough for their pigments to be absorbed and become a permanent
feature of the rock. In regard to weathering, UP drawings and paintings preserved
because they are generally found in cave sites, which are more protected than rock
shelters. In some cases, painted cave art sites such as Lascaux, Altamira, Chauvet
and Consquer were sealed off from the outside environment until they were
discovered in the past 60 years (Bahn 1998). As a result, the cave paintings are
almost perfectly preserved and appear as if they were only recently made.

2.1.3. Dating UP art

Before the discovery of absolute dating techniques in the 1950’s, it was difficult
for archaeologists to determine the antiquity of UP art. Initially, temporal sequencing,
an early seriation-based technique, was the only way to attach a date to UP art. At the
turn of the century, Henri Breuil, an early specialist and recorder of cave art,
developed a stylistic seriation technique based on the appearance of “twisted
perspective”, which Breuil argued was an archaic way to produce art (Bahn 1997). He
argued that art with this form of perspective was from the Early Aurignacian (42,000 –
30,000 BP) while art without perspective was from the Gravettian (30,000 B.P.) period
or later (ibid). Breuil’s theory was later disproved when figures with twisted perspective
were identified in periods that appeared to post-date the Gravettian. Nonetheless, Brieul’s model for stylistically dating art inspired other early archaeologists.

Lamming-Emperaire (1959) developed a simple three-phase scheme based on the complexity of UP art, and Leroi-Gourhan (1958) developed an extremely complicated four-phase scheme where different compilations of styles appear alternatively throughout time (Bahn 1998). In 1967, Leroi-Gourhan developed a stylistic seriation-based technique based on the style of pieces of portable art that were each dated to four different stratigraphic layers that span from the Aurignacian to the Magdalenian. He then attempted to date UP cave paintings by associating the paintings’ style to the style of the portable art that was found in the dated layers. Leroi-Gourhan’s (1967) stylistic dating technique was popular until modern dating techniques proved that style in art was more complex than he hypothesised. Today, some archaeologists argue that stylistic seriation is not a reliable measure of age, while others maintain that a temporal sequence to UP art exists and can be used to date art (Pettitt and Pike 2007).

Once radiocarbon dating techniques were introduced, archaeologists were able to attribute dates to Palaeolithic layers and confidently date portable art that was found in archaeological layers. The size of the carbon sample required for carbon dating was too large to take from cave paintings without destroying them, so cave paintings could not be dated (Bahn 1997). It was not until the 1990’s, when a new method of carbon dating known as accelerator mass spectrometry (AMS) was developed that archaeologists were able to date cave paintings directly. AMS dating requires only a miniscule amount of carbon, which enables archaeologists to date parietal art without compromising its integrity (Pettitt and Pike 2007). While this technique is certainly an advance in the field of UP art research, it is still a new technology that is not yet capable of taking dates from art that is degraded. As most UP art sites are degraded, only 19 sites have been dated so far (Pettitt and Pike 2007). Currently, only 5% of the known UP art cave sites have been reliably dated with radiometric techniques (ibid).
2.1.4. UP representational art

The focus of this study is two-dimensional representational art, which, in the UP largely appears in the form of cave paintings (Figure 3). Most representative cave paintings are quite large – from 2-5 meters in length, and appear as if they are ‘looming’, usually on or near the cave’s ceiling (Bahn 1997). They are usually drawn with pieces of pigment, or painted with pigments that were mixed with a binder, such as animal fat or water, and applied with a brush that was likely made of animal fur (Aujoulat 2005; Lorblanchet 1991). The colours used in the paintings range from black and white to brilliant shades of yellow, orange, red and brown (Bahn 1998). In some cases the images are drawn around, or made part of, natural undulations or cracks in the caves walls (Nowell 2006). Most of the representative images include well-defined, and easily recognizable animals, but humans and anthropomorphic figures also exist (Bahn 1997).
Figure 3. Examples of 2D representative art from the UP. Images 1, 2 and 4 are from Niaux Cave in France are estimated to be from the Magdalenian (20,000 – 14,000 BP). Images 3, 5, and 7 are from Lascaux Cave in France (c. 17,300 B.P.). Images 6 and 8 are from Chauvet Cave in France (c. 32,000 cal B.P.) (Bahn 1997; Aujoutlat 2005; Chauvet et al.)

A diverse array of animal species are represented in UP cave paintings, including bison, horses, mammoths, rhinos, chamois, lions, reindeer, ibex, red deer, musk oxen, seals, rodents, wolves, bears, seals, owls and penguins (Clottes 2003; Guthrie 2005; Leroi-Gourhan 1978). The most commonly depicted animal is the horse with 610 depictions, followed by the bison and mammoth, with 510 and 400 depictions, respectively (Guthrie 2005). The animals are generally shown in natural positions, such as with their head down as if they are grazing. Interestingly, a recent study compared artists’ depictions of quadrupeds from throughout Western Art history, and revealed that UP artists were able to more accurately depict a quadruped’s gait than artists (including Leonardo Da Vinci) from subsequent periods (Horvath et al.)
The sexual characteristics of the figures are often underplayed, or missing, therefore only species that show prominent sexual dimorphism, such as lions and horned ungulates, can be sexed (Bahn 1998). Lastly, faunal remains indicate that AMHs hunted some of the depicted animals, such as various types of ungulates, but most of the painted animals such as the bison, bull, horse, and cats, were probably not used for human subsistence (Bahn 1998).

Most of what is known about the production of representative art has been inferred from replicative experiments (Aujoulat 2005; Bahn 1998; Lorblanchet 1991). Lorblanchet (1991) concluded that coloured figures were initially outlined by engraving or drawing, filled with a solid color when applicable and re-outlined in black charcoal or magnesium oxide. Black and white drawings were made of charcoal, and often highlighted with white calcite. Experimental replicative studies indicate that a lot of charcoal would have been required to make the large art, as one centimeter of charcoal would only produce 10cm of line (Bahn 1998). Drawings with areas of solid colors were likely made by blotting pigment on the walls in 2-3 cm wide overlapping dots (Aujoulat 2005). Another technique used to create areas of solid colour was to blow pigment over a stencil made with the artist’s hand and/or a paper-like material, such as tree bark or animal skin (Aujoulat 2005; Lorblanchet 1991). Experimental replication studies also suggest that animal fur was used to make brushes and the blotting pads (Aujoulat 2005; Bahn 1997). Recovered engraving tools are made with materials that vary in density, such as stone, bone, shell, teeth and antler (Bahn 2007; Guthrie 2005), suggesting that different types of materials were used to make lines of different thicknesses and depths (Aujoulat 2005). Excavations at Lascaux reveal pieces of what appear to have been wooden scaffolding, indicating that UP artists likely used some type of a raised wooden platform so that they could paint large figures (Nowell 2006).

While there is no research involving the drawing skill displayed in UP art directly, the material remains found at cave art sites suggest that planning and experience were factors in its production. For example, the harvesting and processing of the pigments suggests mastery of a complex body of knowledge (Lorblanchet 1991). Geochemical analysis of recovered pigment stubs indicates that some of the
pigments, such as ochre, were not local and would have had to be harvested from areas up to 500 miles away from the cave site (Bahn 1997). In order to obtain the range of colors (orange to yellow) produced by ochre, the material would have to be exposed to very high temperatures to induce the required chemical reactions (Bahn 1998). Experimental analysis of UP pigments indicates that red ochre needs to heat up to 250 degrees Celsius to achieve the shades of orange and yellow that are found in cave art (Bahn 1998). White pigment (calcium phosphate) requires heating bone to 400 degrees Celsius, mixing in calcite from animal bone, and then heating the mixture to 1000 degrees (ibid).

The caves would have been dark, and the artists would have required complex material culture such as lamps and torches in order to see inside the caves (Bahn 1998). Residue analyses indicate that torches made of wood and animal fat were used to illuminate cave interiors. When burned, animal fats give off a blackish smoke and carbon residue, and it appears that the torches were kept nearest to the walls opposite the paintings (Bahn 1997 and 1998). To illuminate the area of the cave wall they were working on, artists used small lamps made of concave stones, beeswax, and lichen. While the existence of torches is mostly based on smoke residue, hundreds of small stone lamps have been recovered from many UP sites (Bahn 1998). Experimental studies by Bahn (1998) indicate that although these lamps do not give off much light, the beeswax does not produce smoke, and consequently their use would have protected the artists' work from smoke discoloration and damage.

2.1.5. Interpreting the meaning of UP art

Most archaeologists have agreed that UP art contains meaning, but they are divided as to whether or not those messages can be identified. Perhaps unsurprisingly, archaeologists who believe that meaning can be inferred directly from UP art have contributed the most diverse and largest number of hypotheses to the study of prehistoric art (Bahn 1997).

Theorizing about the meaning of UP art began in the mid 19th century, when the art was determined to be ancient (Bahn 1997). At this time, archaeologists
admired and meticulously recorded UP art, but they ultimately regarded it as being amateurish, primitive, and strictly decorative (Abadia 2006). They argued that the individuals who created the UP cave paintings did so for pleasure and decoration, and that the depictions did not have a deeper social or religious function (Piette 1887). This hypothesis eventually became known as the ‘art for art’s sake’ hypothesis. By the mid 20th century it was discredited for making negative assumptions about the people who made the art.

Throughout the first half of the 20th century, a movement toward ethnographic comparison heavily influenced the interpretation of UP art. The majority of these ethnography-based hypotheses interpreted abstract art as having many purposes, most commonly as the product of initiation rites or mystical/religious ceremonies (Bahn 1997). Two of the most widely discussed hypotheses, which are usually referred to as the ‘hunting magic hypothesis’ and the ‘fertility magic hypothesis,’ were derived from the same ethnographic source—the Arunta, a hunter-gatherer group from central Australia who traditionally painted images of animals to bring luck (Bahn 1997). This source influenced Breuil (1909) to create the hunting magic hypothesis, which argues that the animals depicted in the paintings were painted ceremonially with the intent that they could be symbolically killed with red ochre to bring luck during hunting. Breuil’s theory explained many oddities found in the paintings, such as the appearance of red dots and ochre painted on or around animal figures, which may represent the blood after the kill.

Less than a decade later, another theory based on the ethnographic account of the Arunta, the fertility magic hypothesis (Leroi-Gourhan 1958; Lamming-Emperaire 1962), gained popularity. According to this hypothesis, the artists expected the painted animals to be symbolically fertilized, bringing fertility luck to humans, plants, and animals (Nougier and Robert 1974). Initially, this theory was based on images thought to depict sex and nudity, but eventually it grew to encompass any image that bore even a faint resemblance to anything phallic or vulvar as being related to fertility. For example, figures that appear near another figures were argued to be in a precopulatory act, while any animal figure with a rounded belly was argued to be pregnant (Bahn 1997).
After the 1960’s, there was a drop in the number of hypotheses regarding UP representative art. The so-called New Archaeologists sought to develop scientific approaches to the analysis of material culture. They categorized and quantified UP art to identify patterns in the spatial distribution of images, i.e. animal types, color types, and gender types. This led to multiple observations of paired figures, most notably horses and bison (Bahn 1997). Leroi-Gourhan (1958) and Laming-Emperaire (1962) argued that UP cave sites are decorated systematically, and that the images are part of a complex metaphysical system, which they referred to as a “mythogram.” A decade later, after extensively mapping UP art, Leroi-Gourhan (1967) argued for the existence of a mythogram based on male/female duality. He argued that paired images were designated with a sign that was either masculine or feminine and categorized the art according to that designation. At first, Leroi-Gourhan’s patterns appeared to fit UP art sites. Upon more careful evaluation, however, numerous flaws in Leroi-Gourhan’s methodology, such as the over-attribution of male and female symbols, and the inaccurate use of quantitative methods, were uncovered (Bahn 1997). By the 1980’s Leroi-Gourhan’s theory was largely discredited (Nowell 2006).

Since the 1980’s, researchers sought interdisciplinary explanations for the creation of UP art. For example, archaeological adaptations of cognitive psychology have played a major role in the understanding of the origins of art as a form of symbolic behaviour. Mithen (1998) draws on research in cognitive science which identifies three foundational aspects of creativity: 1) theory of mind, which is the ability to attribute mental states such as religion, pretending, and knowledge, to oneself or others, 2) language, and 3) the production of symbolic material culture. Mithen argues that these aspects of creativity evolved in early hominins, but became apparent in AMHs of the UP and the Neolithic. Likewise, Lewis-Williams and Dawson (1988) suggested that cross-contiental abstract signs that are found in various prehistoric cultures, such as the symbols in Figure 4, are all similar because the visual cortex and human neural system respond specifically to various geometric shapes.
In the post 1980’s era there was also a general revival of ethnographic comparison utilizing ethnographic accounts of modern Australian Aborigines. For example, an Australian aboriginal belief that ancestral spirits came to leave protective symbols (pictographs) on the walls of their family’s home has lead to hypotheses that argue UP people had similar traditions (Guthrie 2006). Other archaeologists argue that UP art was a critical part of initiation ceremonies and/or seasonal festivals (Bahn 1997). One of the most widely cited of these theories is the idea that UP art was made by shamans, during shamanistic rituals (Hayden 2003).

There are also several theories surrounding the concept that UP art was made to transmit information over long periods of time. These theories generally interpret art as a form of writing, expressing things such as signatures, maps, instruction aids, signs, territory markers, and family or group emblems (Bahn 1997; Marshack 1989). Mithen (1988), for example, argues that abstract signs and other images such as footprints, animals, and grasses, are indicative of hunter-gatherers communicating information about the environment to other members of the group. Marshack (1972) argued that the dots and repetitive broken lines that decorate some figures are a form of writing. Some researchers argue that images are hunting scenes painted for teaching purposes, while others argue that the dots and lines represent a type of proto-mathematics (Bahn 1997). Astrology-based theories argue that images with dots are depictions of constellations or solar and lunar movements across the sky (Lewis-Williams and Dawson 1988).
2.2. Representative art

2.2.1. Defining representative art

As Figure 5 illustrates, there are three different types of art, representative, stylized and abstract. The goal of the present study was to identify skill in representative art, which is defined as art that is a faithful depiction of the natural world (Barber 2005). Representative art is part of a greater art form known as representational art, which also includes stylized art. On a spectrum of representation, representative art is produced to be as true to nature as possible, while stylized art is intentionally simplified and designed with a style (ibid). Stylized art is less realistic than representative art, but they are both representative of a subject, therefore they are referred to as representational. Abstract art is the opposite of representational art and is defined as art without representational qualities (ibid).

![ Representation vs. Stylization Diagram ]

**Figure 5.** The scale of stylization in art (Aujoulat 2005; Bahn 1997; Chauvet et al. 1996;).

Representational art is found in virtually every type of cultural group from hunters-and-gatherers to large-scale civilizations (Kleiner 2010). It is thought that cultural groups with established, long-term artistic traditions began with representative drawing, and either maintained it or developed it until it was more stylized (Hyman...
Europe has a representative art tradition that began in the UP and continues to the present day (Kleiner and Myanma 2006). Non-western cultures with pre-historic and historic traditions of representative art can be found throughout the Middle East and Southwest Asia (Kleiner 2010). Specifically, prehistoric representative art is found in Saudi Arabia, Syria, North Africa, Iraq, Iran, India, Myanmar, Thailand, Vietnam, Malaysia, Cambodia, China, Korea, Japan, Vietnam and Australia (ibid).

2.2.2. How is representational art made?

There are two approaches to executing representative drawings: a ‘top-down’ approach and a ‘bottom-up’ approach. The former emphasizes an increased knowledge of the figure for a more accurate representation (Gombrich 1960, 1991). To employ this method, an artist studies and observes as much about the figure as possible. For example, if an artist were to draw a horse using this approach, he or she would garner as much knowledge as possible about horse anatomy and structure before starting to enable them to place lines in the most descriptive areas when drawing. The top-down approach is most effective when the artist has prior experience in drawing and has experience in perceiving objects for adaptation to drawings (Kozbelt 2010).

Those learning to draw most commonly use the bottom-up approach. With this approach the artist must learn to ignore what they know about what they see, in order to perceive what is actually there (Kozbelt 2010). The human brain catalogues images into a type of two-dimensional symbol system that novice artists refer to when drawing (Edwards 1999). For example, the mention of the word ‘cow’ results in a visual symbol of a cow entering an individual’s consciousness. However, since the human mental image is simplified, an artist would have to ignore their mental image of a cow and focus on a real cow if they wanted to draw it. Unfortunately, ignoring our visual knowledge of objects can be difficult.

Our brain’s encyclopaedia of symbols is established early in childhood (Edwards 1999). Before the age of 12, learning to draw is closely associated with lateralized developments in the brain. Children begin their artistic development with a
scribbling stage, move onto a symbol stage, and then a more detailed symbol stage (Edwards 1999). Finally, between the ages of nine and 12, the child’s brain goes through a lateralization phase, where the language centers of the brain take over. At this age, children are able to see that the symbols they use to represent their subject are not actually representative of the subject at all. They increase detail to aid in their drawing’s realistic appearance, but they are often overwhelmed by the fact they are unable to draw what they see and many stop trying altogether (ibid). If someone stops trying at this age, their drawings as adults will look like the same symbol-based system they used as children.

Regardless of whether or not an artist uses the bottom-up or the top-down approach, all representative artists learn five essential components, or skills, of representative drawing whether they are conscious of it or not (Edwards 1999). Reference to these skills can be found in historical texts that date back to ancient Greece, and in Non-Western countries such as China and Iran (Kleiner and Myanma 2010; McKenzie 2006). The list of essential skills for representative drawing are as follows: 1) line quality 2) positive and negative space 3) relationships (proportion and perspective) 4) light and shadow, and 5) the gestalt, which refers to the overall appeal of the art (Edwards 1999).

2.3. Current research into expertise and skill acquisition

2.3.1. Cognitive psychology’s skill acquisition research

This section of the chapter explores current archaeological research on skill, as well as skill research from the fields of cognitive psychology and representative art. The study of skill in the production of archaeologically recovered material culture is relatively new. Therefore, it is beneficial to explore other fields in which more in-depth research on skill acquisition has taken place. However, the problem with adopting research from other fields is that there are often different terms and/or definitions for skill. In archaeology the definition of skill is “a variable of technological knowledge with recognizable material results” (Bleed 2008;154). Naturally, the archaeological definition focuses on the material correlates of skill rather than the cognitive ones. The
standard dictionary definition of skill is “the ability to do something well, or having expertise” (Barber 2005; 295). In the cognitive sciences skill is referred to as expertise, which is a synonym of skill that is defined as “having skills and being well-informed in a particular field” (Ericsson et. al. 2006). For the purposes of this study, I use that standard definition rather than the archaeological one because this portion of the study is focused on the cognitive rather than the material aspects of skill acquisition. Since the terms ‘skill’ and ‘expertise’ are synonyms, I will use the term skill unless I am speaking about the cognitive studies on expertise specifically.

