ADAPTING MARIONETTE MOVEMENT THROUGH THE PHYSIOLOGICAL STUDY OF ANIMAL MOTION

By

Mienke van Zyl

Submitted in partial fulfilment of the requirements for the degree

MAGISTER TECHNOLOGIAE

Department of Entertainment Technology

Faculty of the Arts

TSHWANE UNIVERSITY OF TECHNOLOGY

Supervisor: Dr O. Seda

Co-supervisor: Mr. P.A. Bezuidenhout

The financial assistance of the National Research Foundation (NRF) towards the realisation of this research is hereby acknowledged. Opinions expressed and conclusions arrived at, are those of the author and are not necessarily to be attributed to the NRF.

DECLARATION BY THE CANDIDATE

2015

‘I hereby declare that this dissertation submitted for the degree of M Tech Performing Arts Technology at Tshwane University of Technology, is my own work and has not been previously submitted to any other institution. The references quoted are indicated and acknowledged by means of a comprehensive list of references.’

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Mienke van Zyl

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude and appreciation to the following people and institutions without whom this study would not have been possible:

- To my supervisor, Dr. Owen Seda who meticulously and patiently supervised the development of this study over the course of three years, from the first days of proposal formulation to the final days of assessment. I appreciate the time and effort you put in to assist me in completing my Master's degree.
- To my co-supervisor, Mr. Pieter A. Bezuidenhout who has been my lecturer for six consecutive years and who was always willing to advise and assist me in my professional development.
- To my beloved husband, Janus Fouché who was a boyfriend, a fiancé and then a husband throughout the development of this study. I thank you for your unwavering support, the computer programs you wrote to assist me in my research and your patience in listening for three years to the pains and pleasures of writing this dissertation.
- To my parents and brother, for your support and your faith in me that I would succeed with this study.
- To my mother, for helping me formulate the words and express the correct meaning.
- To Art Lovers art gallery, for allowing me to use your gallery to test the effectiveness of my marionettes.
- To the National Research Foundation, for granting me a scholarship to finance my study.

ABSTRACT

This research project is based on the construction of five animal marionettes with a specific purpose to have them move realistically on the basis of an in-depth study of animal physiology and locomotion. The study began with an in-depth study of animal anatomy and locomotion which was then used to design and construct five animal marionettes. To test the effectiveness of the movement so realized, the five animal marionettes then performed for an adult audience consisting of thirty respondents whose ages ranged from eighteen to over sixty. The respondents evaluated the effectiveness of the animal marionettes' movement by completing an open-ended questionnaire.

The analysis of the responses to the questionnaire indicates that the movement of the five marionettes' was realistic and effective. Respondents scored the marionettes an overall score of 84% for realistic movement. The majority of respondents were also able to connect emotionally with one or more of the marionettes and they were able to willingly suspend their disbelief. To maintain the focus of the audience on movement and movement alone, the performance was deliberately devoid of the usual attributes of the theatre such as storyline, character roles, sound and lighting. All these were omitted from the performance.

Besides the use of the study of animal physiology and locomotion in order to achieve more effective and realistic marionette movement, a significant finding of the research study is that in spite of the omission of the items listed above, the respondents were still able to ascribe character to the marionettes and become emotionally attached to them. This is an indication that the realistic movement of the marionettes, which was primarily based on a physiological study of animal skeletal structure, was so effective that it persuaded the respondents to attribute persona to the marionettes.

Keywords: Anatomy, animal, locomotion, marionettes, motion, movement, puppetry, realistic, skeleton.

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GLOSSARY OF TERMS

Aerial:	Relating to air (Oxford University Press, 2002)
Aerial locomotion:	Flying in an aerial environment – for example a gannet (Polly, 2011d: 13).
Ambulatorial locomotion:	General locomotion, ‘walking, running, climbing, and digging’ but not specifically specialised – for example a badger (Polly, 2011d: 6)
Appendicular skeleton:	The limbs of a skeleton (Oxford University Press, 2002)
Aquatic:	Relating to water (Oxford University Press, 2002)
Arboreal:	Relating to trees (Oxford University Press, 2002)
Axial skeleton:	The trunk of a skeleton (Oxford University Press, 2002)
Cantilevered:	A projecting beam fixed at one end (Oxford University Press, 2002)
Carpometacarpus:	Combination of ‘wrist’ bones and ‘hand’ bones fused together (Oxford University Press, 2002)
Coracoids:	Extensions of the shoulder blade (Patton, 2015: 266)
Cursorial locomotion:	Four-legged locomotion in a terrestrial environment – for example a deer (Polly, 2011d: 13)

Fossorial:	Relating to underground or burrowing (Oxford University Press, 2002)
Fossorial locomotion:	Locomotion in a fossorial environment – for example a mole (Polly, 2011d: 13)
Gait:	The pattern of steps of an animal at a particular speed (Oxford University Press, 2002)
Graviportal locomotion:	Movement of a large mass at a relatively slow pace in a terrestrial environment – for example an elephant (Polly, 2011d: 13)
Marionette:	A puppet manipulated by strings (Oxford University Press, 2002)
Marotte:	A puppet that has no moving parts except for the head (Jurkowski, 2013: 38)
Natatorial locomotion:	Swimming in an aquatic environment – for example a whale (Polly, 2011d: 13)
Pectoral:	Relating to the chest (Oxford University Press, 2002)
Prehensile:	An animal's limbs or tail that is capable of grasping (Oxford University Press, 2002)
Pronate:	Ability to rotate the forearm to turn the palm downwards, usually found in arboreal animals (Polly, 2013: 4)

Puppet: A theatrical figure, perceived as an object, animated by design, movement and speech to appear to have life (Tillis, 1992: 65)

Saltatorial locomotion: Two-legged locomotion in a terrestrial environment also known as ‘hopping’ – for example a wallaby (Polly, 2011d: 13)