In archaeology, the identification of skill has helped researchers make inferences about the rise of the division of labour, social networks, social stratification, ritual goods, and trade (Bleed 2008; Olausson 2008). Thus far, skill has been investigated in the archaeological sub-fields of lithics, weaving, ceramics/pottery, metallurgy, and bead making. In lithics, systematic trials have revealed the attributes of both novice and expert knappers, which have been used to identify experts and novices in a handful of Palaeolithic, Mesolithic and Neolithic sites (Finlay 2008; Olausson 2008). Evidence of skill in weaving, metallurgy, and ceramics has been identified in various sites, through a combination of modern specialist knowledge and experimental analyses (Bleed 2008; Nicholas and Kramer 2001). Finally, experimental studies also indicate that beads and beaded jewellery from ancient European and African sites are the products of skilled craftsmen (Nicholas and Kramer 2001; White 2007)

In regard to cognitive psychology’s expertise studies, initial success came after the research of Ericsson and Charness (1994), who compared a cross-section of modern skill domains and concluded that approximately 10,000 hours of practice, (rather than just innate “talent”), is the main requirement for becoming an expert. This 10,000-hour ‘rule’ persisted as the study of skill acquisition and expertise grew to include dozens of skill domains, researchers, and publications. Some skill-domain studies include computer science, medicine, surgery, transportation, software design, professional writing, various types of music, various types of sports, acting, ballet, dance, video gaming, chess, math, and memory (Ericsson et al. 2006). Work on skill acquisition has explored topics such as the influence of social and cultural
encouragement, the influence of elitism, task observation analysis, performance retention, and the influence of age (ibid).

The study of skill acquisition is approached in two general ways. The first is to observe exceptional performers to understand how skill manifests, and the second is to compare the skill levels of experts and novices. The latter method is preferred because it involves an analysis of both aspects of skill, and how they interact with one another (Chi 2006). Nonetheless, the former approach is not without merit. Observational studies focusing on exceptional performers indicate that the main difference between a novice and an expert, is the expert’s ability to generate the best solutions to task-related problems, under tight time constraints (Ericsson and Charness 1994). Since exceptional performers are experienced, they are better able to detect problems, predict outcomes, and generate solutions to the obstacles that arise during the execution of a task. Experts are also better at self-monitoring, in terms of judging mistakes, and how their work ranks compared to others (Chi 2006). The negative qualities associated with expertise sometimes include suffering from over-confidence, being overly detail-oriented, and having difficulty adapting to new concepts.

Comparative studies of novices and experts have revealed the importance of constant, repetitive practice (Ericsson and Charness 1994). Even in the case of expert performers who were considered genetically gifted or prodigies, practice still appears to be the overwhelming contributor to skill acquisition (Ericsson 1996). For expert performers in any domain, practice usually begins at a young age and is maintained daily for more than a decade, which equates to 10,000 hours of practice. Practice is imperative for skill acquisition because it provides the feedback mechanisms that allow for a reduction in cognitive operations, which improves speed and smoothness of the operation in question (Hill and Schneider 2006). The perceived benefits of skill are supported by the ‘neural pathway theory,’ which argues that for perceptual-motor skills, such as drawing, the neural impulses travel from the occipital region at the back of the brain, to the various necessary centers in the temporal cortex (Hill and Schneider 2006). With time and practice, neural pathways develop. These pathways quicken the expert’s response time and allow the brain to respond without the need to
consciously think about how to respond. This frees up the expert to be more mindful of the overall operation and perform better. This research is supported by fMRI brain scans that indicate there is an 85% drop in expert brain activity during practice in comparison to a novice. While the motor and perceptual parts of the expert’s brain remained active, the frontal (task control) and posterior (attention control) regions were not being used at all (Hill and Schneider 2006).

The second most important variable in skill acquisition after consistent practice is tenacity—the determination to succeed (Ericsson and Charness 1994). Everyone with the master level of performance had an overwhelming desire to succeed in their given domain. Research indicates that while there are some people, such as prodigies, who learn a skill quickly, it is usually those who struggle the most initially, but are the most determined to succeed, who eventually become experts and masters (Ericsson 1996).

The variables that impact skill acquisition have shown to be quality of practice and social support (Krampe and Charness 2006). The quality of practice, which refers to a level of concentration while practicing, can be impacted by the age of the practitioner and cultural norms of the culture where the practice is taking place. For example, young children often concentrate less during practice than adults. Consequently, children require more practice than adults to achieve the same level of skill. Cross-culturally, the intensity of skill acquisition fluctuates due to the relative importance of a given skill to different cultures (Hunt 2006). Populations with increased social status for certain crafts often produce more of these crafts and have more skilled craftsmen (ibid).

There are thought to be six stages in skill acquisition (Chi 2006). The first is the novice, who is someone new to the skill domain, with little or no exposure to it. The second is the initiate, who is a novice who has been exposed to the procedures involved with their skill and has begun introductory practice. The third is the apprentice, a student who is learning and immersed in practice. The fourth is the journeyman, who can work unsupervised, is competent, and very well versed in their skill. An expert is a more accomplished journeyman and is more consistent in their
execution of a skilled product and is able to do challenging tasks with minimal effort. Finally, a master is an elite expert who has substantial experience and can perform skilfully all the time. Masters rarely ever make mistakes and are generally regarded as a leader in their ‘skill community’ (Chi 2006).

2.3.2. Skill in representative art

The existence of skill in the production of representative art in adults has never been investigated, to the best of my knowledge. However, there are several observational studies that suggest that the production of representative art is a skill-based task. For example, master representative artists strongly emphasize the importance of practice—as much as possible and as frequently as possible. During the Renaissance—a peak in the production of representative art—artists passed through a regimented training program that lasted for approximately 10 years before an apprenticing artist was considered a master (Kleiner 2006). As noted earlier, a ten-year training period is comparable to the 10,000-hour training period that is required to obtain expertise in other established skill domains (Ericsson and Charness 1994). Non-western cultures with representative art, such as China, have ancient documents describing the apprentices’ training period and the importance of practice to achieve realism (Mackenzie 2006). In addition to practice, there are several comparative studies that argue that expert representative artists have attributes that are similar to experts in other skill domains. For example, compared to novices, expert artists have an increased ability to perceive and execute the three dimensionality of an object. This means that the expert can draw the basic form of a figure subconsciously, so that they can fully concentrate on the details of drawing (Fayena-Tawil 2011). Expert artists are also able to draw a figure faster, which results in a smoother line, a more unified drawing, and a more confident execution (ibid).
Chapter 3. Materials and Methods

The objective of the project reported here was to develop a method of assessing the skilfulness and practice time of the artists who produced the representative Upper Palaeolithic art. In order to investigate skill in representative drawing, I devised a study that involved the collection and evaluation of the work of living people with a range of drawing experience. The study involved five steps: 1) creating the evaluation criteria, 2) trialing the evaluation criteria 3) collecting data 4) evaluating the volunteer artists’ drawings, and 5) statistical analysis.

3.1. Creating the Evaluation Criteria

The first step was to create a set of criteria for the evaluation of skill in representative drawing. To do this, I created standards that the evaluation criteria must adhere to. The first was that the evaluation criteria should be characteristic of all of the important aspects of representative art, such as perspective, and proportion. The second was that the evaluation criteria must be comprehensible to the average person, (e.g., non-artists). The third was that the representative art sources I use must be congruent with the historical practices of representative artists. Since the production of representative art dates back to the UP, I considered historic texts, as well as current texts on the production of representative art. In addition, since representative art literature is not peer-reviewed, a source must be credible based on its reputation in the representative art community (professional artists, student artists, drawing instructors, and art history professors).
3.1.1. Identifying and sourcing the representative drawing criteria

To begin with, I familiarized myself with the attributes of production in representative drawing. This required consultation with multiple sources, including books, both current and historic, professional artists, student artists, drawing instructors, and art history professors. From this research it became clear that representative drawing is based on the acquisition of a group of skills. It was also apparent that the nature of these skills is firmly established in the literature, where their definitions have remained more or less the same throughout time.

The next step was to find a source that meets the approval of the representative art community. The source I chose was the book, *Drawing on the Right Side of the Brain* by Edwards (2009). I chose this book because it is both comprehensive and widely used amongst representative art educators and artists. Edwards provides a thorough explanation of how and why artists are required to change their perceptions of a subject in order to achieve accuracy in drawing. She also describes each of the skills in detail and their relationships to one another. The only drawback of using Edwards’ book I could identify is that her claims on right and left side cognition, most notably her claim that a person’s ability to draw is based on left side brain functions, are no longer accepted by most cognitive scientists today. However, since the cognitive claims have no bearing on the skills or their descriptions, I felt confident that Edwards’ book was an adequate source for the evaluation criteria.

3.1.2. Describing the skills/criteria required for representative drawing

There are five skills involved in representative drawing (Edwards 1999). These skills are 1) the execution of edges (lines), 2) positive and negative space, 3) lights and shadows, 4) relationships (perspective and proportion) and 5) the gestalt (the ability to produce an appealing representation) (Edwards 2009). However, some of the skills, such as light and shadow, relationships, and the gestalt, are actually composed of two or more sub-skills. For example, drawing perspective consists of accurately perceiving and representing proportion and perspective simultaneously. Therefore, for
ease of identification in the evaluation portion of the study, Edwards’ five skills were broken down into sub-skills, for a total of nine skills (Table 1).

Table 1. A table indicating how the five basic representative drawing skills were broken down to their sub-skills.

<table>
<thead>
<tr>
<th>Edwards’ (1999) five basic drawing skills</th>
<th>The drawing skills' sub-skills</th>
<th>The nine skills in the evaluation criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Line</td>
<td>n/a</td>
<td>1. Line</td>
</tr>
<tr>
<td>2. Space</td>
<td>n/a</td>
<td>2. Space</td>
</tr>
<tr>
<td>3. Lights and shadows</td>
<td>3a. Light and shadow placement</td>
<td>3. Light and shadow placement</td>
</tr>
<tr>
<td></td>
<td>3b. Tonal balance</td>
<td>4. Tonal balance</td>
</tr>
<tr>
<td></td>
<td>4b. Perspective</td>
<td>6. Perspective</td>
</tr>
<tr>
<td>5. Gestalt</td>
<td>5a. Physical balance</td>
<td>7. Physical balance</td>
</tr>
<tr>
<td></td>
<td>5b. Focal balance</td>
<td>8. Focal balance</td>
</tr>
<tr>
<td></td>
<td>5c. Gestalt</td>
<td>9. Gestalt</td>
</tr>
</tbody>
</table>

Once I had selected the skills to be evaluated, I moved on to establishing the novice and practiced manifestations of each skill. For this I relied on Edwards (1999) book, as well as other sources and the input of representative artists and art instructors. Below is a description of each skill with examples of novice and practiced versions of the skills, and a scale of one to five. It was easier to depict the novice and expert versions of a skill by isolating that skill from the others, therefore the example drawings only depict the novice and expert versions of the skill being discussed. For example the novice line quality example indicates novice lines on a horse that is otherwise accurately drawn.

3.1.2.1 Line

A line is a mark with length and direction. When an artist draws a line, they consciously or unconsciously consider the placement of the perspective angles, proportion and volume of the subject. Novice artists are insecure about how to represent these traits, so they produce a rough, scrubbed-out, and often redundant line (Edwards 1999) (Figure 6a and B). If the novice artist is drawing based on their symbol system, the brain’s encyclopaedia of mental images, and not the subject, they
will produce ‘the child’s line’ which is constant and wobbly (Figure 6b). ‘The child’s line’ is thus named because children regularly draw based on the symbol system, rather than the subject or object itself (Edwards 1999). Practiced artists are accustomed to representing figures and can accurately execute the above-mentioned traits in a quick, confident fashion. Lines produced in this manner have a diagnostic thick and thin quality. In practiced hands, the thick and thin quality of the line is often used to suggest weight, volume, emotion and stylistic personality to the viewer (Eisner 2008).
Figure 7. Two drawings indicating novice negative space (left) and practiced negative space (right).

3.1.2.3. Light and shadow placement

Highlights and shadows are added to drawn figures to give them a sense of dimension (Edwards 1999). Natural light flows from a single source (the sun), but it bounces off angles to illuminate aspects of a figure that cannot be easily anticipated by the artist. Novice artists have a tendency to ignore the natural placement of light, and draw lights and shadows where they assume they will fall (Civardi 2005). Therefore, reflected light, which bounces off nearby objects, is not represented in novice drawing. Instead, novice artists generally shade around the contour of the figure (Figure 8).
Figure 8. Two drawings indicating novice light and shadow placement (left) and practiced light and shadow placement (right).

3.1.2.4. Tone

The term ‘tone’ refers to the values of grey between the white and black extremes (Edwards 1999). Most subjects have all of the values that are represented on the tonal value strip (Figure 9a). Practiced artists will accurately use all of the values in the strip to portray a tonally balanced image while novice artists usually draw values that are too light or dark compared to the actual values of the subject (Figure 9b) (Civardi 2005).
3.1.2.5. Proportion

Proportion refers to the part-to-whole size relationships of all the elements in a drawing (Edwards 1999). Foreshortening is a drawing term that refers to drawing close objects larger than receding objects to give the illusion of projection or extension in space (ibid). Accurately drawing proportion is a departure from a reliance on the human encyclopaedic symbol system, which shows images in two dimensions and not receding into space (Edwards 1999). Drawing figures with accurate perspective means that the artist must rely on an accurate perception of the subject as it is - not how the artist knows it to be from the symbol system. For example, in Figure 10 there are two images of a person holding an umbrella, a novice version (left), and a practiced version (right). In the practiced version the artist foreshortened the hand and forearm, as it would appear naturally. The upper part of the arm holding the umbrella cannot be seen. However, because the novice has utilized their symbol system, they have illustrated the entire arm to display that it is holding the umbrella (Figure 10). Another common mistake that novices make when executing proportion is a tendency

Figure 9. (a) A tonal value strip. (b) Two drawings indicating novice tonal balance (left) and practiced tonal balance (right).
to increase the size of the detailed areas of a figure, such as the head. Figure 11 illustrates both of these aspects of proportion. The practiced drawing is in perfect proportion, with a foreshortened rear end, while the novice figure exhibits oversized head and feet, as well as a rear that does not recede into space.

3.1.2.6. Perspective

Perspective refers to a technique of depicting volumes and spatial relationships on a flat surface (Edwards 1999). All three-dimensional objects in their
natural environment follow the laws of perspective. Drawing a figure in perspective requires making sure all of the figure’s angles recede toward a common point on the horizon. Perspective is a difficult skill to master because accuracy is essential – if even one of the angles is off, the figure will appear crooked. Therefore, as Figure 12 illustrates, all of the details in the practiced artist’s drawing recede toward a spot on the horizon (not pictured), while the angles of the details on the novice’s drawing are multidirectional and inconsistent.

![Figure 12. Two drawings indicating novice perspective (left) and practiced perspective (right).](image)

### 3.1.2.7. Physical balance

Physical balance refers to the stabilization of a figure’s pose (Edwards 1999). As humans and other animals move, their balance is maintained because their weight constantly shifts over their weight-bearing limbs. Portraying a figure’s mass and underlying structure accurately is integral to the overall balance and realism of the figure’s pose. Figure 10 illustrates how the weight-bearing supports of the figure, in this case the horse’s legs, are situated directly underneath the figure’s body. If the underlying structure of the figure’s support is properly aligned with the figure’s body the figure will appear to have weight and balance. Conversely, if the figure’s support is improperly aligned the figure will appear weightless and off balance (Figure 13).
Figure 13. Two drawings indicating novice physical balance (left) and practiced physical balance (right).

3.1.2.8. Focal balance

Focal balance refers to the visual balance between one or more focal points in the drawing (Edwards 1999). This skill is generally not taught, but arises through practice and an improved aesthetic awareness. Practiced artists guide the viewer’s attention to the figure’s focal points by adding increased detail, darker tone, and/or more dramatic contrast. There is generally one major focal point with outwardly receding attention to detail, or secondary, less obvious focal points strategically placed to direct the viewer’s eye. One of the most frequent mistakes new artists make is not correctly utilizing the focal point by applying equal attention to detail throughout the entire figure (Figure 14).
3.1.2.9. Gestalt

In reference to representative drawing, the gestalt refers to all of the skills and how they interact to create a balanced, communicable, and unified image (Edwards 1999). Capturing these characteristics requires a combination of a very keen sense of observation, and ability in all of the other skills. A figure drawn with expert gestalt is very appealing – it not just realistic, but natural, dynamic, and full of movement and character. A novice gestalt drawing is opposite - unnatural and stiff. This gestalt was initially rated based on the presence of the above-mentioned characteristics. However, since the gestalt is ultimately about the drawings appeal, it was determined to be easier, and equally as effective, to rate the gestalt based on how appealing the evaluators found the drawings.
3.1.3. Scoring drawings with the evaluation criteria

Each of the skills in the evaluation criteria were accompanied by specific examples and instructions on how to score the skills (see appendix). For the most part, the skills were rated by the artist's ability to accurately depict the subject. For example, Figure 16 is an example of how the light positioning skill is rated for accuracy. The left image indicates how novices commonly shade and highlight in unnatural areas, such as around the contours of the figure and/or without a directional source, while practiced artists depict light and shadow consistently, from the same source, and in anatomically appropriate areas. On the second page are black and white versions of the reference subject photos that the artists drew from. I pointed out the light direction, which is above the figure, since it is the sun, as well as the less obvious places where the highlights and shadows are on the figure. Then the evaluators assessed the drawing based on the artist's ability to accurately place the highlights and shadows in the areas indicated on the photos. A score of five was given to the drawings that were very accurate and a score of one was given to the artists that were completely inaccurate.
This method of evaluation – where the evaluators compare the artist’s drawing to the subject photos, is the same way that the perspective, proportion, space, and tonal balance skills are evaluated. The remaining line and gestalt skills were rated somewhat differently. Line was rated based on the degree to which the participant artists’ lines resemble the novice and practiced examples provided (Figures 6 a and b). The gestalt was simply rated based on how appealing the evaluators found the drawings.

### 3.1.3.1 Eliminating the focal balance skill

In the process of establishing a method for scoring the focal balance skill it became apparent that focal balance was not a testable skill for this study. To identify focal balance, the evaluators needed to search for a delicate balance of detail and contrast in different areas the subject. This was too refined and time-consuming for this study, which aimed to achieve level of ‘rough detail’ in 30 minutes. Therefore, the ‘focal balance’ skill was eliminated and I proceeded with the remaining eight skills.
3.2. Trialling the evaluation criteria

Before the evaluation criteria were determined to be suitable for the evaluation of the main skills involved in representative drawing, I needed to be sure that they could produce reliable responses. Therefore, the evaluation criteria were only deemed reliable when multiple evaluators were able to score drawings within 1 point of the average score. For example, if the average scores for a skill was 3, then the evaluators’ scores would need to fall between 2 and 4, for the criterion to be accepted.

To test the evaluation criteria I collected nine 5-minute and 30-minute drawings from volunteer artists, with a practice range of 0-44,000 hours. The volunteers did two drawings, one in five minutes and the other in 30 minutes, from photographs of animal subjects, which I provided.

To test the reliability of the evaluation criteria I enlisted five volunteers. Each volunteer received a paper copy of the evaluation criteria, and a detailed explanation of how to use the evaluation criteria. I also indicated that the evaluators should not feel pressured to distribute the drawings evenly between 1 and 5. For example, if the evaluators did not feel that any of the drawings skills achieved a score as high as a 5 or as low as 1, they should not feel it necessary to distribute the scores across the entire scale. I also pointed out that, while it is possible to have an equal grade distribution, it is also possible that there could be more ‘threes’ than ‘fives’, and so on.