Scansorial locomotion: Locomotion in an arboreal environment – for example a lemur (Polly, 2011d: 13)

Sinusoidal: Another term for a sine wave also known as an ‘S’-shaped curve (Oxford University Press, 2002)

Supinate: Ability to rotate the forearm to turn the palm upwards, usually found in arboreal animals (Polly, 2013: 4)

Sternum: Breastbone (Oxford University Press, 2002)

Synsacrum: Fusion of part of the pelvis to the lumbar vertebrae (Bonnan, 2016: 366)

Terrestrial: Relating to the earth (Oxford University Press, 2002)

CHAPTER 1: Introduction

1.1. Introduction

In 1801 Heinrich von Kleist, a famous German writer, wrote an essay titled *Über das Marionettentheater,* 'On the Marionette Theatre'. The essay explores the idea that puppets and animals have more grace and honesty in their movements due to their inability to become self-conscious.

> 'We see how, in the organic world, as reflection grows darker and weaker, grace emerges ever more radiant and supreme.'
>
> -B.H.W. von Kleist (On the Marionette Theatre, 1801)

Before the researcher's intentions can be discussed in full, it is important to define what constitutes a puppet. Steve Tillis has come up with a comprehensive and coherent definition of a puppet. His definition is as follows:

> 'The puppet is a theatrical figure, perceived by an audience to be an object, that is given design, movement and frequently speech, so that it fulfils the audience's desire to imagine it as having life; by creating a double-vision of perception and imagination, the puppet pleasurably challenges the audience's understanding of the relationship between objects and life' (Tillis, 1992: 65).

It can therefore be argued that puppets are physical figures that communicate to their audiences through design, movement and sound (Tillis, 1992: 18-38). However, not all three elements cited above have to be present for a puppet to communicate effectively. For a puppet to convey a message to the audience it must have at least one of the following: a convincing design, realistic movement or comprehensible audio accompaniment.

Puppet horses made by the Handspring Puppet Company for the stage production of the play *War Horse* provide an interesting case in point in terms of the relationship between animal motion and realistic puppet movement. In spite of their design, which left the viewer in no doubt that they were not real horses, the movement and audio accompaniment of the horses were so effective that members of the audience became emotionally attached to the 'horses'.

The researcher was fortunate to see the production of *War Horse* in November 2014 at Monte Casino in Johannesburg. It was a profound experience. In the final scene, as the veterinarian was about to shoot Joey (the protagonist's horse), the mostly adult audience protested audibly. Despite the unrealistic appearance of the Handspring Puppet Company's puppet horses, audiences still perceived them as living creatures. Although somewhat abstract, the design features of the horses incorporated recognisable characteristics of horses. However, it is through their movement that the horse puppets came to life, capturing the imagination of the audience.

A number of puppet makers such as Adrian Kohler and Basil Jones of the Handspring Puppet Company (Taylor, 2009) and Roger Titley (2013) have observed animals in motion and referred to animal anatomy in order to construct what they consider to be more effective puppets. In doing that, they proved that there is a link between the physiology of animal motion and the creation of more convincing puppets in terms of movement. However, to the knowledge of this researcher, apart from the practical work of the Handspring Puppet Company, no in-depth study has been undertaken in South Africa on the link between animal motion and puppet construction to date. J. Bell (2001) mentions that, although there is a considerable number of puppet makers and manipulators across the world, the field of modern puppetry is generally under-researched in most countries.

The purpose of this study therefore is to analyse how physiological motion can be harnessed to create more realistic motion and movement in puppetry. In other words, this study aims to create a more effective link between puppetry and the physiology of animal skeletal movement. It does this by analysing how physiological motion can be harnessed to create more realistic motion and movement in marionettes.

The term 'marionette' refers to a specific type of puppet that is controlled with strings from above. This research is going to use the terms 'marionette' and 'puppet' interchangeably since puppetry is itself a generic term. However, the researcher intends to base the study on marionettes, which are a type of puppet as explained above.

Puppetry is an art form believed to be as ancient as the art of storytelling itself (Champlin, 1998: 3). It has survived for countless years, making one wonder what it is about puppetry that makes it such a timeless art form. In many African cultures storytelling and puppetry have a symbiotic relationship. African puppetry does not always exist in the same form as it does in Western culture, it is more a type of masked theatre with ritual applications (Rubin, 1997: 230).

According to Jurkowski (2013: 38) ancient African puppets were intended for ritualistic purposes. They were constructed from various materials including bamboo, wood, straw, string, cloth, tin, hair and brightly painted for decoration. Their methods of manipulation were also diverse (Jurkowski, 2013: 38), existing as rod puppets and string puppets. Marottes, masks, headdresses or backpack puppets often had their moveable parts limited to essentials, for example a moveable hand or a phallus (Jurkowski, 2013: 39).

African puppeteers used puppetry as a form of entertainment and religion. For instance, the Yoruba of Nigeria uses masked puppets to ‘criticise antisocial behaviour’ and to satirise neighbouring tribes (Rubin, 1997: 230). The puppet masks sometimes have small totemic creatures (birds, snakes, hunters etc.) mounted on top that can be manipulated by the wearer (refer to Fig. 1.1.1).

Fig. 1.1.1: Yoruba Totemic Puppet (Hamill, 2016b)

Also from Nigeria are the Tiv people who perform *Kwagh-hir* puppet theatre which is a form of dramatized folktales. The name *Kwagh-hir* translates into English as ‘magic folktale’ (Pine, 2012: 3). Puppets used in these performances are either giant human or animal puppets or smaller carved puppets mounted on wooden platforms and manipulated from below (Nyager, 2011: 181) (Pine, 2012: 3). The masked theatre is a serious tradition as it touches the line between the living world and the supernatural (Rubin, 1997: 230). Masquerades of humans and animals are also common in other parts of Africa (Nyager, 2011: 181).

The Bamana of Mali for example practise *Sogo Bo.* *Sogo Bo* performances are a combination of puppetry and masquerade dance to tell fables. The term *Sogo Bo* means 'the animals come forth*'.* Animal characters play a key role in these performances. They serve as symbols of qualities such as majesty, mischief and grace (Museum for African Art, 2006: 7). The puppets themselves are generally giant puppets supported and controlled from within (refer to Fig. 1.1.2). Both the puppets and the masked performers dance to the beat of a drum during the performance. A chorus of women sings between but not during the dances as the beat of the drums, the puppets, the masks and the movement of the dancers tell the story (Museum for African Art, 2006: 10).

Fig. 1.1.2: Sogo Bo Puppets (Hamill, 2016a)

The Sogolon Puppet Troupe is a contemporary puppet troupe based in Bamako in Mali (Museum for African Art, 2006: 6,7). Yaya Coulibaly, the director spent his youth mastering the art of Malian puppetry and later studied puppetry in France. In Sogolon Puppet Troupe performances Coulibaly mainly keeps to the traditional Mali performance format, but incorporates voices and marionettes (Museum for African Art, 2006: 12). The Sogolon Puppet Troupe has worked with the Handspring Puppet Company to create the production *Tall Horse* (Taylor, 2009: 118). The style of the giraffe was the typical Malian puppet style with angular edges and bright geometric decorations (refer to Fig. 1.1.3).

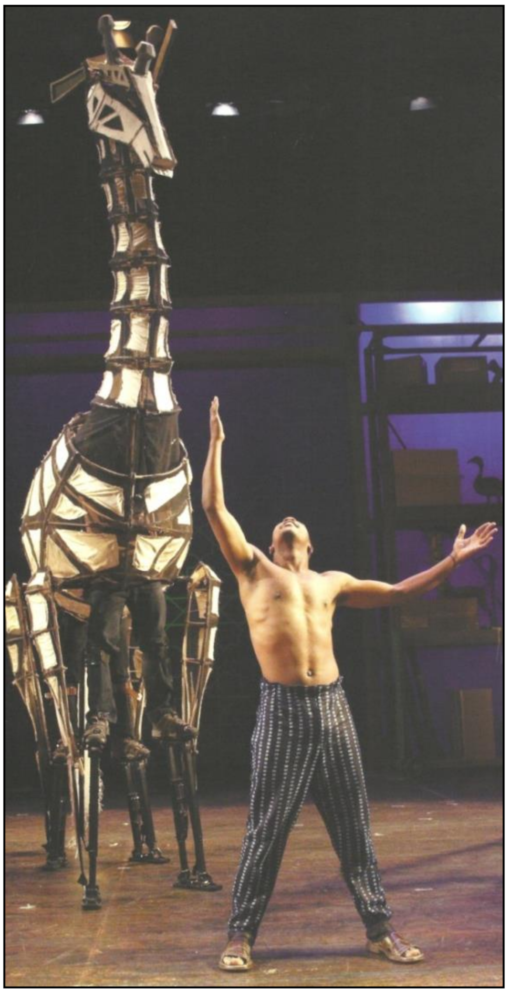

Fig. 1.1.3: The Giraffe from *Tall Horse* (Taylor, 2009: 119)

African stories are rich in animal characters. Considering the diversity of life on the African continent, this comes as no surprise. It makes sense then that if the puppets and masks were used for ritualistic purposes they would represent gods, ancestors or demons and according to Jurkowski (2013: 39) they often manifested as mythical animals.

The Tiv *Kwagh-hir* puppet theatre in Nigeria, the Bamana of Mali who practice *Sogo Bo* and the Sogolon Puppet troupe in Bamako are examples of animal puppetry in Africa. Puppetry is by no means a rare art form in Africa. Today it is still used throughout the continent to educate, rehabilitate, criticize and entertain. However these types of puppetry performance place a great deal of emphasis on the purpose of the story and the symbolism of the puppets, animal or otherwise, and are icons of their respective cultures. The researcher’s intent is to stage a performance where the movement of the marionettes takes precedence over the story, characters and ambience and that is not based on the style of any existing culture.

The researcher believes that there is a lacuna in South African puppetry research from a technical perspective, especially with regard to marionette movement based on animal motion. The researcher is of the opinion that for purposes of puppet-making, merely observing the movement of an animal is not as effective as fully understanding the animal's anatomy and mode of locomotion.

The focus of this study therefore is on exploring and understanding the skeletal system of vertebrate animals in order to construct more realistic motion and movement in marionettes. Although the muscular system of animals is just as important as their skeletal systems in allowing animals to move, this study will only focus on animal skeletal anatomy. The researcher is of the opinion that including a study of muscular anatomy would render the scope of the research too wide.

The current research is inspired by what the Handspring Puppet Company has achieved with Joey the puppet horse: the situation in the play where the horse is about to be shot and the audience audibly protests. Though the researcher will not stage such a dramatic performance, she intends to touch on the emotional connection and willing suspension of disbelief that the Handspring Puppet Company was able to achieve. The study intends to use animal motion in order to create marionettes that will have an impact on audiences. By creating marionettes exhibiting movement adapted to animal skeletal motion, the realism of the movement should alter the perception of the audience into experiencing the marionettes as convincing creatures.

1.2 Research Problem and Sub-problems

Research Problem

The main purpose of this research project is to create a link between animal skeletal structure and marionette construction in order to create convincing marionettes that move in a more realistic manner.

Sub-problems

- To use physiological research on vertebrate animals in order to create convincing marionettes that move in a more realistic manner.

- To stage a performance of the puppet characters for an adult audience to allow the audience to assess the realism of the movement of the marionettes and to obtain feedback thereon.