During the first trial, each evaluator assessed one skill at a time, starting with the five-minute drawings. They recorded their scores on a form I provided, passed the drawing to the evaluator on their right, and then evaluated the next drawing. The evaluators assessed the skills in the following order: gestalt, line, space, proportion, perspective, light and shadow, tonal balance, and physical balance.

The results of the first trial indicated that the variation for the 5-minute drawings (+/- .97) and the 30-minute drawings ( +/- .91) met my criterion for reliability, +/- 1 (Table 2). However, the evaluators reported that it was difficult to rate one drawing at a time, without being able to see the skill range of the other drawings, and that their responses would likely be more accurate if they could compare drawings.
They also reported that the skill “physical balance” was impractical to measure. The physical balance skill is predicated on estimating where the figure’s center of gravity is, so the evaluators need to decide on whether or not the figure’s weight-bearing legs were adequately positioned beneath it. However the evaluators struggled to identify the centers of gravity of the figures, particularly in the novice’s drawings. This difficulty was evident in the amount of variation in their physical balance scores. The variation of +/- 1.4 for physical balance was considerably higher than the variation of all the other skills, +/- .91. Therefore, I eliminated the physical balance skill as I did the focal balance skill.

For the second trial I enlisted five more volunteers. In this trial, the method for scoring the drawings was altered in accordance with the results of the first trial. The evaluators divided all of the drawings into five piles, each representing a score of one through five. They evaluated one skill at a time, beginning with the five-minute drawing and followed by the 30-minute drawing, until each skill was evaluated. The results of the second trial indicated improved reliability, with scores of +/- .68 for the 5-minute study and +/- .58 for the 30-minute study (Table 2).

Table 2. The results of the first (left) and second (right) evaluation criteria trials.

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number</strong></td>
<td><strong>5 Min.</strong></td>
</tr>
<tr>
<td>1</td>
<td>.8*</td>
</tr>
<tr>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>3</td>
<td>.7*</td>
</tr>
<tr>
<td>4</td>
<td>1.3</td>
</tr>
<tr>
<td>5</td>
<td>1*</td>
</tr>
<tr>
<td>6</td>
<td>.8*</td>
</tr>
<tr>
<td>7</td>
<td>1*</td>
</tr>
<tr>
<td>8</td>
<td>1.1*</td>
</tr>
<tr>
<td>9</td>
<td>.8*</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>.97</strong></td>
</tr>
</tbody>
</table>
3.3. Collecting data

3.3.1. Materials

The drawing instructions, materials, and subject matter were standardized for all the participants. The drawing conditions were replicated to be as close as possible to what one would expect from UP conditions without compromising the primary goal of maintaining consistency. UP representative artists drew from actual animal subjects, as well as using charcoal and cave walls—none of which can be easily reproduced in laboratory conditions, obviously. Therefore, a number of compromises had to be made, including using photographs of animals for the drawing subject, a graphite pencil instead of charcoal, and paper instead of cave walls. As most of the animal subjects represented in UP art are now extinct, images of modern ungulates were chosen as the drawing subject. Instead of picking a drawing surface that is cave wall reminiscent, I chose paper as a drawing surface for two reasons. Firstly, the texture and density of UP cave walls vary from site to site, so there is no one typical UP drawing surface that I could emulate for the study. Secondly, paper is more conducive to achieving consistency in a laboratory setting. Lastly, charcoal is available today, but it is so soft that it cannot maintain a pointed tip, which is needed to add detail to a small (8" x 10") drawing. While UP artists used charcoal to create detail, their drawings were often much larger. Graphite pencils were chosen to work within the space constraints of a laboratory experiment, as they allowed the artists to get similar detailing at a much smaller size.

To keep the artists’ drawing as consistent as possible, I wanted them to all draw within a specific time frame. Representative art, both prehistoric and historic, appears to have been made in both short and long time durations. Representative drawing is commonly done over a very wide time range - anywhere from 30 seconds up to several months (Kleiner and Myanma 2006). A gestural drawing is a quick (30 seconds to five minutes) drawing that captures the pose and the most diagnostic features of the subject with as few details as possible (Eisner 2008). Figures 17 (A and B), exemplify how a gestural drawing compares to a more refined drawing. To aid
in identification of gestural drawings in the UP, a time limit of five minutes was set for one of the drawings.

**Figure 17.** An illustration of the differences between a gestural drawing and a more developed drawing. (a) A gestural drawing, drawn in two to five minutes. (b) The same drawing after twenty minutes of work (Jen Hagen 2011).

With regard to non-gestural drawings, the greater the detail, the more time the drawing takes. For an average-size drawing, it usually takes ca. 20 minutes to rough out the figures structure (Figure 17)(Doherty 2010). Additional time is usually dedicated to polishing and detailing, which can range from ‘roughly detailed’ (20-40 min) to ‘cleanly detailed’ (one-six hours) to ‘photo realistic’ (days, months). Most of the non-gestural UP representative drawings are detailed enough to be considered realistic, but are still quite rough compared to more modern depictions. Therefore, the second drawing was given a 30-minute time frame.

The next step was to find a subject for the evaluators to draw. Because the participants were going to do two drawings, I chose two animal species that were easily distinguished from each other. Since a familiarity with the animal subject could be advantageous for a representative artist (Edwards 1999), I decided to choose animal subjects that were likely to be equally familiar to all the participants. Eventually I settled on an image of a camel for the five-minute study, and a donkey for
the 30-minute study (Figure 18). The animals were photographed on a sunny day with high contrast light and shadow to limit the confusion as to where the boundaries of light and shadow are. The donkey is in perspective, as it is standing at a three-quarter angle so that the artists can employ their linear perspective skill. The camel was chosen because it is in profile, without perspective, because there are very few UP gestural drawings that are in perspective.

![Camel and Donkey Images]

**Figure 18.** The 5-minute (left) and 30-minute (right) reference subjects.

### 3.3.2. Collecting practice history

Ericsson and Charness (1994) performed several trials on skill acquisition and investigated several methods of recording participants practice history. They found that recording practice history in terms of hours spent in an average working day was the most effective way of recording practice. For this study, I adopted Ericsson and Charness’ (1994) method of evaluating skill based on hours of practice. Each participant was given a practice evaluation form and was instructed to recall their drawing practice in different periods of their life and what an average week of drawing was like for each of those periods. Then, period-by-period, they estimated their weekly hours of practice, determined their annual practice by multiplying their weekly practice by 52, to get their total practice, which is their annual practice multiplied by the duration of the period.

The participants were instructed to regard ‘practice’ as any time spent drawing, whether intentional or not. If a period of no practice exceeded three months, then the
participants were instructed to record it. Shorter periods of time without practice were not recorded.

The volunteer artists filled out all of the time periods, beginning at the age of 12 and ending at the day of the trial. As previously noted in Chapter 1, lateralization is an important developmental period regarding the child’s ability to perceive a subject. It generally occurs between the ages of nine and 12. Therefore, so as not to confuse developmental change with practice-related change, I recorded practice after that age period. Instead, the volunteer artists were instructed to answer the question at the top of the page, “before the age of 12 I drew how much?” by checking one of three boxes, ‘less than average’, ‘average’ and ‘more than average’.

**3.3.3. Data Collection - Trials**

For the data collection portion of the study, the aim was to collect drawings from 30 artists with an approximate practice range of 0 to 40,000 hours. Novice artists were recruited via the SFU Department of Archaeology, as well as at fine arts stores and art galleries. Apprentice artists were recruited via institutions that teach drawing, specifically Vancouver Film School, Emily Carr University, Langara Community College, Simon Fraser University School of Contemporary Arts, University of British Columbia Fine Arts department, and Capilano College Fine Arts Program. Professional artists were sought through numerous illustration and animation studios and advertised in the wanted ads on Craigslist. All volunteer artists were compensated $50 for their time. Novice artists were accepted based on their claims that they had little or no experience. The apprenticing and professional artists applied with a resume and a portfolio. The volunteer artists were contacted through an email address created specifically for the study. The volunteer sample comprised ten novices (0-2 years experience), ten apprentices (2-8 years experience), and ten professionals (9+ years experience).

The drawing sessions took place in a large conference room at SFU’s downtown campus. The conference room had a series of large tables, where ‘artist stations’ were set up. The artists each sat approximately 1 meter apart for privacy.
They were provided with six sheets of paper, a graphite pencil (either HB, B, or 2B), and a kneadable eraser. A kneadable eraser is a soft rubber that lightens graphite when applied to a drawing without erasing it completely. This allows the artist control of the tone and contrast of their line like a regular eraser, while allowing evaluators the ability to identify any erasing. The artists were also given two stickers: a ‘1’ sticker to designate their five-minute drawing and ‘2’ sticker to designate their 30-minute drawing. The initial task for the artists was to fill out the consent form for the ethics board. The artists were then asked to draw from the color copies of photographs of the donkey and camel indicated in Figure 13, but first they were given the following instructions:

1. Please only use the materials provided.
2. The five-minute study is meant to be a quick, gestural drawing that is as descriptive of the figure in the photo as possible.
3. The 30-minute study is meant to be more detailed and descriptive.
4. If anyone feels that his or her drawing is finished before the time is up, you can record the time in the corner of the page and wait until everyone else is finished.
5. This is a study for representative (realistic) drawing only. Any artist that does not try to do the drawing realistically (i.e., abstractly) will have their drawing disqualified.
6. Please try to do the drawings to the best of your ability.
7. When the time is up, please place the ‘1’ sticker on the back of the five-minute drawing, and the ‘2’ sticker on the back of the 30-minute drawing.

After the trial was completed, it was clear that I needed to obtain more artists’ drawings if I was to achieve a desired sample of 30 participants. Firstly, only 23 of the 30 expected participants attended the trial. Secondly, two of the volunteer participants did not follow instructions. The first participant to be rejected was an interior and fashion designer. Design is not usually considered representative drawing because although it is representative-like, it comes from the artist’s imagination, not from perceiving a subject. The participant did have representative drawing experience, but he recorded both his design and representative drawing experience on the practice evaluation form. After the trial commenced, I discovered that the participant was a designer, and I asked him to indicate which of his practice hours were from design,
and which were from representative drawing practice. Unfortunately, he was offended at the suggestion that design is different from representative drawing and refused to clarify his practice evaluation form. Therefore, he was eliminated from the study.

The second participant to be rejected was an artist and a teacher with over 30 years experience, and a portfolio that included many beautifully rendered representative drawings. However, he chose to draw the figures in an unmistakably abstract manner. Since the evaluation criteria were not designed to evaluate abstract drawings this individual’s drawings were also removed from the study.

I had to obtain nine more artists to do the drawings. To recruit these artists I went back to my original list of applicants and enlisted the participants who did not make the cut off for the first trial. These participants’ drawings were collected with the same methods and materials as the initial trial, with the only difference being location, as the drawings were either collocated in an empty classroom at Simon Fraser University or at the public library.

3.4. Evaluating the volunteer artists’ drawings

Five volunteers, all graduate students at SFU, were recruited to evaluate the participant’s drawings. The five-minute drawings were evaluated first, followed by the 30-minute drawings. They evaluated the gestalt first, followed by line quality, space, proportion, perspective, light placement, tonal and balance. The evaluation process ran for 3 to 6 hours per evaluator.

Once the drawings were evaluated, two inter-observer error tests were run to determine the reliability of the evaluator’s scores. The first method of error testing was to measure the maximum and minimum amount of distance from the mean. As Table 3 indicates, the average distance of +/- .99 for the 5-minute drawings, and +/- .53 for the 30-minute drawings was within my parameter of +/- 1 for reliable results. The individual skills also scored within the +/- 1 parameter, with the exception of line quality in the 5-minute study, which scored +/- 1.15.
Table 3. The results of the consistency test for the evaluators’ scores.

<table>
<thead>
<tr>
<th>Skills</th>
<th>5 minute drawings</th>
<th>30 minute drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestalt</td>
<td>.93*</td>
<td>.9*</td>
</tr>
<tr>
<td>Line Quality</td>
<td>1.15</td>
<td>.95*</td>
</tr>
<tr>
<td>Space</td>
<td>.85*</td>
<td>.91*</td>
</tr>
<tr>
<td>Proportion</td>
<td>.95*</td>
<td>.93*</td>
</tr>
<tr>
<td>Perspective</td>
<td>n/a</td>
<td>1.0*</td>
</tr>
<tr>
<td>Light Positioning</td>
<td>n/a</td>
<td>1.0*</td>
</tr>
<tr>
<td>Tonal Balance</td>
<td>n/a</td>
<td>1.0*</td>
</tr>
<tr>
<td>Totaled Skills (not including gestalt)</td>
<td>.99*</td>
<td>.53*</td>
</tr>
</tbody>
</table>

The second measure of error that was applied to the evaluator’s scores was the Cronbach’s alpha test. Cronbach's alpha is a statistic that is commonly used to measure the reliability of data collected from psychological questionnaires (Striener 1996). The range of reliability is expressed on a scale of 0 and 1. The more consistent the responses (the evaluator’s scores’), the higher the reliability score will be. For this test, the lowest acceptable score is > 0.7.

The results of the Cronbach’s alpha test are presented in Table 4. All of the skill scores, with the exception of the space and proportion skills in the five-minute study, have a value greater than 0.7. Since the space and proportion skills are so close to 0.7 (0.63), and since I only intended to use the results of the 30-minute study drawing to address my primary hypothesis, I included their scores in the analysis and made a note of the not significant score.

Table 4. The results of the Cronbach’s alpha reliability test.

<table>
<thead>
<tr>
<th>Skills</th>
<th>5 minute drawings</th>
<th>30 minute drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gestalt</td>
<td>.85*</td>
<td>.84*</td>
</tr>
<tr>
<td>Line</td>
<td>.77*</td>
<td>.84*</td>
</tr>
<tr>
<td>Space</td>
<td>.63</td>
<td>.81*</td>
</tr>
<tr>
<td>Proportion</td>
<td>.63</td>
<td>.84*</td>
</tr>
<tr>
<td>Perspective</td>
<td>n/a</td>
<td>.78*</td>
</tr>
<tr>
<td>Light Positioning</td>
<td>n/a</td>
<td>.86*</td>
</tr>
<tr>
<td>Tonal Balance</td>
<td>n/a</td>
<td>.87*</td>
</tr>
<tr>
<td>Average (not including gestalt)</td>
<td>.84*</td>
<td>.92*</td>
</tr>
</tbody>
</table>
3.5. Statistical Analysis

The primary hypothesis of this study is that skill in representative drawing is predicted through practice. To test this hypothesis I performed a regression in SPSS 21.0. The regression determined what percentage of the dependent variable, the artists' skill scores, is explained by the independent variable, the artists' hours of practice. The data is positively skewed, therefore the participants' hours of practice were logged and I used a quadratic (non-linear) regression. If the results of the regression are significant, a p value of (p= <0.05), then skill is explained by practice and the hypothesis is supported.

Upon the verification of the hypothesis, secondary avenues of inquiry were investigated. First, to get a better sense of the rate of skill acquisition, I conducted a quadratic regression analysis on the unlogged hours of practice. Second, to identify how each of the individual skills relate, I conducted a regression analysis where the participants' individual skill scores are the dependent variable, and their hours of practice are the independent variable. Like the regression of the average score, I performed the analyses with logged hours of practice and a quadratic regression on every skill except perspective and proportion, which were analyzed with linear regressions. To compare each of the rates of acquisition for each of the individual skills,, I plotted the regression lines for the individual skills on a chart with the participant's skill on the Y-axis and their logged hours of practice on the X-axis. Finally, I identified the relationship between drawing skill acquisition in the more gestural 5-minute drawings compared to the 30-minute drawing by performing a quadratic regression analysis on the 5 minute drawings with the logged practice hours on the x axis and the skill scores on the Y axis, and comparing the results to that of the 30-minute drawings.
Chapter 4. Results

In this chapter I review the results of the regression analyses outlined in section 3.5 Statistical Analysis.

4.1. Describing the data

To reiterate, the sample consisted of 30 participants with an accumulated practice history range from 0 – 55,025 hours of practice and an average of 11,629 hours. Each participant did two drawings, one in 5-minutes and the other in 30-minutes, and filled out a practice evaluation form. The drawings were then evaluated for skill by five evaluators. The final score was the average of all five evaluators’ scores.

The participant artists’ average skill score range is 1.3 - 3.8, with an average of 2.2. Figure 19 is a scatterplot of the artists’ hours of practice on the Y-axis, and their average skill score on the X-axis. The distribution of the data points indicates a strong, positively associated relationship. Figure 20 indicates that the differences in realism of the drawings with an average skill score of 1,2,3, and 3.8. The scores of the individual skills resemble their average. Line has a range of 1 - 4 and an average of 2.8, while apace has a range of 1 – 4.2 and an average of 3.1. The relationship skills, perspective and proportion, have a score range of 1.4 – 4.6 and 1.4 – 4.8, and an average of 2.6 and 2.9, respectively. The skills related to shading, light and shadow placement and tonal balance have a range of 1.4 – 4.6 and 1- 4.4, and an average of 3.1 and 2.9, respectively. Lastly, the gestalt skill has a range of scores from 1.2 – 3.6 and an average of 2.7.
Figure 19. A scatterplot indicating the participants’ hours of practice on the Y-axis and average skill score on the X-axis.

Figure 20. An example of the range of skill found in the study drawings; each drawing is associated with its skill score, ranging from 1.0 to 3.8.
4.2. Describing the results

To test whether or not skill in representative drawing is dependent on practice, I referenced the skill scores from the 30-minute drawings, as they represent the most standard length of drawing. The results of the regression indicated the average score of the 30-minute study had an $r^2$ value of 0.679, which is statistically significant ($p = .000$). This result indicates that approximately .68% of the variance in the dependent variable (skill) is explained by the independent variable (practice). Therefore the hypothesis, that drawing skill is related to practice, is supported by the data.

Figure 21 illustrates the results related to the artist’s rate of skill acquisition. The regression line on the chart indicates a rapid acquisition of skills until about 5,000 hours, where the rate of skill acquisition slows down until it tapers off at near 10,000 hours and a skill score of 3.1. From 10,000 hours on the rate of practice increases slowly as the average score goes from 3.1 to 3.5 over the remaining 34,000 hours of practice. Therefore, the regression analysis indicates that artists see a rapid rate of skill acquisition until they reach approximately 10,000 hours of practice, where their rate of acquisition decreases considerably.

![Figure 21](image)

Figure 21. A 30-minute drawing scatterplot with drawing skills on the X-axis, the hours of practice on the Y-axis, and the quadratic regression line.

Table 5 indicates the results of the regression analysis of the individual skills. All of the skills (except perspective) have significant relationships with hours of
practice and $r^2$ values that range between 0.62 and 0.76. Line quality and space are significant with high $r^2$ values of .707 ($p = .000$) and .737 ($p = .000$), respectively. Of the ‘relationship’ skills, perspective was not significant with an $r^2$ value of 0.117 ($p < .065$), while the proportion skill was significant ($p = .024$), but with a low $r^2$ value of .169. The skills related to shading, light and shadow placement and tonal balance were significant with high $r^2$ values of .624 ($p = .000$) and .702 ($p = .000$), respectively, while the gestalt skill was also significant with a high $r^2$ value of .765 ($p = .000$).