1.3 Research Aims and Objectives

Research Aim

The research aims to adapt animal marionette movement through a study of animal anatomy and motion in order to achieve convincing and more realistic marionette movement.

Objectives

- To design and construct five animal marionettes based on the research done on animal anatomy and motion.
- To stage a puppet show involving the five animal marionettes for an adult audience of thirty participants. This will be done in order to test the effectiveness of the animal marionettes in terms of realistic movement.

1.4 Methodology

The research methodology adopted for the study is a united method between action, qualitative and quantitative research. Since the research intends to create marionettes based on personal observation and study of animal motion, the over-arching research method or main research method adopted is practice led action research. Action research is used throughout the development of an activity to improve on the methods usually associated with the activity (Watkins, 2001). Action research was used to improve on marionette construction by incorporating a physiological study of animal anatomy and motion. Additionally, qualitative and quantitative methods of research are used to assess the realism of the marionette's movement.

The researcher asked participants to evaluate the marionettes' movement and express an opinion on how realistically they moved. The supporting research method is theoretical research, as the researcher gathered data on animal anatomy and motion and subjected the data to interpretation.

The researcher identified the five animals that are discussed in the study. The researcher discusses the types of bone, types of joint and skeletal construction of each animal by reference to their skeletons. The researcher also watched wildlife footage of the animals in their natural habitats, especially the footage of British naturalist Sir David F. Attenborough.

The researcher used the information gathered on the animals' anatomy and motion to design and draw the construction drawings of the animal marionettes. The marionettes were then constructed from the construction drawings. Performances with the marionettes were staged for an adult audience on two evenings at the Art Lovers art gallery situated in Waterkloof, Pretoria. Direct participatory observation was used to gather data from the people observing the marionette performances.

Three different groups of people served as respondents. The first group consisted of ten young adults ranging from ages 18 to 39, the second group consisted of ten adults ranging from ages 40 to 59 and the final group consisted of ten elderly persons aged 60 years and older. Adults were used to view and evaluate the marionette performances for purposes of the study, because the notion of suspended disbelief is more applicable to adults than to children. In addition, the researcher is of the opinion that adults would be more critical when assessing a marionette performance in terms of how convincing and realistic they find the marionettes' movements.

To garner participants the researcher invited people via the electronic mailing list of the Art Lovers art gallery where the performance was held. Using persons who have an interest or background in the arts ensured that the feedback received after the marionette performance came from participants who are more critically astute and knowledgeable on the subject.

The participants were required to complete an open-ended questionnaire (refer to addendum A) after the marionette performance. This was the main method employed to obtain data pertaining to the participants' perception. The questionnaire contained structured questions about the participants' age and gender and unstructured questions relating to their perceptions and appreciation of the performance. Age and gender groups were compared to find patterns of similarity or dissimilarity in the response to the questionnaire. The data from the questionnaires were analysed using qualitative and quantitative methods. The answers to unstructured questions were analysed to find patterns of similar or recurring thoughts. The answers to structured questions were analysed to develop statistics on the age and gender of the respondents. It was also used depict the rating of the realistic movement as a numerical value.

The puppeteers that were used to manipulate the marionettes during the performances were amateurs (refer to addendum B). This was a deliberate decision as the researcher was concerned that professional puppeteers would likely be able to move the marionettes convincingly regardless of the quality of the marionette construction. This is especially relevant since the study was focused on the realism of the marionettes' movement and not the proficiency of the puppeteers. Both puppeteers are familiar to the researcher and were able to practice with the marionettes designed and constructed for the study.

The marionettes did not perform to a fictionalized storyline as this might have run the risk of not exposing them to the audience in equal measure for the purposes of audience perception and analysis. The researcher also feared that a fictional story may immerse the participants to such a degree that they forget to observe and analyse the movement of the marionettes.

The puppeteers moved among the audience with the marionettes. This method is more interactive and enabled the audience to observe the marionettes' movement up close. The fact that Art Lovers is an art gallery facilitated this decision as the space is designed to allow people to walk around. The audience were therefore able to move around at their leisure and watch the puppeteers perform.

1.5 Ethics

This research project involves people who were expected to view a performance and complete an open-ended questionnaire in order to give their opinion. The only personal information requested from the participants was their age and gender. Open-ended questionnaires allow the participants to give opinions freely and to comment on any aspect of the performance. Although participants had to be over the age of eighteen, the process of selecting participants was non-discriminatory. The age requirement was necessary because the animal marionettes and marionette performance were designed for an adult audience. This was in view of the notion that the dramaturgical concept of the deliberate suspension of disbelief applies more to adults than to children.

Before the start of the performance the researcher explained what was expected of participants and mentioned that the performance would not contain any harmful images. Participants were also requested to sign an informed consent form. If participants felt uncomfortable with any aspect of the project they were allowed to leave at any stage during the performance. Participants were then expected to watch the performance and complete the open-ended questionnaire at the end of the performance.

Only the researcher, her supervisors, the examiners and the TUT Research Ethics Committee have access to the returned questionnaires.

CHAPTER 2: Animal Physiology

2.1 Introduction

This project focuses on the adaptation of marionette movement through a study of animal locomotion. The following sections will make extensive reference to, as well as use of, biological terms that are used in the study of animal physiology. This is done in order to stay as true to the physiological side of the study as possible. The researcher however makes every effort to adapt these biological terms to the field of puppet construction.

An animal is described as “a living organism which is typically distinguished from a plant by feeding on organic matter, having specialized sense organs and nervous system, and being able to move about and to respond rapidly to stimuli” Oxford Dictionary (2002).