Table 5. The results of the regression analysis for the 30-minute drawings.

<table>
<thead>
<tr>
<th>All Drawing Skills</th>
<th>30 minute drawings</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$r^2$</td>
<td>Constant</td>
<td>b 1</td>
</tr>
<tr>
<td>Gestalt</td>
<td>.765</td>
<td>-3.201</td>
<td>4.569</td>
</tr>
<tr>
<td>Line</td>
<td>.707</td>
<td>-2.101</td>
<td>3.829</td>
</tr>
<tr>
<td>Space</td>
<td>.737</td>
<td>-2.695</td>
<td>3.559</td>
</tr>
<tr>
<td>Proportion</td>
<td>.169</td>
<td>2.088</td>
<td>.499</td>
</tr>
<tr>
<td>Perspective</td>
<td>.117</td>
<td>2.344</td>
<td>.453</td>
</tr>
<tr>
<td>L. Positioning</td>
<td>.624</td>
<td>-1.705</td>
<td>2.989</td>
</tr>
<tr>
<td>Tonal Balance</td>
<td>.702</td>
<td>-1.416</td>
<td>3.231</td>
</tr>
<tr>
<td>Average</td>
<td>.679</td>
<td>-3.614</td>
<td>4.451</td>
</tr>
</tbody>
</table>

Figure 22 is a compilation of the quadratic regression lines for all of the skills and the average. It indicates that all of the skills, with the exception of perspective and proportion, have a very similar rate of acquisition that is very close the skills’ average rate of acquisition. Although proportion was significant and perspective was not, the two skills have a similar relationship that is less correlated with practice.
Figure 22. The regression lines of the individual drawing skills and the average from the 30-minute analysis. The logged hours of practice is on the X-axis and the skill scores are on the Y-axis.

Lastly, the purpose of doing a 5-minute study was to see if skill can be recognized in quicker drawings, as it is recognized in the 30 minute drawings. As Table 6 indicates, with an $r^2$ of .474 ($p = .000$), the acquisition of skill in the 5-minute drawings is also dependent on practice. The relationship between skill and practice in the 5-minute study (0.474) is weaker than in the 30-minute study (.679), but the values are close. This suggests that while slightly less dependable than more detailed drawings, quicker and more gestural drawings can be evaluated for skill. In addition, all of the individual skills for the 5-minute drawing are also significant. The $r^2$ value for the all of the individual skills (0.288 to 0.599) are also lower than the 30-minute drawing skills, but with the exception of proportion, which has an $r^2$ value of .27 ($p < .001$), they are still significant.
Table 6. The results of the regression analyses for the 30 and 5-minute drawings.

<table>
<thead>
<tr>
<th>Drawing Skills</th>
<th>5-minute drawings</th>
<th>30-minute drawings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r²</td>
<td>p-value</td>
</tr>
<tr>
<td>Gestalt</td>
<td>.599</td>
<td>.000*</td>
</tr>
<tr>
<td>Line</td>
<td>.372</td>
<td>.002*</td>
</tr>
<tr>
<td>Space</td>
<td>.505</td>
<td>.000*</td>
</tr>
<tr>
<td>Proportion</td>
<td>.288</td>
<td>.010</td>
</tr>
<tr>
<td>Perspective</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Light Positioning</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Tonal Balance</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Average</td>
<td>.474</td>
<td>.000*</td>
</tr>
</tbody>
</table>

4.3. Summary

The results of the statistical analysis indicate that the acquisition of drawing skill is dependent on practice. Artists experience a steady and a rapid rate of skill acquisition until approximately 10,000 hours, and a skill score of 3.1, after which the rate of acquisition slows down considerably. The individual skills have a similar rate of acquisition to the average, except for perspective and proportion, which have slopes that are less steep. Lastly, the results also indicate that the 5-minute and the 30-minute drawings can be evaluated for skill, and that skill in both drawing types are acquired at similar rates. With a functioning evaluation criteria and statistical results that suggest that representative drawing is a skill, I have met the objective of the study.
Chapter 5. Discussion

This chapter reviews the results of the present study and discusses their applications to archaeology.

5.1. Summary of results

This study was carried out in five steps. The first was to create a set of criteria for the evaluation of skill in representative drawing. I identified the individual skills involved in representative drawing and established their novice and practiced characteristics. I used these skills as the foundation of a rating system, where the drawings were scored from 1-5 based on whether or not the skills had novice (1) or skilled (5) characteristics.

The evaluation criteria were tested to be sure that they could be used to produce consistent evaluations from multiple evaluators. After two trials, the evaluation criteria were deemed operable, as the trial evaluators’ scores proved to be reliable, with low internal variation.

Thirty participants, with varying degrees of practice ranging from 0 – 55,000 hours, drew two drawings in a 5 and 30-minute time frame each. The drawings were each drawn from different photographs of animals, and all artists used the same drawing materials. After completion of the drawings, the artists filled out a practice evaluation form to record their practice history in hours.

Five evaluators independently evaluated all 60 drawings. Error tests were performed to ensure results were consistent. Separate regressions with the skill scores as the dependent variable and practice as the independent variable, were
performed on the average of all the skills together, and on each of the individual skill scores.

The results indicate that the average score and all of the skill scores, with the exception of perspective, had a significant relationship with total hours of practice. The rate of learning, which was based on the slopes of the regression analysis of the skills’ average, indicated a steep learning curve that reached a peak at about 10,000 hours. This study also indicated that skill can be evaluated in both the 5 and 30-minute drawings.

5.1.1. Shortcomings of the study

This is a preliminary study that was designed to identify a general association between drawing skill and number of hours of practice. In retrospect, there are some areas that I would change and some areas that can be improved. Below I outlined the improvements that can be made.

It would be beneficial to increase the sample size of participants in order to fill in the gaps of practice time that are only represented by few, if any artists. As Figure 23 indicates, there are gaps in the sample at the 100-500 hour and 5,000 – 10,000 hour range. Filling these gaps would give a better understanding of the how the relationship between skill and practice, thereby improving the ability to predict the number of practice hours based on evaluated skill level.
Figure 23. A boxplot indicating the artists’ hours of practice (X axis) based on their skill score (Y axis).

It would also be beneficial to get some drawings that score above the study’s highest scoring drawing, which was 3.8. I do not expect anyone to achieve a perfect score of five. Firstly, no one can draw perfect realism in only 30 minutes. Secondly, the artist's final score is an average of all the evaluator’s scores, and it is improbable that all of the participants will score the drawings exactly the same. However, I think the sample drawings appear less skilled than they could potentially be, and capturing a skill level greater than 3.8 is still possible. Samples of higher scoring drawings will potentially improve the range of skill and allow me to better understand the attributes of master level drawing.

First it is necessary to review all of the possible reasons for a lack of scores above 3.8. The most obvious reason is that I simply did not have many expert and master level artists enrolled in the study. It proved difficult to contact very successful artists, gain their interest in the study and arrange for them to participate. Hopefully, publication of this study will help garner the interest of expert artists in the future. An additional reason can be found in the practice history evaluation forms, which indicate that most of the practiced artists who participated in the study were out of practice during the time of trials. Being out of practice does not change the artist’s ability to
perceive a subject, but it does affect their confidence and their ability to process the task as quickly as would be expected (Fayena-Tawil 2011). A lack of recent practice is not hugely detrimental to an experienced artist, as none of them have skill scores below 3, but it could be why they did not score above 3.8. To address this issue, future researchers should ensure the expert artists are practicing at the time of trials.

Future researchers should also make sure that the subject matter provided for reference is appealing. Inspiration, or a lack thereof, may have also played a part the lack of high scoring drawings. Inspiration in drawing often comes from seeing something, anything - a landscape, a playing child, a bouquet of flowers, that is so appealing it prompts the artist to want to record it (Gardener 1993). It is the driver behind most artists’ works (Edwards 1999). Arguably, there has never been a popular representative drawing that was created without inspiration (ibid). However, in the process of choosing a subject from an array of photographs of animals, I failed to consider that the appeal of the photo and the subject might affect the artist’s drawing, and did not choose an especially appealing subject. Thus, the overall composition of the photo for the 30 minute drawing is unbalanced, the angle is difficult, the figure lacks movement, and the subtle personality and character traits of a subject that expert artists are known to pick up on are not apparent.

A further limitation of the study is the performance anxiety that the artist likely experienced from having to draw in front of other people. At the end of the trial a few of the participants indicated to me that they thought nerves affected their performance. Their anxiety could be eased if they could draw unsupervised and in a more comfortable environment.

Future studies in skill and representative drawing will also benefit from including the participant’s childhood practice hours. Figure 24 illustrates the distribution of answers to the question “did you have less than average, average, or more than average amounts of childhood practice?” It indicates that most of the artists with a score of 3 or higher had more than average childhood practice. Therefore, if childhood practice hours were factored in most of the high-scoring artists would have a considerable increase in hours. This increase in hours will likely increase the
accuracy of attributing a practice range to a skill score. For example, Figure 24 also indicates there are a couple of artists with low practice (<5,000 hours) who scored a 3, rather than a 1 or 2 like other low-practice artists. As both of these artists indicated they had a considerable amount of childhood practice, it is likely they will have more than 5,000 hours of practice in total if their childhood hours are included. In that event, artists with a score of 3 will have a more accurate estimation of their minimum required hours of practice.

Figure 24. A scatter plot indicating the distribution of the participant’s responses to the question: before the age of 12 did you draw less than average, average, or more than average? The data points circled are participants with more than average childhood practice.

Previous studies on skill acquisition indicate that quality of practice also has an impact on the amount of time it takes to acquire a skill (Ericsson 2006). The quality of practice refers to the level of the participant’s concentration during practice sessions. Expert level participants with a notable decrease in quality in their practice history have been shown to take up to 2,000 hours longer than the average 10,000 hours that is required to become an expert (Ericsson 2006). Conversely, participants with an exceptionally high quality of practice, usually people who started learning after reaching adulthood, can take up to 2,000 hours less practice time to become an expert (ibid). There are two types of participants with whom the quality of practice is
generally an issue, young participants and participants who were raised in non-Western cultures. Those who begin their training at a young age are generally less focused than an adult and the quality of their practice is comparatively less. Similarly, skill acquisition on a global scale is generally the same, with the exception of variation regarding the cultural acceptance of a skill. If a culture does not support a particular specialization, economically or otherwise, the quality of practice is reduced (Ericsson 2006). Therefore, an inclusion of a system to monitor the participant’s quality of practice is expected to increase the accuracy of the participants practice estimations.

Lastly, future research into skill and representative drawing will benefit from a multicultural analysis for two reasons. First, studies on expertise indicate that the degree to which a culture supports and encourages a skill domain is known to affect the rate of skill acquisition (Hunt 2006). Second, a multicultural analysis could also uncover other cultural differences in the acquisition of representative drawing that are currently unrecorded. Therefore the degree to which multicultural support affects skill acquisition in representative drawing should be tested for.

5.2. Archaeological implications

5.2.1. Applying the evaluation criteria to UP art

In this subsection I present a trial analysis of two UP representative drawings. The purpose of the analysis is to illustrate how the evaluation criteria can be used to evaluate UP drawings. It is important to remember that the trial analyses presented here are only estimations. The exact methods for evaluating skill in UP art are not yet refined, and proper evaluations would require several evaluators while the trial analyses presented here is done by one evaluator (myself).

5.2.1.1 Identifying and replicating the UP reference subject

Representative art is art that attempts to be true to life (Barber 2005). To draw something life like, artists must have something from life to draw, such as humans, animals, landscapes, etc. What the artists choose to draw—the reference subject—is essential to the skill evaluation process. In the study reported here, the evaluators
checked for accuracy by comparing the artist’s drawing to the reference subject (the photos of the camel and donkey). Since I do not have the UP artists’ reference for comparison, one important step in the adaptation of the evaluation criteria is identifying an appropriate reference.

It is assumed by some archaeologists that UP cave drawings were done from memory, as the artist would likely be unable to see animals from inside the cave (Bahn 1998; Clottes 2003). However, I argue that if it was possible for UP artists to bring in some type of pre-drawn reference, then they probably did. Research on drawing from memory indicates that it requires an excessive amount of practice (Edwards 1999). In representative drawing, artists need to refer to the subject regularly. In order to reproduce a representative drawing from memory, the artist must first memorize the exact position of every feature and detail on the figure. For example, if one is going to recreate the figure’s eye, one would need to memorize the exact distance from the corners of the eye to the ends of the brow, the size of the iris as it relates to the whites of the eye, the size of the whites of the eye as they relate to the shape of the lid, the exact location of where the lid breaks and bends over the cornea, and so on, with every single detail of the subject (ibid). If a detail is off by even a small amount, the drawing will appear unrealistic. Edwards (1999) argues that drawing from memory requires such a substantial amount of practice that it could be considered an additional drawing skill. Unless there was some reason that UP artists’ could not carry a piece of bark or a stone plaquette with a reference drawing on it into the cave, I think it is unlikely that an artist would not utilize some type of reference. Since there is no way to know either way, and it is impossible to control for this factor, the analysis will be undertaken with the assumption that drawing from memory will not impact the results.

The majority of the animals depicted in UP art are now extinct. Therefore, palaeontological replicas based on the remains of Pleistocene species were used as the reference subject matter. There is generally enough detail in most UP art for us to be able to infer the extant relatives of the depicted animals. There are many animal species represented in UP art, and palaeontologists have been able to create three-dimensional reproductions of most of them based on fossil evidence. As Figure 25
indicates, the reproductions are made with careful consideration to the physiological aspects of the figure. With the exception of the lips and ears, most aspects of the reproduction are representative of the animal and can be used for comparison. The lips and ears cannot be inferred from the bone and muscle tissue directly, so palaeontologists base the reproduced morphology on that of their extant relatives (Smith and Turner 2005). Therefore, the lips and ears should not be factored into analysis. Finally, the reproduction can be scanned with a 3D scanner so that it can be posed and manipulated digitally or used as reference.

![Figure 25. An illustration of the reconstruction of a Smilodon, in four steps. The first step is to prepare an identical replica of a complete skull. The second is to apply the masticatory muscles. The third step is to attach the facial muscles and the facial features. The morphology of the ear, mouth opening and nose are inferred from a related species. In the fourth step the skin and fur applied. The length and colour of the fur are also inferred from a related species (Turner 1997).](image)

The reconstruction was based on the fossil evidence of one individual, but there is morphological variation within every species. It is possible that although the species is the same, the exact animal that was depicted looked slightly different from the reproduction. To address this, I outlined the degree of morphological variation that is expected, based on the morphological variation of their extant relatives.
Another aspect of recreating the reference subject was determining how to pose the replica. I could not simply pose the reconstructed figure in the same manner the drawing indicates because I cannot assume that the artists drew the pose accurately to begin with. However, by posing the replica the same as the drawing, I could determine if the drawing’s pose is plausible or not. For example, if the figure is not drawn realistically it will not be anatomically possible to pose the replica model in the same way as it is in the drawing. If the drawing is accurate, it should be easy to pose the replica in the same manner. This does not guarantee that the artist accurately depicted the subject’s pose, but it gave me a close approximation of the artist’s ability to draw realistically.

Many poses seen in UP depictions are easy to replicate, such as an ungulate grazing with its head down (Bahn 1997). Since there are only so many types of poses that can result from grazing, the true pose is easier to replicate with greater confidence. Similarly, UP representative drawings commonly feature only a portion of the body, such as the lion’s head in figure 23, which limits the potential poses of the subject.

Animals that were drawn in an active pose were presumably alive when they were drawn, but other drawings that either appear lifeless or are only parts of the figure could have been drawn from a dead figure. After all, studying a dead animal is a good way to gain knowledge of the animal’s anatomy – particularly if the animal is a predator. One way to determine if the subject was alive when drawn is by the presence of redrawing. Redrawing refers to overlapping contour lines that usually appear on the parts of the figure that are the most likely to move, such as arms, legs, and head (Figure 26 a and b) (Edwards 1975). Animals drawn in any kind of standing position have a tendency to move while the artist is drawing and that movement can be recorded. If the animal moves, the artist can draw the new position, and if the animal moves again, the artist draws it again, and so forth. Therefore, UP drawings that exhibit redrawing characteristics were likely drawn from live subjects. As to the drawings that do not exhibit redrawing, there is no way to know if their subject was alive or dead. The differences in drawing live or dead animals could be established in
an experimental analysis and applied to the evaluations of UP art where the mortality of the subject is indicated.

![Figure 26. (a) A representative drawing exhibiting re-drawing, by Rodin c. 1891. (b) An engraving on a plaquette from the UP that appears to have re-drawing in the figures front limb (Tosello 2003).]

5.2.1.2 Non-reference related differences in UP drawing

Modern and UP representative art differ in aspects beyond the reference matter. These differences are in the size of the drawings, the artist’s materials, and the artist’s drawing environment. Many cave drawings are much larger than the drawings used in the present study. For example, the cave lion drawings from Chauvet in Figure 23 are approximately two square meters in size. The production of drawings this large is similar to making murals today, except today, artists usually use an overhead projector to shine an image over a large surface so that it can be traced (Grund 2003). Without a projector, mural painting is more labour-intensive because it is difficult for the artist to see the area they are working on as it relates to the image as a whole. As a result, the artist constantly needs to leave their work to stand back and look at the image. The process is more time consuming and there is increased difficulty in achieving realism and fluidity (ibid). It is possible that the size of a drawing can affect the way that the drawing skills appear. For example, it is easy to anticipate potential difficulty in the execution of some skills, such as line quality and proportion, when artists are drawing at such a large scale. On a small drawing, one stroke has to
define a large aspect of the figure, but on a large drawing the contour is defined with thick lines that would require numerous stokes to make. Similarity, the artist’s inability to see the entire figure from their workspace would make proportion, the measurement of size relationships, difficult to analyze. Therefore, the variations in skill in large-scale drawings should be established and considered before the evaluation of large-scale UP drawings.

In regard to differences in media, UP artists drew via engraving, painting, or drawing on cave walls, while my volunteer artists drew with a graphite pencil and paper. These media types have qualities that are known to affect the appearance of drawings, so I expect them to have an effect on UP drawing as well. Also, experimental analyses suggest that UP artists may have had more difficulties than a modern artist (Bahn 1998; Lorblanchet 1993). For example, Bahn (1998) suggests that UP charcoal likely produced 10 cm of line for every 1 cm of charcoal. Charcoal varies in hardness, but even the hardest form of charcoal is quite soft, and soft charcoal on a rough cave wall would not last long. It would take a large amount of charcoal to produce a large panel of drawings, such as the drawings in Figure 23. The charcoal was likely prepared by an assistant or manufactured in advance, as it is unlikely the artist would stop drawing to produce more charcoal when needed. Drawing fine lines and details with charcoal can also be difficult, particularly when it comes to details (Lorblanchet 1991). Therefore, differences in the way the individual drawing skills appear when drawn with different media types should be analyzed.

Many cave sites, including Chauvet, are devoid of light in the interior. However, it appears that UP artists were able to light the cave’s interior sufficiently for an artist to draw with ease. Material remains from these sites suggest that the artist worked by the light of torches and small handheld lamps (Bahn 1997). Torches would have illuminated the general interior of the cave and handheld lamps the area of the wall being worked. With these techniques, the UP lighting conditions should have been sufficient for the artist to see clearly.
5.2.2. Evaluating UP drawings skill by skill

All skills, with the exception of line quality and the gestalt, are evaluated based on the artist’s ability to draw with accuracy. In this study, the degree of accuracy was determined by comparing the participant’s drawings to their reference subject, the camel and donkey photos. Since I do not have the actual subject that UP artist drew from, all limitations discussed below are related to the creation of a replica subject.

5.2.2.1. Line

Skill in line quality is measured by the appearance of confidence in an artist’s stroke (Edwards 1999). The study drawings indicate that a novice artist’s line is hesitant, uneven, scratchy, and redundant. Conversely, an experienced artist’s line is confident and stroke-like, with a diagnostic thick and thin quality. It is executed quickly, but accurately, as fewer lines are needed to describe the figure (ibid).

The first and most important step in evaluating line quality is to isolate the individual lines for analysis. Based on photos of UP representative art, only some lines are identifiable while others are smudged or heavily overlapped, making them difficult to isolate and analyze. A potential solution to this problem may lie with the 3D recording technique developed by Fritz and Tosello (2007). Their methods involved scanning UP drawings from Chauvet cave with a 3D high-resolution laser scanner. The scanned image was then mapped onto a 3D model of the surface of the cave walls to view the art digitally as it appears in situ (Fritz and Tosello 2007). Gilles and Tosello (2007) found the 3D images to be clear enough that they were able to isolate each of the individual lines and identify the order in which they were drawn. Therefore, Fritz and Tosello’s (2007) recording technique could be used on the UP drawing that will be evaluated for skill. While I cannot use their technique for the trial evaluations, it could be used to isolate and analyze overlapping lines in future skill evaluations.

In the UP, drawing was largely done by etching, painting, and/or drawing with pigment pieces or ‘crayons’ (Bahn 1998). Thus far, there are no studies regarding the appearance of skill in line using different types of UP media. However, there are several experimental studies investigating the use of various UP materials that suggest the differences in media type affect the appearance of skill in line quality. For
example, pigment ‘crayons’ are made of soft materials, such as charcoal, which do not last long on rough cave walls. An artist could only draw ~35 cm of line before needing a new piece and starting a new line (ibid). This starting and stopping could make an expert’s lines appear more redundant or hesitant than they do in the current study. Similarly, harder materials, such as engraving tools, and ochre, dig into the surface of the walls (Aujoulat 2005). This digging creates resistance, which also impacts the appearance of the line’s stroke and control.

The size of UP drawings could also potentially affect the appearance of skill in line quality. The evaluation criterion states that experienced artists use fewer lines to describe the figure, and a thick and thin quality that accentuates the figures’ weight. The larger the image is, the more lines are required to draw the figure. In a small drawing, similar to the study drawings, an experienced artist can describe the belly of the donkey with only one or two lines, but it would take more lines to describe a belly of a figure that is six feet long. These additional lines could make the artist’s line quality appear more redundant and less accurate than it would if the figure were drawn smaller. Similarly, the contour lines of a largely drawn figure need to be thicker and darker so that they can be seen by observers standing back to look at the image as a whole. Thicker lines require more strokes, which will increase the difficulty of identifying individual lines and their thick and thin characteristics.

5.2.2.2. Perspective

The vast majority of UP figures are drawn in profile. In these cases perspective is not a concern. The UP drawings with perspective can be evaluated by drawing a line through the figures’ most diagnostic features, such as the eyes, ankles, and knees. If the lines are consistent and parallel with the same diminishing point, the artist’s perspective is accurate. Drawings with incorrect perspective will exhibit the opposite, nonparallel lines at different angles.

5.2.2.3. Proportion

Proportion refers to the size relationships of the figures’ features as they appear in relation to each other. In the evaluation criterion, proportion is measured by comparing the size of the figure’s head to its body in the reference photo. However,
since many of the animals represented in the UP drawings are now extinct, I relied on fossil recreations to better understand their real life proportions. To get the best estimation of skill, I identified the range of morphological variation that naturally occurs in the extant species of the depicted animals. Then, I compared the proportions of the drawn figure to that of the reproduction, while considering the degree of variation inferred from extant species.

5.2.2.4. Space

Negative space is the space that surrounds a figure. In the experimental study, it was measured by comparing the accuracy of the negative space in the participants’ drawing to the negative space in the photo. However, since the exact pose of the UP subject is unknown, the subject’s negative space is also unknown. Therefore, in the same manner outlined in the previous section, the pose of the figure in the drawing will be recreated with the replica of the UP animal. The negative space of the posed reproduction can be compared to the negative space in the UP drawing. The only potential problem in evaluating negative space is re-drawing (overlapping lines caused by drawing a moving figure). If there are many lines to indicate an aspect of the figure, such as a leg, it could be difficult to distinguish which part of the drawing is supposed to be the figure and which is the negative space.

5.2.2.5. Light Positioning

Light positioning refers to the placement of shadows and highlights on a figure to give it dimension. Experienced artists place lights and shadows in anatomically appropriate places and with identifiable directionality. A novice artist either randomly shades, shades around the contours of the figure, or does not shade at all. In the experimental study, the evaluators compared the positioning of the highlights and shadows in the drawings to their corresponding positions in the photo.

Unfortunately, of all the skills that require a reference subject, the light and shadow skill suffers the most in its absence. This is largely due to the fact that the evaluation criteria were only designed to evaluate directional light, which does not include firelight. I could not anticipate the exact nature of the light source in a UP drawing, but it was safe to assume that it was either the sun or fire. Unlike firelight,
sunlight is directional and easier to identify and replicate. When the sun is rising and setting, its light hits a figure at an angle that can be easily predicted based on the movement of the sun. Although I could not assume that the light direction in a UP drawing is an accurate representation of where the sun actually was, I could check to see if the lights and shadows fall directionally, and within the range of all the possible angles of the sun. I could also use the reproductions from the space and proportion skills, to see if the highlights and shadows are drawn in anatomically correct areas.

Issues with the evaluation of lights and shadows in UP art began when firelight was taken into consideration. Unlike sunlight, firelight is non-directional. The light from fire highlights the surfaces of the subject that are closest to the light, while the shadows fall around the periphery of the form. When artists draw light and shadow based on firelight, the shadows on the drawing fall around the perimeter of the figure, which results in a shading that looks just like the kind of contour shading that is typical of novice behaviour with directional light. Therefore, an expert’s expression of light and shadow by firelight could easily be confused with a novice’s contour shading with directional light. However, since this study established that the drawings skills are all acquired at a very similar rate, I assumed that UP artists also acquired their drawing skills at a similar rate. If a drawing that exhibits contour shading also has high scores in all of the other skills, it could indicate that the artist was an expert who was by drawing by firelight, rather than a novice who was drawing by directional light.

5.2.2.6. Tonal Balance

Tonal balance refers to the distribution of tones in a drawing (Edwards 1999). In the experimental study, the artists’ range of tones was compared to the value strip (Figure 30a). An experienced artist will utilize all tones to create contrast that has a balanced distribution throughout the drawing. Novice’s drawings usually have tones that are overly ‘muddy’ and lacking in contrast, as they only utilize the tones from a part of the value strip. The evaluators in the experimental study had a black and white photo of the subject for reference. However, tonal balance can be evaluated based on the distribution of tones as they relate to the tonal strip alone.
5.2.3.7. The gestalt

The gestalt refers to all of the skills and how they work together to make an image appealing. Under the domain of modern representative art, the compositional aspects of design, such as balance, symmetry, focus, and movement, are terms that are used to characterize appeal. However, it has been demonstrated that humans have evolved an innate sense of symmetry, which is tied to a human’s sense of appeal (Jacobsen et. al. 2006; Kozbelt 2010). Any person can recognize when the symmetry, and therefore the appeal of a drawing is not accurate. Therefore, when evaluating the gestalt, the evaluators based their evaluations on the drawings they found most and least appealing.

When evaluating the gestalt in UP art, it could be argued that modern evaluators could be biased in their definition of expert skill, as modern people are influenced by thousands of years of masterful representative art – a standard which did not exist in the UP. Perfect realism in representative art was arguably not achieved until ancient Greece (Kleiner and Myanma 2006). However, it is important that the UP gestalt is evaluated with the same expectations as the gestalt was during trials. If the UP artist’s drawing are not evaluated with the same scrutiny that the study’s drawing were then the UP artists’ hours of practice cannot be accurately inferred.

5.2.3. A trial analysis of two UP drawings

I did two trial analyses, one of the lion drawing from Chauvet (Figure 26), and one of an unidentified animal from Lascaux (Figure 33) to illustrate how the skills can be used to evaluate UP drawings. It is important to note that these analyses are only a rough estimation, as the experimental studies and proper replicas are not yet available for comparison.

5.2.3.1. Trial analysis 1 – A Cave Lion Drawing from Chauvet cave, France

The first drawing I will analyze is from Chauvet cave in the south of France. I considered a couple of factors in choosing this drawing. I wanted a drawing that was detailed and appeared to be realistic. Second, I wanted an image from Chauvet, as it
is the earliest representative drawing site in the UP. Therefore, I chose a cave lion drawing from a panel at Chauvet (Figure 27).

Figure 27. A cave lion drawing from ‘The Panel of the Lions’ at Chauvet Cave (Chauvet 199).

5.2.3.1.1. Line

The lion in Figure 27 was drawn with black charcoal and highlighted with white calcite (Clottes 2003). Since I am not looking at a high-resolution image, I cannot identify many of the individual lines. The lines around the head of the lion are partly smudged due to shading and are partly covered by the white highlights, so I will focus on the visibly isolated lines around the mouth, ears and the top shoulder region. These lines suggest that the artist was not a novice, as there is no evidence of wobbly, redundant and/or scratchy lines. Instead, the lines appear to be confident, directional, and precise. The thick and thin aspects of an expert line are too difficult to discern. However, the figure is accentuated with thicker lines on the underside of the neck and face - a typical expert technique to give a figure the illusion of volume and weight (Eisner 2009). Based on the results of the experimental study, I think the line quality of this drawing should be rated between 3 and 4.
5.2.3.1.2. Space, Proportion, Perspective

Unlike line and the gestalt, space, proportion and perspective are the skills that rely the most on the creation of a species reproduction. However, the lion figure in Figure 27 is in profile, so the perspective skill was eliminated. I did not have an actual three-dimensional species replica available for the trial analysis. Therefore, the following section will explain how I evaluated perspective and proportion with a temporary species reproduction.

The lion species depicted in the Chauvet drawing is thought to be *Panthera leo spelaea*, also known as the cave lion (Turner 1997). Palaeontologists think that the UP depictions are of cave lions, because the only other cat species present in Europe at the time, the Sabretoothed cat (*Homotherium latidens*), is morphologically different (Smith and Turner 2005, Turner 1997). For this trial evaluation I do not have a replicate model of the cave lion for reference, so I will use a reproduction drawing (Figure 28a). The cave lion in the reference drawing is depicted open mouthed and the cave lions in the UP drawings are posed closed mouthed, so I provided a closed mouthed drawing of another UP African lion species that is nearly morphologically identical to the cave lion for reference (Figure 28b) (Turner 1997).

![A. B.](image)

**Figure 28.** Replica drawings of two similar prehistoric cats, (a) *Panthera leo spelaea* and (b) *Panthera leo atrox* (Turner 1997).

To estimate morphological variation in the cave lion I will refer to the morphological variation of the modern lion, *Panthera leo*, the cave lion’s extant relative. Apart from size, the morphological variation of the modern subspecies of
Panthera Leo is minimal and largely includes superficial differences, such as fur and mane color and length. The morphology of the cave lion fits within the morphological variation of the modern lion sub species. In regard to size, the cave lion was considerably larger than the largest modern lion - approximately one third larger, however size has little to do with the bones morphology (Anton et. al. 2009). Therefore, when estimating the morphological variation of the cave lion, it can be reasoned that the cave lion’s degree of variation is not likely to exceed that of modern lions (Anton et. al. 2009). In the end, the main morphological variation of modern lions is in the width of the muzzle and nasal bones, and slightly shortened or elongated faces (Sotnikova and Nikolskiy 2006). Potential variation in the muzzle and face were taken into consideration in the evaluation of the UP cave lion.

Sexual dimorphism also influences the morphology of lions (Turner 1997). In modern lions, the most notable differences between the sexes is the size of the canines, the presence or absence of a mane, and overall body size, as males are approximately one third larger than females. The sexual dimorphism of cave lions is thought to be similar to modern lions, but there is debate as to whether cave lions had manes, as UP art does not depict any individuals with manes (Yamaguchi et. al. 2004). However, the cave lion in the replica is thought to be female based on the size of the canines (Turner 1997). The lion in Figure 26 is also thought be female because of the lack of a mane and because there is a larger lion that appears to be male sitting beside her (Yamaguchi et al. 2004).

5.2.3.1.2. Proportion

A comparison illustrated in Figure 29 indicates that the overall appearance of the UP cave lion’s proportions is quite similar to that of the reconstruction. The eyes, ears, nose, mouth and the shape of the skull are all fairly accurate, but the area under the mandible and neck may be too thick. The angle of the nose projects too far past the jaw, whereas the nose in the reference is squared off at the jaw. The shape of the lips and the tuft of fur at the chin also vary, but they are not included in my analysis as they are superficial, soft tissue areas. The most significant difference is in the UP artist’s depiction of the ear. The reference drawings and all modern lions have large ears that are thick with fur, while the ears in all of the Chauvet lions are small and
jaguar-like. This variation could be an example of a difference between modern and extinct lions, so I omitted it from this evaluation, and gave proportion a score of 3.

Figure 29. (a) A cave lion drawing from ‘the panel of the lions’ at Chauvet cave (Chauvet et al. 1996). (b) A replica drawing of Panthera leo atrox (Tunrer 1997).

5.2.3.1.3. Space

The lion’s head depicted in the UP drawing has a distinct positive and negative space, but as only the head is represented, there is not much negative space to measure. The most significant anatomical landmarks are the dip in the skull for the eye sockets, nose, jaw and the dip in the neck. Again, the ears, lips and chin area will not be considered. When I compared the distribution of the landmark features in the drawing’s silhouette against the silhouette of the model (Figure 30), it is clear that more than half of these areas line up, so I scored the space skill as a 3.

Figure 30. (a) A cave lion drawing from ‘the panel of the lions’ at Chauvet cave (Chauvet et al. 1996). (b) A silhouette of Panthera atrox’s head (not including fur and ears).
5.2.3.1.4. Light and shadow placement and Tonal Balance

The UP drawing of the cave lion has shading around the contour lines, which could indicate drawing by firelight, so I will not evaluate this drawing with the light and shadow skill.

To evaluate tone, I compared the grey scale UP drawing to the tonal strip, Figure 31(a). The drawing is in black and white and the cave wall is brown, so I am evaluating a black and white image, and the grey tone from the brown wall is included in my analysis. As can be seen, the addition of the white calcite balances the drawing’s tones, and although there are missing tones, there is wide spectrum of tone available. I scored tonal balance as a 4.

Figure 31. (a) The value strip. (b) A cave lion drawing from ‘the panel of the lions’ at Chauvet (Chauvet et al. 1996).

5.2.3.1.5. Gestalt

The gestalt skill refers to the appeal of the drawing as a whole. The drawing I am evaluating is part of a larger composition of lions (Figure 32b), so I will evaluate the drawing as it appears with its neighbouring drawings - not as it appears on its own. I will also compare the lion drawings to gestalt drawings from the study that scored a one through four (Figure 33). Based on these comparisons I rate the gestalt of Figure 32b as a 3.
5.2.3.2. Trial analysis 2 – An ungulate figure from Lascaux, France

The second drawing to be analyzed is much simpler than the drawing discussed in Section 5.2.3.1. (Figure 34). This drawing was chosen in order to reflect the range of skill that appears in UP art, and to highlight the differences between the evaluation of quickly drawn drawings and more developed drawings. The results of
the present study indicated that there is a difference in rating skills between 5 and 30-minute drawings, as the general lack of accuracy in five-minute drawings affects the appearance and use of individual skills. Therefore, for the evaluation this drawing, I referred to the study’s five-minute drawings, rather than the study’s 30-minute drawings.

Figure 34. A photograph of drawing depicting an unknown animal found near the entrance of Lascaux cave (Aujoulat 2005).

I eliminated the light and shadow, tonal balance and perspective skills as I did in the 5-minute study (see Chapter 3). The light and shadow positioning and the tonal balance skills evaluate the shading of a drawing, but the drawing in figure 34 does not appear to be shaded. Please note that the greyish areas on the front of the body are due to rock discoloration, not shading. The figure’s hind limbs are coloured in, but this could have been done because the animal had darkened hind legs and not for shading purposes, so I did not evaluate the drawing with the shading skills. Perspective was not evaluated because the figure was drawn in profile and therefore is drawn without perspective.

5.2.3.2.1. Line Quality

The line quality of the drawing in Figure 34 is a typical example of the ‘child’s line’, which is a typical type of novice line (Edwards 1999). It is nicknamed the ‘child’s line’ because children commonly draw from their mental images and not from life. Since the line quality appears to be the child’s line, I scored line quality as a 1.
5.2.3.2.2. Space and Proportion

To evaluate the space and proportion skills of the drawing in Figure 34 I needed a replica to reference. However, in this case it is only possible to identify a four-legged animal with very long horns. Therefore, for this analysis, a photo of any four-legged animal with Palaeolithic relatives will suffice. After some searching, it was determined that the Ibex would provide an adequate reference (Figure 35 a and b) because it has Palaeolithic relatives in Europe and is well represented in UP art. The animal depicted in the UP drawing appears to be in a standing pose, which is is the easiest pose to replicate with some certainty. I chose an Ibex image in a similar angle and a similar pose, which is the closest to the UP drawing that I could possibly get.

![Figure 35. (a) A charcoal drawing from Lascaux cave (c. ~ 17,000 B.P.) (Aujoulat 2005) (b) A photograph of a Siberian ibex.](image)

5.2.3.2.3. Space

In Figures 36 a and b, the figure is blacked out to make the negative space easier to discern. The drawing’s hind legs and rear appear to be relativly close to the reference, while the front legs, the torso and the head shape are not. The proportion is not quite as novice-looking as the novices’ proportion in the study drawings, so I scored this skill as a 2.
5.2.3.2.3. Proportion

The proportion of a figure is estimated by measuring the width and length of a figure compared to the length of the figure’s head. As Figure 37a and b indicates, I superimposed both of the figures’ head lengths across the length and width of the figures. The figure in the UP drawing is 5 heads long and 3 1/3 heads high, while the reference figure is just over 3 heads long and 2 2/3 heads high. The UP drawing is two heads longer and two thirds of a head wider than what would be realistic, therefore I gave this skill a score of 2.
5.2.3.2.4. Gestalt

Figure 34 indicates that the UP drawing is near another figure as the cave lion drawing was, but as the figures are not overlapping they do not appear to be part of the same composition. Therefore, to evaluate the gestalt of this drawing I removed the background image (Figure 38a). I included for reference the five-minute study drawings that scored a one through four for the gestalt skill in the experimental study (Figure 38b). Due to the composition of this drawing, I did not find it appealing. In addition, the drawing most closely matches the five-minute study drawing that scored 1, so I also scored the gestalt as 1.