In order to narrow the scope of the research, the study will focus on the classes of animal that have backbones, also known as vertebrates (Burton, 2010: 3,4). Sadava, Hillis, Heller & Berenbaum (2011) state that there are seven classes of living vertebrate animal consisting of: *mammals, birds, reptiles*, *amphibians, bony fish, cartilaginous fish* and *jawless fish*.

For the purposes of this study the three fish classes will be grouped together. The study will therefore focus on *mammals, birds, reptiles, amphibians* and *fish*. Diverse as these animal classes may be, they all have a common feature, which Burton (2010: 4) describes as a spinal cord that is surrounded by a segmented backbone, and that extends from the skull to the tip of the tail.

2.2 Animal Anatomy and Motion

This part focuses on animal anatomy and animal motion. It consists of five sections, with each section focusing on a class of vertebrate animal, namely: mammals, birds, reptiles, amphibians and fish. A specific animal from each class has been selected as the animal from which a marionette will be constructed. The factors which influenced the selection will be motivated at the end of the section on *General Animal Anatomy and Motion* (refer to section 2.2.1).

The section on each animal is divided into two parts. The part on anatomy identifies characteristics specific to the animal in question and includes figures of the animal's skeleton. The part on motion discusses the type of locomotion that the animal employs.

Chapter two is concluded by a discussion on joint types. Because the five animals chosen for this study share similar types of joint, joints will be discussed at the end of this section (refer to 2.2.7) to avoid unnecessary repetition of information.

2.2.1 General Animal Anatomy and Motion

There is a strong link between an animal's anatomy and its lifestyle (Burton, 2010: 6). Although animal skeletons differ markedly due to the diversity of their habitats and lifestyles, all of them share the same general body plan (see Fig. 2.2.1.1) (Starr, Evers and Starr, 2015: 298). According to Starr, Evers and Starr (2015: 391) vertebrates have endoskeletons that are bilaterally symmetrical. Their skeletons consist of two parts: the axial skeleton which compromises the skull and vertebrate column; and the appendicular skeleton which forms the limbs of the animal. The purpose of the skeleton is to protect the major organs of the body and to assist in locomotion (Starr, Evers and Starr, 2015: 392).

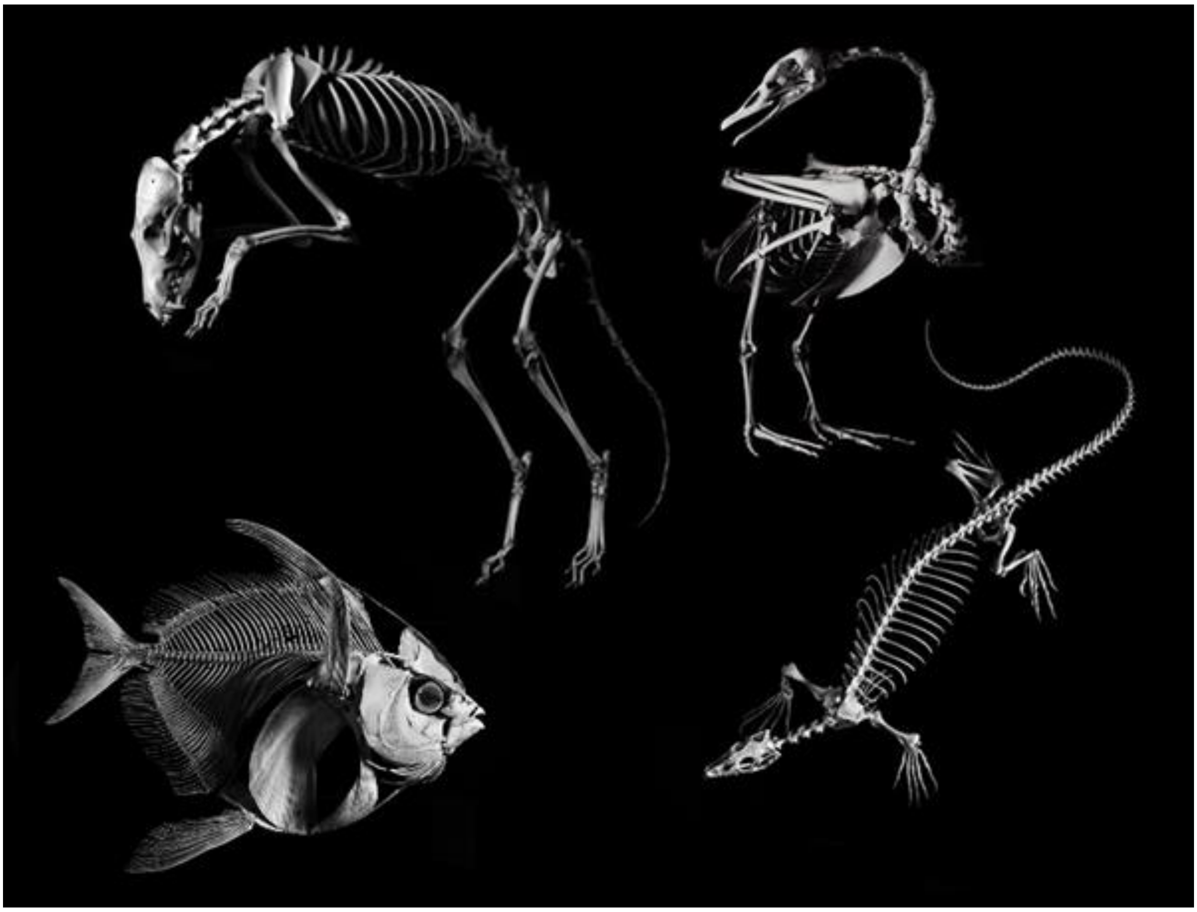

Fig. 2.2.1.1: Various Vertebrate Skeletons (De Panafieu and Gries, 2011: 53, 71, 160, 242)

Starr, Evers and Starr (2015: 391) explains that to be able to move, an animal requires control mechanisms and propulsion mechanisms that ‘involve a contractile structure’ to create the necessary propulsive force. Polly (2011a: 2) similarly describes locomotion, stating that it is started by forces that create forward progress and the means of controlling that progress. As a result, locomotion is formed by a combination of forward progress and directional control. Kisia (2011: 145) expresses the view that, to determine the types of movement a vertebrate animal is capable of, one must understand its joints and the ligaments functioning with the joints.