![Figure 38](image)

**Figure 38.** (a) The test drawing from Lascaux cave with the background figure removed. (b) The five-minute study drawings with gestalt skill scores of 1, 2, 3, and 3.7.
5.2.3.3. **Summary**

While more adjustments to the evaluation criteria will need to be made before UP is formally evaluated for skill, I feel that this study provides a baseline for future research. With skill scores of 1.5 and 3.2, the two UP drawings that I performed a trial evaluation on indicate a considerable range of skill. If, in the future, an adequate sample of UP art is evaluated for skill, it is likely that a similar range of skill will be uncovered on a larger geographic and temporal scale.

5.2.4. **The potential impact of skill evaluations in the UP**

In this section I will discuss how the evaluation of skill of UP representative art might impact current research on UP art. I will begin by defining the different stages of representative art skill acquisition and their expected distribution amongst an average population. I will then discuss how each stage might be identified and interpreted archaeologically. Lastly, I will discuss how the results of UP art skill evaluations can affect existing UP art research and more general UP research.

5.2.4.1. **Defining the stages of representative art skill acquisition**

As indicated in Chapter 2, there are generally six stages in the acquisition of a skill (Ericsson and Charness 1994). I found that there was a substantial overlap in the descriptions of the skill stages and the stages of practice that were identified in the study’s data. Therefore, I applied Ericsson and Charness’ (1994) definitions of the six stages of skill acquisition to the stages of practice that I had previously identified in the data. Below are the definitions of the skill stages, and below that is a figure that shows how the skill stages overlap with the stages of practice in the data (Figure 39).

The six stages of representative art skill acquisition:

- **Novice** - someone new to the skill domain, with little or no exposure to it. A novice is unpractised.
- **Initiate** – A novice who has been exposed to the procedures involved and has begun introductory practice.
- **Apprentice** – A student who is learning and immersed in practice. This period is expected to see most of the variation in practice time.
• Journeyman – A journeyman can work unsupervised, is competent, and is well versed in their skill.

• Expert – a more accomplished journeyman. Experts are more consistent in their execution of skilled-looking drawings and are able to do challenging tasks with minimal effort.

• Master – the master level is for an elite group of experts. The main difference between an expert and a master is that a master performs skilfully all the time. They rarely ever make mistakes and they are generally regarded as a leader the artistic community.

(Ericsson and Charness 1994)

Figure 39. The distribution Ericsson and Charness’ (1994) skill stages over the representative drawing skill stages (X axis) and the skill scores (Y axis).

5.2.4.2. Estimating the likely population distribution of the representative artists

I also created a model of the likely distribution of skill in an UP population, based on what is known about the distribution of artists and experts in a modern population (Figure 40). In making this model my first step was to find the percentage of practicing artists today. In America, less than 15% of the post-lateralized (adult) population have attempted to produce art, but the percentage of art producers in non-Western countries, where art is considered more valuable, can be twice that (Finney 1993; Huntsinger et al. 2011). Therefore, for this model I took the more generous
estimate, and allotted twice the percentage of expected Western artists, which is 30%, to the hypothetical UP population. If 30% of a population has tried making art, then the inverse 70% of the population is novice or initiate.

The next step is to divide the 30% of practicing artists amongst initiates, apprentices, experts and masters. Studies on expertise indicate that experts make up no more than 2% of the population and only an average of one in six experts will become masters (Ericsson and Charness 1994). Assuming the expert to master ratio in the UP was similar, I assigned one sixth of 2%, which is .33%, to the master and the remaining 1.67% to the expert. This leaves the remaining 28% of the hypothetical UP population to be divided up amongst the journeymen, apprentices, and initiates. Journeymen often work in their field as assistants to experts or masters (Ericsson and Charness 1994). Historically, specialized craftsman in painting, sculpture and architecture, had a range of two to six apprentices working under their guidance (Kleiner and Myanma 2006; Nicholas and Krammer 2001). I took the average amount of apprentices that master and expert artists might have, which is four, multiplied it by the 2% of masters and experts in the hypothetical population, and arrived at an estimation of 8% for apprenticing artists of the hypothetical population. Lastly, there is very little information as to how the initiate and the practicing skill stages are distributed amongst a population. Therefore, I will not assign a precise percentage to each skill, and allot the remaining 20% of the hypothetical population to both the initiate and the apprenticing stages.
5.2.4.3. How to identify and analyze art produced by each skill stage in the UP

In this section I will use the skill stages as they are defined and distributed amongst a hypothetical UP population to discuss how each stage might be identified and interpreted archaeologically. However, before I begin it is important to recognize that these definitions are based on artists in a modern society and they may not exactly reflect how UP artists viewed themselves, or how others viewed them. For example, it is possible that an artist with a journeyman skill level was viewed as an expert or even a master amongst UP people.

5.2.4.3.1 Expert and Master

Before beginning a discussion of master and expert level drawings, I must first state that I do not expect to find master level art in the UP. Achieving a master level requires roughly 30,000 to 60,000 hours of practice, which is much more than the standard 10,000 hours of practice that is required for an expert (Chi 2006). That is roughly 30-60 years of practice, which is probably too long for the UP AMH whose life span is estimated at 30 – 50 years (Bahn 1998). If an UP AMH did achieve a master
level status, they would be so rare that it is unlikely that their art would survive for archaeologists to evaluate.

Identifying an expert’s art can be more difficult than the other skill stages because it only represents 1.67% of a population, and at the same time it is easier because their drawings are considerably more realistic. Generally speaking, if the species is recognizable, then the study’s drawings indicate that the artist was probably more practiced than not. If the figure looks dislocated, wobbly, or disproportionate then the drawing was likely not made by an expert. If expert level UP art is found, it could be indicative of the socioeconomic structure of UP populations. Expert level art indicates that the production of art was specialized, and specialist crafts of any kind are indicators of a culture’s economic organization (Nicholas and Krammer 2001). Ethnographically, craft specialization is only found in cultures that are socially complex or stratified and not in cultures with a hunter-gather economy, which the UP is argued to be (Morris 2013). Only stratified societies have mass-produced subsistence resources that are controlled and re-distributed. As Figure 41 illustrates, a stratified society generally takes on a pyramid form, where a large part of the population are farmers who produce the subsistence resources that are subsequently re-distributed throughout the population via the elite (ibid). Since the farmers do all the work involved in food producing, a part of the population is able to spend their time specializing in a craft or a trade and trading their services or goods for the substance resources.
If evidence of specialization in UP representative art is found, there will be several implications. The UP will be considered the earliest time period in human evolution to see a transition to cultural complexity. Currently, the earliest complex societies are generally thought to be from the time period following the UP (~10,000 – 6,000 cal B.P.) (Scarre 2009). Secondly, UP art will be considered one of the earliest known craft specializations, predating other early specializations that emerged in the subsequent Neolithic and Iron Age periods, such as pottery and metallurgy (Morris 2013). Thirdly, if art is deemed specialized, archaeologists will be able to utilize a large body of ethnographic literature on the influence of craft specialization for inference. For example, ethnographically, specialized crafts are correlated with other aspects of human behaviour such as trade, ritual behaviour, aggrandizer strategies, and the allocation of resources (Nicholas and Krammer 2001). Lastly, the identification of skill in UP art will allow archaeologists to identify the spatial and temporal distribution of sites that are associated with a stratified population, and those that are not. This insight into the distribution of stratified societies will provide a much clearer picture of how individual UP sites relate to each other on a socioeconomic level, and the rate of growth and/or decline of sites with stratification throughout the period. This increased understanding of the socioeconomic nature of the UP would then provide an additional mode of inference for other types of Palaeolithic artifacts such as lithics, and faunal remains.
In summary, compared to the other skill stages, expert representative artists are rare, but evidence of expert art in the UP may have a substantial impact on UP research thus far. However, evidence of expert art is not the only indication of representative art specialization in the UP. Becoming a specialist requires surpassing the four previous skill stages, novice, initiate, apprentice and journeyman. Therefore, in an archaeological context, evidence of the earlier stages might indicate that expert art existed, but was never uncovered.

5.2.4.3.2. The practicing stages: Apprentice and Journeyman

Both the apprentice and journeyman skill stages are practice-heavy but this study indicates that their skill related characteristics are quite different (Ericsson and Charness 1994). The study’s apprentice drawings look partially novice and partially expert. Their drawings have more detail and structure than novice drawings do, but compared to an expert, an apprentice is still developing their ability to perceive and draw accurately. By comparison, the journeyman’s drawings look a lot more similar to the expert’s drawings, but they differ in two ways. The first is the degree of accuracy between the artist’s representation and their drawing subject. The second is that journeymen drawings appear less appealing. In the study, journeyman and apprentices were capable of scoring as high as some experts in many skills, but only the experts held the highest scores in the gestalt.

Compared to the other skill stages the practicing stages are the most likely to generate the most art and art related material culture. Apprentices and journeyman represent 93% of the population of art producers. In addition, their skill stages represent approximately 9,000-hours of practice. If only one artist drew an average of two drawings per hour - a conservative estimate for a practicing artist, they would produce at least 18,000 drawings in a 9,000 hour time period. One person’s drawing productivity multiplied by (approximately) 28% of a hypothetical population illustrates the potential quantity of drawings that can be produced by the practicing skill stages.

However, while there would be a large quantity of apprentice and journeymen drawings, they are also the least likely to survive. Usually, practice drawings are meant for practice, not to be kept. They were likely drawn on materials that are not
durable enough to survive in the archaeological record. This does not suggest that apprentice and journeyman drawings will not be found, it suggests that they might not be found in the numbers that will reflect the amount that of art that is expected from these phases.

5.2.5. This study’s impact on UP art research

In this section I will discuss how the establishment of the skill level of UP representative art can affect existing UP art hypotheses. Outlined below are three areas of UP art research that I expect will be impacted.

5.2.5.1 Over interpretation of novice drawings

The objective of representative art is to make art that is realistic. Therefore, when it comes to discussing ‘intention’ in art, it is arguable that the primary intention of the representative artist is to produce a realistic image because the objective of representative art is to make a realistic image. This study indicates that an artist’s ability to produce what they intend depends on the amount of practice and skill that the artist has obtained. Thus, it can be argued that a viewer’s ability to infer the artist’s intentions is also dependent on the amount of practice that the artist has obtained. Therefore, the artist’s skill level should be considered when drawings are interpreted.

As noted in the Introduction, a large body of work on UP representative art centers on the interpretation of its meaning. While this study does not support any particular theory on the meaning of art, it does suggest that drawings that are not made by a practiced artist should not be interpreted based on the appearance of the figure. Since novice artists cannot draw with accuracy, it is inappropriate to interpret meaning from a figure when any aspect of it could have been drawn unintentionally. For example, it has been argued that the horses from Lascaux, including those in Figure 42, are “images of pregnant mares” because the horse’s bellies appear rounded (Leroi-Gourhan 1968; 34). However, it is more parsimonious that the horses’ midsections in the drawing appear too round because the artist has not developed enough of a command over their line and proportion skills to achieve an accurate shape of the figure. For example, using the study drawings as a comparison, the
drawings in Figure 42 appear to be the work of an initiate, an artist with a small amount of practice, 100 – 400 hours. The figures are not completely novice, as the drawings are recognizable as horses, but the artist’s level of control and accuracy appears to be low. For example, the proportion of every one of the horse’s extremities is ‘off’ in relation to size of the horse’s body. The heads are too small, the necks are too thick, the legs are too short and appear to be disjointed, and the tails are both too small and too big. If the artist cannot control the shape and the proportions of the figure, then how can one argue that the figure’s belly was intentionally drawn to be slightly rounder than usual? Additionally, the comparison with the study drawings indicated that the drawings in Figure 42 more closely resemble the 5-minute drawings instead of the 30-minute drawings, which suggests that they were quickly drawn. In general, there was a significant reduction in the accuracy of the depictions in the participant 5-minute drawings. Even the experts’ 5-minute drawings were simply not detailed and accurate enough to argue that slight morphological differences, such as the size and roundness of a horse’s belly, were intentionally drawn.

Figure 42. An image of horse drawings from Lascaux cave, in France (Aujoulat 2005).

The second area of UP research that this study may improve is the general lack of reference to the production of UP art in studies on UP art. The processes related to production of art, such as the production and application of paint, are discussed extensively. However, the cognitive, and practice-related aspects of the production of art are generally not taken into consideration in the formulation of most UP hypotheses, particularly those that involve the meaning of the art. Therefore, this study can have a significant impact by taking what is known about the production of representative art and applying it to hypotheses on UP art.
The lack of focus on the production of representative art has affected the formulation of UP art theories, in particular with a lack of appropriate terminology, the formulation of unlikely hypotheses, and/or the formulation of hypotheses that cannot be falsified. One recent hypothesis exemplifies these problems. In their article *Animation and Palaeolithic art: a pre-echo of cinema*, Azema and Rivere (2012), argue that certain drawn figures with extremities in overlapping poses (Figures 43 a and b) are examples of animation. The authors argued that the figures are drawn to create the illusion of movement and to appear animated to the viewer. To illustrate this point, Azema and Rivere (2012) made an animation of the drawings by covering and revealing different areas of the figure in different frames of film. For example, to make the legs in the drawing from figure 43b move they covered all of the legs except the one to the far left, by the animals rear, and the far right near the animal’s head. For the next picture they covered all but the middle legs, until all the animals front and hind legs are photographed individually. The result is an animation where the figure’s body is stationary, but the legs are moving as if the animal is walking or running.

5.2.5.2. Applying knowledge of representative art to research on UP representative art

The second area of UP research that this study may improve is the general lack of reference to the production of UP art in studies on UP art. The processes related to production of art, such as the production and application of paint, are discussed extensively. However, the cognitive, and practice-related aspects of the production of art are generally not taken into consideration in the formulation of most UP hypotheses, particularly those that involve the meaning of the art. Therefore, this study can have a significant impact by taking what is known about the production of representative art and applying it to hypotheses on UP art.

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![Figure 43](image_url)

**Figure 43.** Two drawing examples from Azema and Rivere’s (2012) argument for animation in UP art.

However, there are two serious flaws in this argument. The first is the confusion of the terms ‘animation’ and ‘movement’. In regard to figurative drawing, movement refers to a figure that is drawn in a dynamic pose with loose, overlapping lines to give the illusion that it is in motion (Eisner 2008). Animation is a technique of photographing successive drawings or positions of puppets or models to create an illusion of movement when the drawings are shown as a sequence (Barber 2005). Suggesting that the drawings in Figure 45 depict movement is defensible. However, Azema and Rivere (2012) have taken the concept of the art exhibiting movement to suggest that the art was intended to be viewed as an animation, and therefore is animation. This is misleading for two reasons. First, all animation requires a minimum of two drawings that can be viewed consecutively, and Azema and Rivere’s (2012) examples are of individual drawings. Second, while it is plausible that an UP person could see a series of images drawn in succession as animation, it is not likely that an
UP person would look at a drawing with multiple legs (Figure 43) and think that the legs could be isolated and viewed in successive frames to appear animated. If filmmaking did not exist in the UP then is not likely that the artists intended their drawings to be viewed as if they were frames in a movie.

The second flaw in Azema and Rivere’s (2012) argument is that they overlook a common representative drawing trait that better explains the appearance of overlapping limb lines in a figure. Re-drawing, which is an unintentional trait of drawing live figures that move, is a common trait of representative drawing. As the life drawings in Figures 44 (a) and (b) illustrate, re-drawing occurs when an artist repeatedly draws the figure’s position as the figure moves. If the figure is standing like Azema and Rivere’s (2012) examples, most of the animal’s movement occurs in their extremities, such as their legs, head, and tail, therefore these are the areas that are the most subject to re-drawing. The examples that Azema and Rivere (2012) used in their argument are actually quite diagnostic of this typical aspect of representative drawing. Therefore, while it can also be argued that the drawings in Figure 43 are depicted to give the impression of movement, the location and nature of the overlapped areas suggest that re-drawing is the most likely explanation for this phenomenon.
Figure 44. Two representative drawings that exhibit re-drawing. (a) An example of re-drawing on the figures left side (Rodin c.1891. (b). An example of re-drawing on the figures left arm by Adolf Menzel.

5.2.5.3 The identification of the individual artist or style

The third area of UP art research that this study may impact is the identification of individual styles or individual artists in UP art. The identification of the individual will allow archaeologists to infer whether or not the same person made groups of drawings in presumably the same event, or if different members in a group made them at different times. This research is of particular interest to some archaeologists who have hypotheses that will either be confirmed or denied based on the results of inquiry into the individual artist. For example two hypotheses argue that the procession at Lascaux (Figure 45) was a depiction of a hunting event, where animals are being herded over a cliff, for either instructional reasons or as a record of an event (Aujoulal 2005; Bahn 1998). If art were intended for either of these purposes, the same person would have likely made it in one event, as that is how artists usually work (Edwards 1999). There are hypotheses which argue that UP art was made by different people as a part of a ritual, while another hypothesis argues that art was
made for ‘calendric’ or ‘chronicling/language’ reasons, which includes the recording of changing seasons, chronicling events, and marking territories (Lewis-Williams and Davidson 1988; Marshack 1989). These hypotheses rely on the idea that individual images were made by different members in a group. Therefore, a determination of whether or not groupings of UP drawings were made by an individual artist is expected to impact these UP art hypotheses.

![Image](image1.jpg)

**Figure 45.** The procession at Lascaux (Aujoulat 2006).

To date, research into the identification of the individual artist in representative art is sparse. It has been hypothesised that the same person made in some of the art from individual sties, but until recently there was no way to test these hypotheses (Bahn 1997). In 2009, Fritz and Tosello introduced a new method for identifying the individual artist, which they used to determine that the drawings in Chauvet cave were likely he work of one artist. In their article, they indicate that a sophisticated high-resolution 3D recording technique was used to capture, isolate and compare the individual lines of the drawings in Chauvet. With such a refined level of detail Fritz and Tosello were able to observe specific characteristics of the lines execution and conclude that the same person made all of the drawings analysed (2009).

The findings of this study can aid research into the identification of individual artists in the UP in two ways. The first is to address the critiques that disregard the possibility of identifying individual artists by addressing their two main arguments: that
artists do not have a definable style and do not consistently draw in the same style. While the first claim would need to be formally tested, each of this study’s drawings appear to be unique. Considering the artists were all referencing the same image and drawing with the same media, each one of the study’s drawings was remarkably different from the next (Figure 46). This does not prove that artists always draw in the same style, but it does suggest that one artist’s work is not easily confused with another’s.

Figure 46. A variation in drawing styles from the participants in the study.

To address the second argument that artists do not draw consistently in one style, I will refer to research on the neurological behaviour behind skill acquisition.
This research states that the execution of the motor tasks associated with practicing a skill creates a series of neural signals to the parts of the brain that are used in the task. As that task is practiced, a series of neural pathways that guide the signals begin to develop in the brain. Once neural pathways are formed, the practitioner will continue to perform that task in the same way. Since an artist’s style is a reflection of the artist’s drawing techniques, it can be inferred that an artist’s style is also predetermined by his or her neural pathways and is therefore consistently used by the artist (Hill and Schneider 2006).