Burton (2010: 7) states that the movement of an animal is dictated by its structure and size. Whales for example are so big that the only environment that can support their weight is an aquatic environment (Burton, 2010: 7). According to Polly (2011d: 4) locomotion can be considered to be a 'compromise between movement and gravity'.

An animal's mode of locomotion depends on the animal's environment. The Encyclopædia Britannica (2013: Locomotion) describes four types of habitat, namely: aquatic, fossorial, terrestrial and aerial (which includes arboreal). An aquatic environment is an underwater habitat, while a fossorial environment is an underground habitat. A terrestrial environment is on land and an aerial environment is a habitat in the air. An arboreal environment is the habitat of animals that live in trees.

In each environment there are two elements that restrain movement: gravity and drag. Drag is also known as resistance, most notably air resistance and water resistance. Although gravity and drag are essentially the same in all four environments, they differ in degree (Krausman and Cain, 2013: 156). To counteract gravity and drag animals have specially adapted skeletal systems.

Movement in general is created by either axial locomotion – i.e. movement of the entire body; or appendicular locomotion – i.e. movement of the limbs. Axial locomotion is created by the body's interaction with its environment. This interaction usually alters the shape of the body to create propulsion. Appendicular locomotion is created by the appendages of the animal interacting with its environment (Encyclopædia Britannica, 2013: Locomotion).

According to Polly (2011d: 13) there are eight definitive types of locomotion, namely: cursorial, saltatorial, fossorial, ambulatorial, graviportal, scansorial, natatorial and aerial (see Fig. 2.2.1.2). Cursorial locomotion is quadruped locomotion in a terrestrial environment (on land), for example a deer. Saltatorial locomotion is bipedal locomotion (hopping) in a terrestrial environment, for example a wallaby (Polly, 2011d: 13). Fossorial locomotion is locomotion in a subterranean environment, for example a mole (Polly, 2011d: 13). Polly (2011d: 6) describes ambulatorial locomotion as general locomotion: 'walking, running, climbing, and digging but … specialized for none', for example a badger.

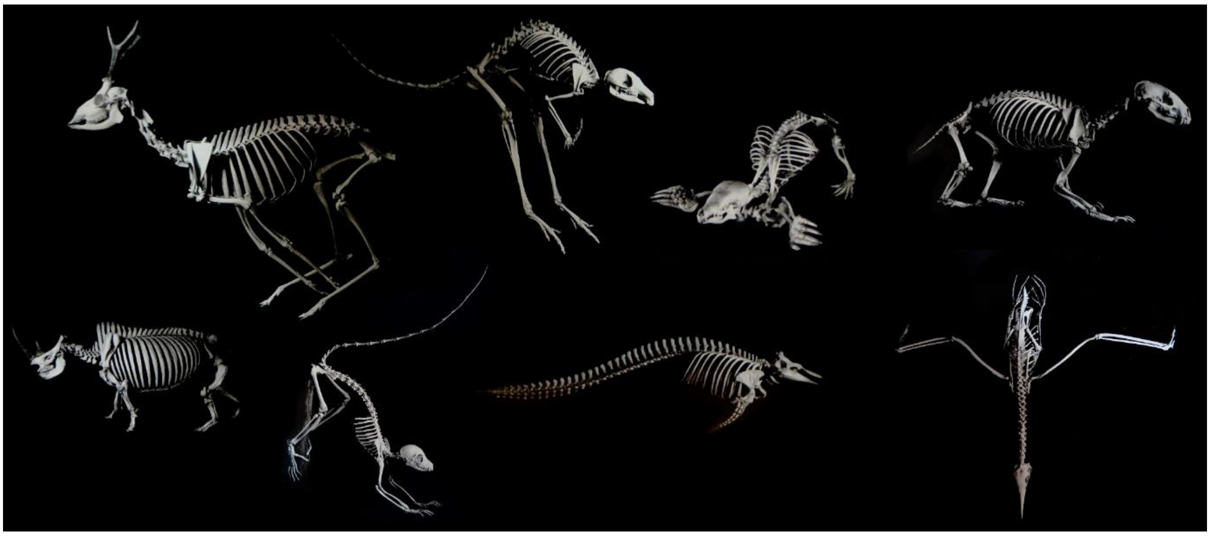

Fig. 2.2.1.2: Cursorial, Saltatorial, Fossorial, Ambulatorial, Graviportal, Scansorial, Natatorial and Aerial adapted Skeletons (De Panafieu and Gries, 2011: 39, 166, 200, 201, 225, 250, 314, 315, 351, 357)

Graviportal locomotion is movement of a large mass at a relatively slow pace in a terrestrial environment (on land). Animals such as elephants and rhinoceros employ graviportal locomotion (Polly, 2011d: 13). Scansorial locomotion is locomotion in an arboreal environment (in trees). Animals that employ scansorial locomotion have often evolved prehensile tails (gripping tails), for example a lemur (Polly, 2011d: 13).

Natatorial locomotion involves swimming in an aquatic environment, for example a whale, and aerial locomotion is flying in an aerial environment, for example a gannet (Polly, 2011d: 13).

The table below (refer to table 2.2.1.1) lists the animals that the researcher chose for the study. The researcher took the following factors into consideration to determine the choice of animals:

- Each animal marionette exhibits a different type of locomotion.
- The locomotion restrictions applicable to the various animal classes, for example: a fish cannot employ any form of locomotion other than natatorial because its anatomy is adapted to an aquatic environment (fish cannot climb trees, fly, run, etc.).
- The size of the animal: large animals move slower and their movement is more controlled, translating into easier marionette movement.

CLASS	**ANIMAL**	**LOCOMOTION**
Mammal	Sloth	Scansorial
Bird	Owl	Aerial
Reptile	Crocodile	Cursorial
Amphibian	Frog	Saltatorial
Fish	Shark	Natatorial

Table 2.2.1.1: Animals

2.2.2 The Mammal

Mammals are characterised by being warm blooded and having bodies that generate heat internally. Mammals have fur and the females are able to produce milk by means of their mammary glands, a trait that makes mammals unique. According to Star, Evers and Star (2015: 303) mammals are extremely diverse in form and habit due to the way they have evolved. Mammals can be found in every major habitat.

2.2.2.1 The Two-toed Sloth

For the purposes of this study the researcher chose a large arboreal mammal that employs scansorial locomotion. The sloth is an interesting choice in that it employs a unique form of scansorial locomotion – hanging from tree branches by its claws (refer to 2.2.2.1 *Locomotion*) – and it has an unnaturally elongated skeleton (see Fig. 2.2.2.1.1). The researcher specifically chose the two-toed sloth with its two-fingered front limbs as opposed to other sloths that have three fingers. The reason for this is that in the researcher's experience, in terms of marionette manipulation it is easier to control less appendages (Van Zyl, 2013: 231). Appendages that are easier to control also allow for more expressive and controlled movement.

Fig. 2.2.2.1.1: Sloth Skeleton (De Panafieu and Gries, 2011: 348, 349)

Anatomy

Two-toed sloths have two claws on their front limbs that are longer than the animal's three-clawed hind limbs (Encyclopædia Britannica, 2013: Sloth). These claws hook over branches so that the sloth can hang without putting too much strain on its muscles (Microsoft, 2009: Sloth) (see Fig. 2.2.2.1.1), which have been reduced to thin ribbons (Attenborough, 2002: Plant Predators).

Observing the skeleton (see Fig. 2.2.2.1.1) it is clear that the animal's skeleton is large and heavy. It has an elongated neck and ribcage while the pelvic bone is more dense and compact. Its forelimb and hind limb bones are also thick and heavy with the forelimbs being more developed and longer than the hind limbs (Microsoft, 2009: Sloth).

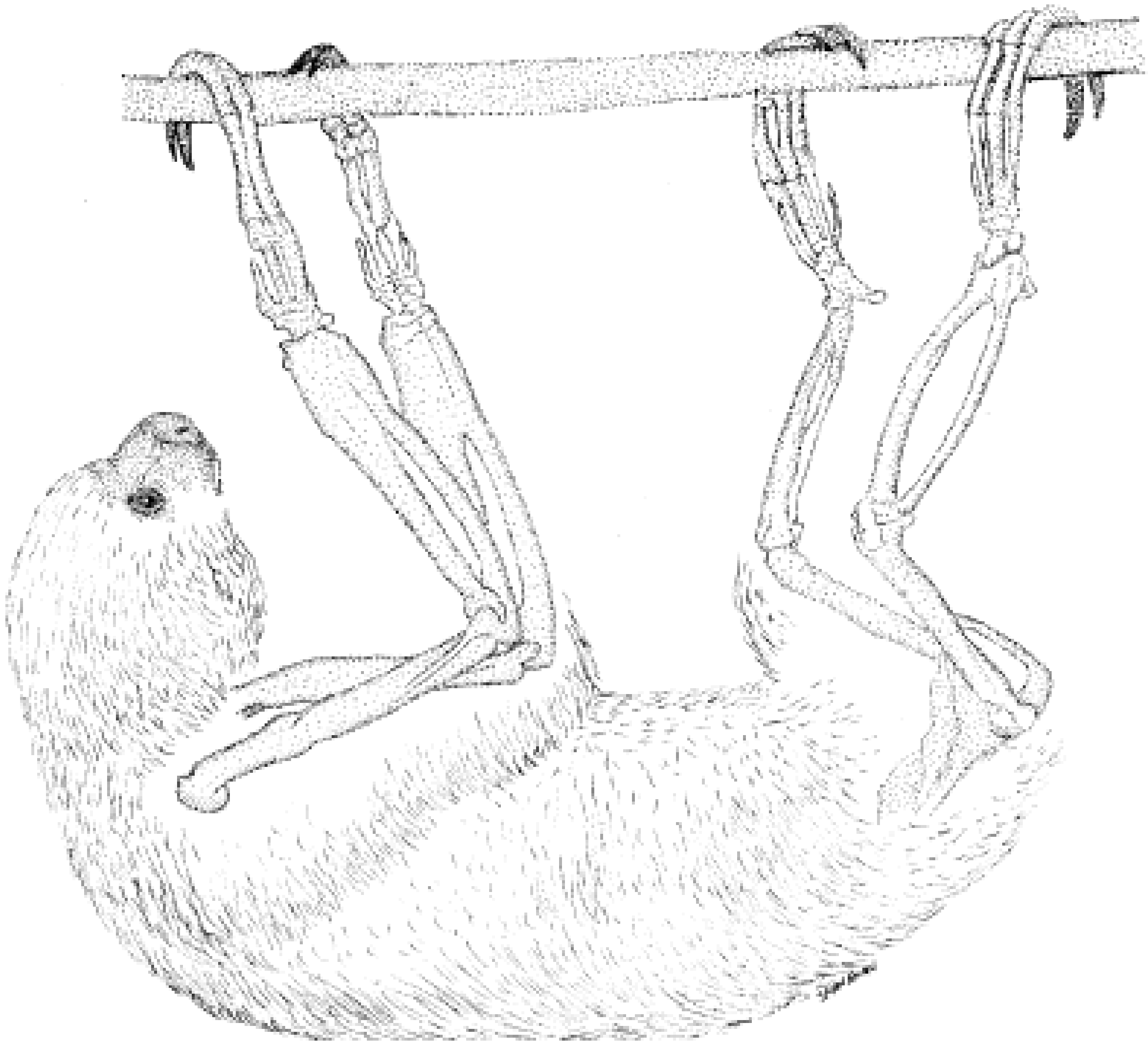

Fig. 2.2.2.1.2: Two-toed Sloth Anatomy (Piper, 2007: 135)