The findings of this study may also impact Tosello and Fritz’s (2007) work in identifying the individual with their 3D recording method. Their research is very exciting, but their methods might prove to be problematic when applied to sites with many drawings in different styles, such as at Lascaux cave. At Chauvet, Tosello and Fritz (2007) were able to determine that a few of the drawings were made by the same individual, based on one drawing attribute, the artist’s line. However, since there are only so many ways that one attribute can be affected by different styles, the evaluation of an individual style would require looking at several drawing attributes. In this respect, this study can be used to enhance the research capabilities of Tosello and Fritz’s (2007) method. Firstly, knowledge of drawing skill scores will help researchers identify groups of related drawings by grouping drawings with similar skill scores. If one artist produced several drawings in a single event, then it can be reasoned that all of those drawings should have approximately the same skill level. It is not a perfect method, as other artists could also have similar skill scores, but it could be helpful. Secondly, the individual drawing skills can be used to help differentiate one artist’s style from another. If Tosello and Fritz (2007) can use the similarities of one drawing skill (line), then their analysis technique can likely be used with the other skills to help define an individual style amongst multiple styles.

5.2.6. This study’s impact on Palaeolithic archaeology

Apart from impacting research on UP art, the evaluation of skill in UP representative art could also impact more generalized research into the Palaeolithic. Most Palaeolithic studies fall under the domain of cultural evolution, focusing on the
transmission and fitness of cultural traits over time and space. Palaeolithic analyses are usually based on a synthesis of data generated from different forms of Palaeolithic remains – which mostly includes lithics and faunal remains. Unfortunately, although UP art makes up a significant portion of UP material culture, it is difficult to quantify. The method developed in the current study presents an empirical method for evaluating skills in UP art that will make it possible to integrate the analysis of UP art into Palaeolithic research.

5.2.6.1. **Faunal and Lithic research in the UP**

Specialization is associated with socioeconomic complexity (Nicholas and Kramer 2001). Evidence of skilled art in an assemblage can shed light on the socioeconomic position of not only the people who produced the art, but may also provide information on the people who made other artifacts found in the same context. For example, most UP material culture can be categorized as either lithics or faunal remains (Kuhn 2013). Thus far, the lithic and faunal UP material culture indicates a transition to social complexity that began around 80,000 – 60,000 BP, but exploded in density and complexity during the UP revolution, from 50,000 – 40,000 BP (Kuhn 2013; Munzel and Conrad 2004; Stiner and Kuhn 2006; Stiner and Munro 2002). In lithic analyses, complexity is indicated by the use of new materials, more complex modes of production, and specialized tools for a more diverse range of prey. Complexity in faunal remains was found with increased prey diversity and an apparent division of labour by 50,000 BP (Stiner and Kuhn 2009). If specialized art is found in context with the faunal and lithic remains that indicate complexity, than this study will support claims of complexity. In addition, knowledge of the skill level of UP art will also help identify which sites and regions were complex socioeconomically. This will allow archaeologists to contrast and compare the socioeconomic structure of individual sites, as well as make inferences as to site use. Since skilled art is often used for aggrandizing purposes, an excess of skilled art could be indicative of elite dwellings, such as town centers, elite homes, and places of ritual.

5.2.6.2. **Demographic models**

In 2001, Shennan put forth a model that estimated UP populations based on the rate of innovation in the material record. Shennan (2001) created a simulation that
estimates the rate of innovation expected from different population sizes, and estimated Palaeolithic population sizes based on the rate of craft innovations found during Palaeolithic time periods. An example of these results can be seen in Figure 47, which indicates that the massive influx of material culture can be explained by population growth during the UP transition. Since the production of representative art explodes in the Aurignacian (42,000 – 28,000 BP), and begins to decline during the Magdalenien (20,000 – 14,000 BP), Shennan’s (2001) model also suggests that the rapid onset and decline of the production of art was the result of a rise and decline of populations between 33,000 – 17,000 BP.

![Figure 47](image)

*Figure 47. Estimated Palaeolithic population rates (Ambrose 1998).*

One limitation of Shennan’s (2001) model is that there is a significant overreliance on lithic material culture (Kuhn 2013). Shennan’s (2001) model includes faunal remains and innovations associated with art, but they are comparatively sparse and cannot be easily evaluated for the appearance of innovation. The innovations associated with art, such as the use of lamps, new pigments etc., are limited in representative art production because the methods for producing art have remained continuous for thousands of years. Therefore the transmission of art cannot be measured based on the rate of innovation, as it is with Shennan's (2001) article.

Fortunately, Heinrich (2004) published a demographic model that can be applied to estimates of skill in UP art. His model estimates the number of social learners required to sustain the adaptive processes in the production and transmission
of a skill, and estimates population size based on the prevalence of skilled material culture from different time periods. With use of this model, skill in UP art can be used to help predict population levels in two ways. The first is to evaluate skill in art so that it can be contrasted and compared to Shennan’s results to see if art predicts population size in the same manner as Shennan’s model. The second way is to analyze lithics and representative art for skill, to create a demographic estimate that is inclusive of most of the available UP material culture. In sum, a demographic analysis of skill in UP art will give archaeologists a much clearer picture of the economic growth and decline of UP populations.

5.2.7. This study’s impact on archaeology in general

5.2.7.1. The evaluation criteria

Arguably, this study’s most significant contribution to archaeology could be the development of standardized evaluation criteria for skill in art. Firstly, the operability of the evaluation criteria suggests that it can be used to evaluate any form of two-dimensional representative art. This includes the two dimensional representative art from any culture, prehistoric or not, that appears in any form, human or animal, painted or drawn, on pottery or on canvass, or as a form of writing. The evaluation criteria can be altered and applied to 3D forms of representative art, such as sculpture and sculpted frieze. In sum, the evaluation criteria have the potential to be used to evaluate any type of representative art. Since approximately half of the art from prehistoric sites in the archaeological record is representative (Kleiner 2010), the evaluation criteria have the potential to be influential to the study of art in many other cultures.

The skill level of other craft domains, such as pottery and metallurgy, can also be evaluated by using the evaluation criteria as a model. The evaluation criteria works by evaluating the sub-skills of representative drawing based on novice and practiced examples of each skill. Since most craft specializations are whole skills composed of sub skills, the sub skills can be used like the evaluation criteria were used in the evaluation of representative art.
5.2.7.2. Embodied cognition theory

Another area of research this study could potentially impact is in the emerging field of embodied cognition, also referred to as extended cognition or embodiment (Malafouris 2013). Embodied cognition is based on the premise that human thought and the material world are utterly inseparable. The cognitive processes associated with tasks, such as the modification and use of material objects, have an effect on a human’s consciousness, while the human’s consciousness has a reciprocal effect on the task and the object (ibid). This theory is partly based on the neurological revelation that the brain is plastic — changing in accordance with how it is used — and partly based on concepts in cognitivism, which identify the ‘mind’ as being separate from the brain (Malafouris 2013, Malafouris and Renfrew 2010).

In relation to material culture, embodied cognition argues that artifacts have a ‘cognitive life’, because they are the product of cognitive processes. In archaeological research, embodied cognition can be applied to the analysis of artifacts, since all artifacts are the ‘products’ of the human mind. First, the archaeologist attempts to identify the ‘cognitive markers’ associated with the production of an artifact, and to determine if and how those markers have had a lasting impact on the human mind. The analysis and interpretation proceeds from this, to a consideration of the reciprocal effect that the human mind and the artifacts it produces have on one another (Clark 2010; Malafouris 2013). Thus far, research into embodied cognition in archaeology has led to hypotheses that early tool making, pottery, metallurgy, cultural practices, social skills and symbol use have had a lasting impact on the human mind, and human consciousness (Coward and Gamble 2010; Frith 2009; Hastorf 2010; Malafouris 2010; Roddick and Hastorf 2010; Roepstorff 2009; Stout et. al. 2009).

The study described here deals with the material remains of a common human behavior (drawing), and thus, can be integrated into research on embodiment. Firstly, this study’s drawings can be used as a way of testing the degree to which an artist’s consciousness affects his ability to draw a representation of a figure. In this study, 30 artists drew two drawings, each from the same reference. If the artist’s perception of the animal in the photograph was altered by his mind, then it may be possible to identify differences in the individual artist’s drawings.
Secondly, embodied cognition argues that the ‘mind’, rather than the brain, has an impact on how material culture is made and used. Mental representations are partially filtered by a certain belief about the world (Malafouris 2013). Thus far, the embodiment research that relates to image production and interpretation indicates that the processes related to making and interpreting common symbolic images (internal images) are found in the older parts of the brain that control motor perceptual skills (Roepstorff 2010). In contrast, images that are new, or need to be examined, (external images) are processed in the prefrontal cortex — a more recently developed part of the brain.

In the production of representative art, realistic images are made by training the brain not to draw based on our internal or symbolic images, but based on what the image actually looks like. While the premise of representative art production is simple enough, this study indicates that developing the ability to draw what one actually sees, rather than reproducing one’s internal, symbolic image of an object, takes a great deal of practice — approximately 10,000 hours — to do successfully. It is not yet clear if novice representative drawing and symbol drawing are the same cognitive process, but, if they are proven to be same, the fact that internal images are such an integral part of human cognition may explain why learning to draw representatively — to reproduce the image one actually sees — is such a long and arduous process.

5.3. **This study’s contributions to representative art research**

In this section I will discuss the impact the current study may have on the field of representative art. First I will discuss the ‘perspective phenomenon’, which refers to the discovery of a phenomenon related to some of the study’s expert artists, followed by a discussion of the other applications of this research.

5.3.1. **The Perspective phenomenon**

The term ‘perspective phenomenon’ refers to an idiosyncrasy in expert behaviour that was identified in the evaluation of the perspective skill. The results of
this study indicate that the perspective skill did not correlate positively with the number of hours of practice, and while the proportion skill did have a significant relationship with practice hours, it was a weaker relationship than the other skills. This deviation from the rest of the skills is surprising. Many high scoring artists had abnormally low perspective scores, which is the opposite of what would be expected. I examined the extent of this phenomenon by making a scatterplot with hours of practice on the Y-axis and the ‘difference score’, a value obtained by subtracting the artist’s perspective score from the average score of the other skills, on the X-axis (Figure 48). A significant negative relationship of $r^2 = .139$ was found to indicate a decrease in artist’s skill score compared to the average of their other scores.

![Figure 48](image)

**Figure 48.** A scatterplot with the participants’ difference score on the Y-axis and their hours of practice on the X-axis. The regression line illustrates how the artist’s perspective scores have a negative relationship with practice.

A subsequent analysis of the drawings helped clarify why the drawings’ perspective was off. As Figure 49 illustrates, I discovered that most of the experienced artists lifted the head of the figure, while the horse on the right is depicted with accurate perspective.
Figure 49. A comparison between an apprentice-level drawing of accurate perspective (left) with four expert drawings that show the lifted head of the figure (right).

To help clarify why the experienced artists lifted the figure’s head I contacted some of the artists who aided in my research of representative art. They all suggested that the head was lifted to increase the balance of the figure. With the figure drawn with proper perspective it appears unbalanced and sloped forward, so it is possible that the experienced artists lifted the head to correct this unbalance. The lifting of the horse’s head also breaks up the distribution of space above the figure, which increases the balance of the picture’s overall composition. I then questioned the artists who altered the drawings, and they unanimously responded that they did not intentionally change the figure. Therefore, I concluded that the changes to the donkey’s head were done unintentionally, and to increase the appeal of the drawing.

To the best of my knowledge, there is no literature describing the phenomenon of artists subconsciously altering drawings to make them more appealing. However, the literature and this study indicate that experts are confident and capable of handling the mechanical aspects of drawing subconsciously. Therefore it could be argued that the adjustments to the figure’s head were the result of an expert’s subconscious concern for the appeal of the final product. The expert artists who changed the figure
may have had jobs that encouraged them to make their drawings as appealing as possible, and increasing the study drawing perspective was simply done out of habit.

Nonetheless, there appears to be a relationship between this phenomenon and another drawing phenomenon known as stylization. As discussed in Chapter 2, stylization refers to the act of simplifying representative drawings in an attempt to increase appeal (Barber 2005). It is established that many experienced representative artists tend toward stylistic drawing after having mastered representation (Kleiner and Myanma 2006). This is the case with the artists who ushered stylized art into Western culture, such as Braque, Picasso and Monet (Kleiner and Myanma 2006). It is also established that stylization happens at a cultural level, as there is an established transition to stylization throughout ancient Asian, African, and Central/South American art (Kleiner 2006; Makensie 2001). However, it is not clear exactly why this happens with some people and not others, and in some cultures and not others. Since stylization is predicated on improving appeal, this study may have inadvertently uncovered an example of the human propensity to stylize art. If future research indicates that the propensity to improve appeal is a trait of expert artists that leads to the artist’s production of stylized art, then this discovery will be impactful for two reasons. The first is that it will explain why artists, and by extension whole cultures, adapt a stylized style of art. The second is that it will draw attention to the skilled nature of stylized drawing, which is often viewed as being simple, cartoonish, and less skilful than representative art (Eisner 2009).

5.3.2. Pedagogical applications

My experimental study uncovered aspects of representative art that had not previously been tested and may have pedagogical implications. For example, the results of this study can broaden the understanding of the importance of pre-lateralized childhood practice to the achievement of skill. Figure 50 is a scatter plot indicating the participants answer to the question “before the age of twelve how much did you draw?” It shows that while some high-scoring artists had very little childhood practice, no artist with more than average amounts of childhood practice has a skill score below 2.5, and most of the practiced artists with a score of three or higher had
more than average childhood practice. This indicates that highly practiced artists had an apparent interest in drawing that started in childhood. However, there were some participants who had less than average childhood practice and high skill scores. These participants started drawing later in life, but were able to achieve a high level of skill as a representative artist. Therefore it can be concluded that while most representative artists have a lifelong interest in drawing.

Figure 50. A the distribution of the responses to the question “how much did you practice before the age of 12?” 1= less than average 2= average 3= more than average.

The establishment of the learning curve for representative drawing also has pedagogical implications for post-lateralized children. When children are young, they draw using an abstract form of symbols until they are approximately twelve years of age, when lateralization, an increase communication of the brain’s hemispheres, begins (Edwards 1999). Once this happens, children are able to perceive objects properly and make accurate representative drawings. However, after lateralization children who are new to representative drawing and they are unable to produce realistic drawings. When young artists see that they cannot draw realistically they often think that it is because they are not talented and give up (Edwards 1999). Subsequently, art teachers of post-lateralized aged children have difficulty teaching
kids who have a preconceived notion that they are not artists because they “cannot draw” (Edwards 1975).

The understanding of the acquisition of representative drawing skill put forth by this study can help with the education of artists. For example, this study indicates that the ability to draw realistically is only obtained through practice. This means that new artists are unlikely to produce realistic drawings when they begin and that artists who can draw realistically, are able to do so do so because they are practiced. Therefore, preconceived notions of artists being born with talent can now be challenged. Second, having knowledge about the acquisition of representative drawing will likely help keep practicing artists from getting discouraged. It takes a very long time for an aspiring artist to reach the skill level they desire, and it is disheartening to think that learning to draw will be a struggle for so long. However, the learning curve of representative drawing skill acquisition indicates there is a sharp increase of skill in the first 5,000 hours, followed by a much slower increase in skill acquisition until mastery is attained. This suggests that an artist's initials struggles with drawing are a response to rapid skill acquisition, but that about half way through the entire skill acquisition period, artists have achieved enough skill to draw comfortably while improving the more subtle aspects of drawing. This knowledge might not seem very significant to a novice, but may be quite influential to artists in the apprenticing stages of acquisition.

This study also has contributions to cognitive psychology’s skill acquisition research that will be beneficial. In the last 30 years, the field of skill acquisition has grown to include dozens of skill domains that range from music to chess playing, and now representative art should be included. This study indicates that the average rate of expertise in representative drawing acquisition is 10,000 hours of practice, which is consistent with the rate of expertise that occurs in other skill domains (Ericsson and Charness 1994). Similarly, studies on skilled representative artists indicate consistencies between expert artist behaviour and expert behaviour that is found in other skill domains (ibid). For example, compared to novices, expert artists have an increased ability to perceive the global aspects of images, meaning that the basic aspects of drawing are done subconsciously, allowing the artist to fully concentrate on the drawing's appeal (Fayena-Tawil 2011).
The limitations of the current study should be improved before representative art is accepted as a 10,000-hour skill. There is too much variation between 5,000 and 10,000 hours for me to confidently conclude that representative drawing meets the 10,000-hour rule. The impact of the participant’s childhood practice hours also need to be understood, and factored into their total hours. Once those two measures are taken, a more confident determination of the 10,000-hour rule in representative drawing can be made.

There are a couple of additional areas of potential research related to the discovery of the ‘expert phenomenon’, i.e. an expert’s tendency to alter the subject and increase the drawing’s appeal. As the expert artists changed the perspective of the figure, I currently do not have a strong understanding of how perspective would normally behave. Re-evaluating perspective is not essential to my continuance of this topic as there are almost no UP figures drawn in perspective, but a re-evaluation of drawing skill should be done so that perspective is adequately understood for future research. The phenomenon that was indicated by the perspective skill should also be reproduced and observed more closely. Future research into perspective phenomena could confirm that experienced artists make subconscious decisions to alter the subject and increase appeal. If this research is done, it could offer insight into why some cultures’ art develop to be stylized and some do not, it would be the first research to shed light on this topic.

Additionally, enthnoarchaeologists who study specialization in early civilizations and cognitive scientists in the field of skill acquisition are without any explanation as to the evolution of skill acquisition (Chi 2006; Nicholas and Kramer 2001). If UP art, and perhaps UP lithic technologies, are evaluated for skill, then archaeologists and cognitive psychologists can obtain insight into the origins of skill acquisition for the first time.

Finally, this study has potential to help change popular misconceptions about representative art. Representative art is a subfield of art that is now recognized as being a skill that can only be acquired through practice. In that respect, it is quite unlike modern (abstract) forms of art. Artists who practice modern art usually have a
masters or a PhD in fine art from a university where they trained to express themselves using a variety of media (Finney 1993). Representative art is an expression of nature, whereas modern (abstract) art is need not relate to the natural world at all (Barber 2005). Ever since modern art became the dominant art form of Western art, representative art is more often considered a “craft”, akin to illustration, or drafting (Abadia and Morales 2004). Today there is no standard definition of representative art, making it difficult for people to make the distinction between representative and modern (abstract) art forms. Therefore, this study has the potential to clarify our culture’s perceptions of modern and representative art.
Chapter 6. Conclusions

Art is one of the few fundamental aspects of human behaviour that is ubiquitous in the material record (Bahn 1998). It is a feature of virtually every culture that has been documented (Bahn 1998). As such, the analysis of art has the potential to lead to the identification of cultural sub-groups, economies, belief systems, social structures, religious orientations, and histories. The production of representative art is also an important aspect of human evolution, as it is considered an aspect of symbolic behaviour, which is a defining trait of modern human behaviour (Nowell 2010). Compared to other symbolic behavioural traits, such as intentional burials, personal ornamentation, and incised objects, the production of representative art is a trait that is only found in modern humans and not Neanderthals and/or non-human primates (Nowell 2010, 2013). Therefore, research into the production of representative art has great potential to offer insight into the success of modern humans.

While art has the potential to be a rich source of information, workable methods for the evaluation and integration of art in archaeological analyses are not nearly as developed as other important fields of archaeology. In my mind this is due to the fact that the public generally perceives all art, including representative art, to be like modern art. The production of representative art is consistent throughout time, until approximately 100 years ago, when the modern art movement dramatically decreased its production (Kleiner and Myanma 2006). Modern (abstract) art has evolved to include a variety of types, philosophies, and niches that do not usually include representative art (Kleiner and Myanma 2006). Even though representative art was an ancient and dominant art form, abstract art is so ubiquitous in Western and Non-Western societies today that representative art has become irrelevant and misunderstood. If modern (abstract) art is not perceived as a skilled artistic expression, the public – and by extension many UP archaeologists, might assume that UP representative art is made in the same manner.
The objective of this study was to create a method for the evaluation of artists’ drawing skill and practice time. In light of my deduction and my conclusions, it was clear that any information garnered from the production of representative art would be beneficial to the understanding of UP art. Therefore I formulated my hypothesis, that representative art is a set of skills that are acquired through practice. To test my hypothesis I created a study for the evaluation of skill in representative art in five steps. The first step was to develop a set of criteria to evaluate art with. I assembled the skills required for representative drawing, and established the novice and practiced examples of those skills. The drawings were rated on a scale of one to five based on how the skills appeared compared to the novice and practiced examples. In the second step I trialed the evaluation criteria for its ability for produce reliable ratings with volunteer evaluators. After two trials of five people each, the evaluators showed consistent ratings of +/- .5, which was considered to be acceptable. The data was collected during a trial where 30 individuals completed drawings drawn in a 5 and 30 minute time duration. Participants also filled-out a practice-history form, indicating their hours of practice. In the fourth step, five evaluators evaluated all 60 drawings using the evaluation criteria. The evaluators evaluated the drawings individually in sessions that took four to seven hours per evaluator. Finally, in the fifth step, I performed a regression analysis using the artist’s skill scores to predict practice history. Separate regressions were run using each of the individual skills as well as the average of the skills for both the 5 and 30-minute drawings.

With the results of my regression analyses, I came to several conclusions. My first conclusion is that there was a statistically significant relationship between an artist’s level of drawing ability and their hours of practice. Skill was obtained at a steady rate until approximately 10,000 hours of practice, at which point the rate of learning evened out. This conclusion will likely impact archaeology, as well and other disciplines that deal with representative art because the production of all art is largely perceived to be talent-based, i.e., an ability one is born with – rather than practice-based (Edwards 1999). As a result, representative art, current or prehistoric, is perceived as being created without effort, learning, or practice. This study has determined this assumption is potentially invalid and detrimental to forms of academic and pedagogical approaches to representative art.
The results of this study also indicate that representative art is a skill domain like the other skill domains represented in cognitive psychology’s expertise studies. Like other skill domains researched in the cognitive sciences, skill in representative art appears to peak and taper off at around 10,000 hours of practice. This result is consistent with the 10,000 hour rule, which argues that expertise in a variety of skill domains is reached after 10,000 hours of practice (Ericsson and Charness 1994). In addition to this study’s finding, other studies on the production of representative art are congruent this study’s results. For example, observational studies of expert representative artists indicate they have specific traits, such as an increased ability to detect problems, predict outcomes, and generate solutions (Fayena-Tawil 2011). These sets of traits are also identified in observational studies on expert performers from other skill domains (Chi 2006). Similarly, fMRI brain scans of representative artists’ indicate an 85% reduction in the practiced artists frontal (task control) and posterior (attention control) regions of the brain during practice (Hill and Schneider 2006). This reduction is due to the fact that practiced artists are able to draw out of habit, which is a phenomenon that was initially documented in skill acquisition research (Ericsson and Charness 1994)

Another conclusion of this study is that novices cannot draw with accuracy. Therefore a figure drawn by a novice should not be analyzed with scrutiny. The study’s drawings indicate that the artist’s ability to draw a subject realistically is related to the amount of practice hours they have. Oftentimes it is difficult to identify the subject in a novice drawing at all. As such, a novice’s drawing should only be interpreted with extreme caution, if it is interpreted at all. Unfortunately there are many UP art hypotheses that make inferences on the meaning of art based on the details of a depiction. Therefore, in the event UP art is evaluated for skill there will likely be many examples of novice art that is over-interpreted.

My final conclusion is that the evaluation criteria presented in this study are a practical tool for the evaluation of skill in UP representative art. Reliability tests indicate the evaluation criteria produces consistent and reliable results from evaluators with no artistic training. In the Discussion chapter, I demonstrated how the evaluation criteria could be adjusted to meet UP conditions and did a trial evaluation
of two drawings. The trial evaluations were only meant for demonstrative purposes, as there are many steps that need to be taken before official trials can be held. However, if the trial evaluations prove to be roughly correct, future skill evaluations will indicate a range of skill in UP representative art from novice to journeymen, or possibly expert. If highly skilled art is identified with the evaluation criteria, it can be inferred that UP art was a specialized craft. As many ethnoarchaeological sources indicate that specialized crafts are directly linked to stratified societies, evidence of skilled art in the UP could suggest that AMH’s were not the hunter-gathers they are currently assumed to be (Guthrie 2006). A range of skill will also allow archaeologists to make inferences on the allocation of wealth and resources in UP sites, as well as on the existence of aggrandizer strategies and ritual behaviour (Nicholas and Kramer 2001). In sum, the evaluation criteria presented in this study have the potential to utilize UP art, a commonly under-analyzed form of Palaeolithic material culture, as a remarkable source of information into the socioeconomic aspects of UP life.
References

Abadia, Oscar M.

Abadia, Oscar M., and Maunuel R. Morales

Adams, Henry
2004 Seven Secrets of Andrew Wyeth's Technique. American Artist, Drawing (2):36-46

Anton, Mauricio, Manuel Salesa, Alan H. Turner, Angel Galobart, and Juan F. Pastor

Ambrose, S.H.

Apel, Jan

Aristides, Juliette
2012 Qualities of Line: Contour, Rhythm and Weight. American Artist, Drawing (3) :36-43.

Aujoulat, Norbert

Azema, Mere, and Florent Rivere

Bahn, Paul G.

Bahn, Paul G.

Bamforth, Douglas, and Nyree Finlay
Barber, Katherine (editor)

Bar-Yosef, O.

Beal, Jack

Bleed, Peter

Breuil, A.

Bricker, Harvey M.

Chan, David W., and Yongjun Zhao

Chauvet, Jean-Marie, Elitte B Deschamps. and Christopher Hillaire

Chazan, Michael

Cheno, Dan

Chi, Michelene T. H.

Cianciolo, Anna

Civardi, Giovanni

Civardi, Giovanni

Clark, Andy

Clottes, Jean (editor)

Clottes, Jean, Jean Courtain, and Luc Vanrell

Clutton-Brock, A.

Coward, Fiona and Clive Gamble

Cox, Maureen
1993 *Children’s Drawing of the Human Figure*. Erlbaum Associates Ltd., Sussex.

Darville, Timothy (editor)

Demartin, Jon

Doherty, Stephan

Edwards, Betty
1975 *An Experiment in the Perceptual Skills of Drawing, Ph.D. dissertation*. University of California, California

Edwards, Betty

Eisner, Will

Ericsson, Anders K., and Neil Charness
Ericsson, Anders K.  

Ericsson, Anders K., Neil Charness, Paul J. Feltovich, and Robert R. Hoffman (editors)  

Evetts, Julia, Harold A. Meig, and Ulrike Felt  

Fayena-Tawil, Frieda  

Ferguson, Jeffery R.  

Finlay, Nyree  

Finlayson C.  
2004 Neanderthals and modern humans: an ecological and evolutionary perspective. Cambridge University Press, Cambridge

Finney, Henry C.  

Flenniken, Jeffery  

Foss, Lawrence  

Frith, Chris  

Frith, Chris, and John Law  
Fritz, G., and G. Tosello

Geribàs, Núria, Marina Mosquera and Joseph M Vergès.
2010 What novice knappers have to learn to become expert stone toolmakers. *Journal of Archaeological Science* 37(11):2857-2870.

Gheno, Dan
2010 The Core Figure: A Source of Power and Accuracy. *American Artist, Drawing* 1:21-27.

Gombrich, E. H.

Gombrich, E. H.

Graves-Brown, P. M.

Grund, Charles

Guthrie, Dale R.

Halverson, John
1987 Art for Art’s Sake in the Paleolithic. *Current Anthropology* 126(3):221-236.

Halverson, John

Hayden, Brian

Hayden, Brian

Henrich, Joseph

Hill, Nicole, and Walter Schneider

Hogberg, Anders

Horvath G., Farkas E., I. Boncz, M. Blaho, G. Kriska
2012 Cavemen were better at depicting quadruped walking in illustration in the fine arts from prehistory to today. PLoS one 7(12):e49786

Hunt, Earl

Huntsinger, Carol S., Joseph M. Jose, Dana Krieg, and Luo Zupei

Hyman, John

Jacobsen, Schubotz, R.I., Hofel, and D. Y. V., Crammon

Jaumotte, Andre

Kehoe, T. F.

Klein R.G.

Kircher, Lauren

Kleiner, Fred S., and Christian J. Mamiya (editors)

Kleiner, Fred S. (editor)
2010 Gardner’s Art Through the Ages, Non-Western Perspectives. Wadsworth, U.S.A.

Konstam, Nigel
Kozbelt, Aaron

Krampe, Ralf, and Neil Charness

Kuhn, Steven L.

Lamming-Emperaire, A.

Lamming-Emperaire, A.

Leroi-Gourhan, A.

Leroi-Gourhan, A.

Lewis-Williams, and J. Dawson

Lorblanchet, Michael

Mackenzie, Lynn

Malafouris, Lambros

Malafouris, Lambros

Malafouris, L. and C. Renfrew

Marshack, Alexander
Marshack, Alexander

Marshack, Alexander

Marshack, Alexander

Marshack, Alexander

McBrearty, S., and A. S. Brooks

Mellars, Paul

Mellars, Paul and French, Jennifer

Miller, Geoffrey F.

Mithen, Steven J.

Mithen, Steven J.

Mithen, Steven J.

Mithen, Steven J.

Mithen, Steven J.

Morris, Ian
Munzel, S. C., and Conrad, N.J.  

Nicholas, David, and Carol Kramer  

Nougier L. R., and Robert R.  

Nowell, April  

Nowell, April  

Nowell, April  
2013 All work and no play left little time for art. *New Scientist* 217:28-29.

Olausson, Deborah J.  

Oster G.  

Packer, Craig and Jean Clottes  

Pettitt, Paul and Allistar Pike  

Piette, T.  

Pigeaud, Romain  

Powell, Adam, Stephen Shennan, and Mark G. Thomas  

Reed, Walt  
1984 *The Figure, A Classic Approach to Drawing and Construction*. North Light Books, Ohio.
Roepstorff, Andreas  

Rosenbaum, David A., Jason Augustyn, Rajal G. Cohen and Steven A.Jax  

Scarre, Christopher  
2009 The human past: world prehistory and the development of human societies. Thames and Hudson, New York

Scott, Sarah  

Shennan, Stephen  

Smith, Nathan D., and Turner, Alan  

Sotnikova M. and Nicholskiy P.  
2006 Systematic position of the cave lion panthera spelaea based on cranial and dental characteristics. Quaternary International 142(2006):218-228

Sonneville-Bordes, Denise  

Sotnikova, Marina and Pavel Nikolskiy  
2005 Systematic position of the cave lion Panthera spealaea based on cranial and dental characteristics. Quaternary International 142-143:218-228.

Spielmann, Katerine A.  

Stapert, Dick  

Stout, Dietrich, Nicholas Toth, Kathy Schick and Thierry Chananade  

Stiner, Mary, and Natalie D. Munro  
Stiner, Mary, and Steven Kuhn
2009 Paleolithic Diet and the Division of Labor in Mediterranean Eurasia. In 
*Integrating Approaches to the Study of Palaeolithic Subsistence*, edited by Jean-Jacques Hublin and Michael P. Richards, pp. 157-169. Springer Verlag,

Stiner, Mary C., and Steven L. Kuhn

Striener DL.

Stuver, Minze and Pieter Grootes

Tattersall, Ian

Tosello, Gilles

Tosello G., and Fritz, C.

Turner, Alan H.

Upton, Graham, and Ian Cook (Editors)

Vaesen, Krist

Van Andel, H. Tjeerd, William Davies, and Leslie Aiello
2003 Neanderthals and modern humans in the European landscape during the last glaciation: archaeological results of the Stage 3 Project. McDonald Institute for Archaeological Research, Oxford.

Van Andel T.H. and P.C. Tzedaskis
1996 Palaeolithic landscapes of Europe and environs, 150,000–25,000 years ago: An overview. *Quaternary Science Reviews* 15:481-500

Voss, James F., and Jennifer Wiley

White, Randall
White R., Arts N., Bahn P.G., Binford L.R., Devez, M.
1982 Rethinking the Middle/Upper Palaeolithic Transition in Western Europe.

Williams, Austin R.
2012 A Many Sided Approach to the Figure. American Artist, Drawing 2:30-37.

Yamaguchi, Nobuyuki, Alan Cooper, Lars Werdelin, and Jared Macdonald
Appendix A

The evaluation criteria for representative drawing

Evaluation Criteria for Representative Drawing

Enclosed are the descriptions of seven drawing skills that are necessary to produce representative drawing. Each skill is explained with examples of novice and practiced drawings, and will be used to evaluate participants drawing on a scale of one to five.

On a scale of one to five, the novice example represents a one, and the practiced example represents a five.
Skill #1: Line

When a practiced artist draws a line they are considering the placement, perspective, angles, proportion, and volume of the subject. New artists are unsure of how to represent these traits so they leave a insecure, rough, scrubbed-out, and redundant line. Practiced artists are accustomed to representing figures so they can accurately execute the above mentioned traits in a quick, confident fashion. As such, their line quality suggests weight, volume, emotion and stylistic personality to the viewer.

The practiced line

The quick, confident line is easier to see on a fast drawing.

Strong, confident strokes

In a refined drawing, the line is more subtle.

Close up you can see a quick but controlled line.

Illustrations (left) by Adam Rogers, (right) by Giovanni Civardi (Civardi 1994)
The Novice Line

There are two types of novice line. The "scrubbed" line is redundant, messy and often smudged because the artist is hesitant and lacks confidence. The "child's line" is a result of the artist not paying attention to the subject being drawn. It is thus named because children do not often reference subjects when drawing. The result of this lack of attention is a quickly drawn, haphazard line that is a uniform thickness.

The child's line

Novice drawings often have both types of line.
Skill #2 **Space**

*Positive space* refers to the space occupied by the drawn figure and *negative space* refers to the space that surrounds it.

New artists often do not consider the distribution of space. They generally focus on the most representative aspects of the positive space while understating the negative space. The result is a wonky and disproportionate figure. Skilled artists are aware of this influence and understand the importance of correctly representing negative space.

Illustration (top) from (Edwards 1999)
Skill 3: Proportion

Proportion refers to the size of the object as it appears alone, and relative to another object. To achieve accurate proportion, practiced artists measure the size of one object against another.

For example, the measurements of the apples in perspective indicate that the furthest apple is half the size of the apple closest to us.

The proportions in the horse of the practiced artists matches the photo, while the novice image shows to be very disproportionate.
Skill 5 Light positioning

Lights and shadows give objects dimension. Natural light should be perceived as a flow of water from a single source (i.e., the sun), as it bounces off of angles and surfaces illuminating subjects in ways that is often irregular, spontaneous and unexpected.

Novice artists have a tendency to ignore the natural placement of light and draw lights and shadows where they think they might fall and shade around the contour line of the drawing.

This drawing shows the inappropriate placement of highlights and shadows, and shading around contours.
Notice how the figure appears flattened.

This drawing shows the shadows, highlights and mid tones of the horse in the photograph.
Skill 6: Tonal Balance

The word ‘tone’ refers to the values of grey between the lightest and darkest extremes. Novice drawings are generally tonally too light or dark compared to the subject. To portray a tonally balanced image practiced artists generally use all of the values in the strip.

Keeping tones accurate and consistent can be difficult because our eyes play tricks on us. For example, even though every center dot is the same tone, the dot surrounding light tones appears darker than the dot surrounded by dark tones.

Illustration (above) by Giovani Civardi (Civardi 2005)
Skill 7: **Gestalt**

This skill is generally not taught, but one that arises through practice and an improved aesthetic awareness. In drawing, the gestalt refers to the unification of skills to create balanced, communicable and unified image. It embodies the principals of design such as unity, variety, contrast and emphasis, with intent to create compositional balance. Please rate the participants’ drawings as a whole.

*How appealing is the drawing?*
Appendix B

A practice evaluation form filled out by a participant during trials.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Duration</th>
<th>Weekly Hours</th>
<th>Annual Hours (weekly hours x 52 weeks)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGE 13 - 17</td>
<td>High school art class</td>
<td>2.5 years</td>
<td>8 hrs.</td>
<td>1040</td>
</tr>
<tr>
<td>AGE 17 - 19</td>
<td>Kwantlen College</td>
<td>2 years</td>
<td>12 hrs.</td>
<td>1,248</td>
</tr>
<tr>
<td>AGE 19 - 20</td>
<td>Emily Carr Foundation</td>
<td>1 year</td>
<td>15 hrs.</td>
<td>780</td>
</tr>
<tr>
<td>AGE 20 - 23</td>
<td>Emily Carr. Animation</td>
<td>3 years</td>
<td>35 hrs.</td>
<td>5,460</td>
</tr>
<tr>
<td>AGE 24 - 27</td>
<td>NOA (Work w/Anim)</td>
<td>3 years</td>
<td>50 hrs.</td>
<td>7,800</td>
</tr>
<tr>
<td>AGE 27 - 30</td>
<td>Barkin Guildford (Art)</td>
<td>2.5 years</td>
<td>50 hrs.</td>
<td>6,800</td>
</tr>
<tr>
<td>AGE 30 - 32</td>
<td>Digital Teaching</td>
<td>3 years</td>
<td>14 hrs.</td>
<td>2,184</td>
</tr>
<tr>
<td>- AGE 32 - 33</td>
<td>Teaching + Hardcore Cinema</td>
<td>6 months</td>
<td>30 hrs.</td>
<td>780</td>
</tr>
<tr>
<td>AGE 33 - Now</td>
<td>Carbon Black Animatics</td>
<td>9 months</td>
<td>65 hrs.</td>
<td>2,165</td>
</tr>
<tr>
<td>AGE 34 - 37</td>
<td>Nitey: 3D Anim.</td>
<td>3 years</td>
<td>7 hrs.</td>
<td>2,548</td>
</tr>
<tr>
<td>AGE 37 - Now</td>
<td></td>
<td>5 years</td>
<td>8 hrs.</td>
<td>2,088</td>
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</table>

Total 33,163