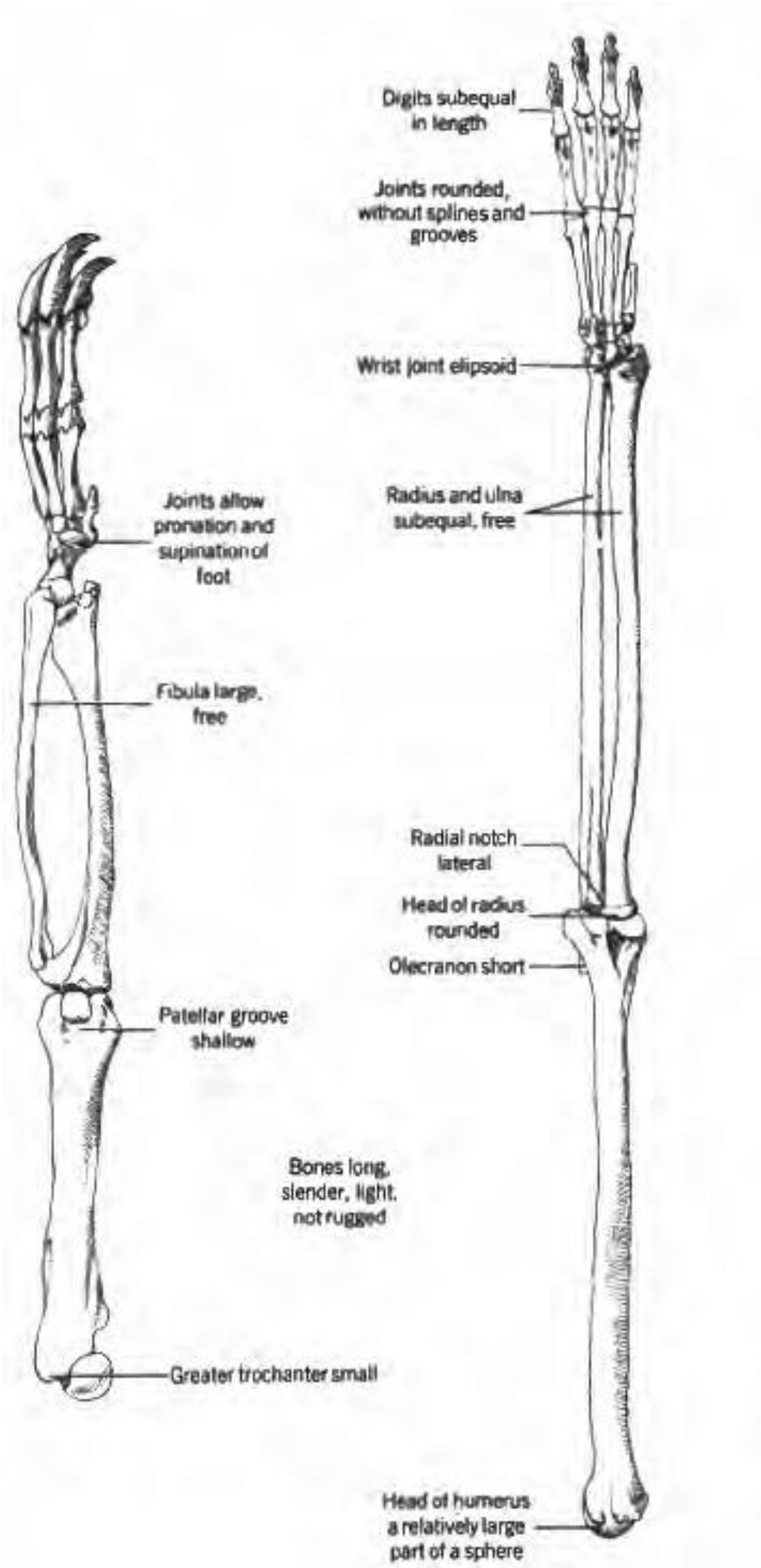

Fig. 2.2.2.1.3: Detailed Front and Hind Limb of a Sloth (Polly, 2013: 8)

Motion

The sloth is adapted for an arboreal lifestyle and thus employs scansorial locomotion. Specialised vertebrae in the neck allow the head to make complex rotational movements, which terrestrial animals (like dogs for example) are not capable of (Encyclopædia Britannica, 2013: Mammal). The legs are long and made for suspension of the body rather than for support. Sloths are thus most often found hanging horizontally, using their long claws to drag themselves along branches. When on the ground sloths are quite helpless and defenceless (Encyclopædia Britannica, 2013: Sloth).

Scansorial mammals have extremely mobile limbs capable of extensive rotations. Pronation (turning the palm down) and supination (turning the palm up) are important movements for purposes of scansorial locomotion (see Fig. 2.2.2.1.3) (Polly, 2013: 4). A rounder radial head at the proximal end of the radius allows an animal to pronate and supinate with greater ease (see Fig. 2.2.2.1.4), thus the rounder the radial head the better the ability to pronate and supinate (Polly, 2013: 4). This ability is also well developed in the hind limbs of the sloth (Polly, 2013: 6).

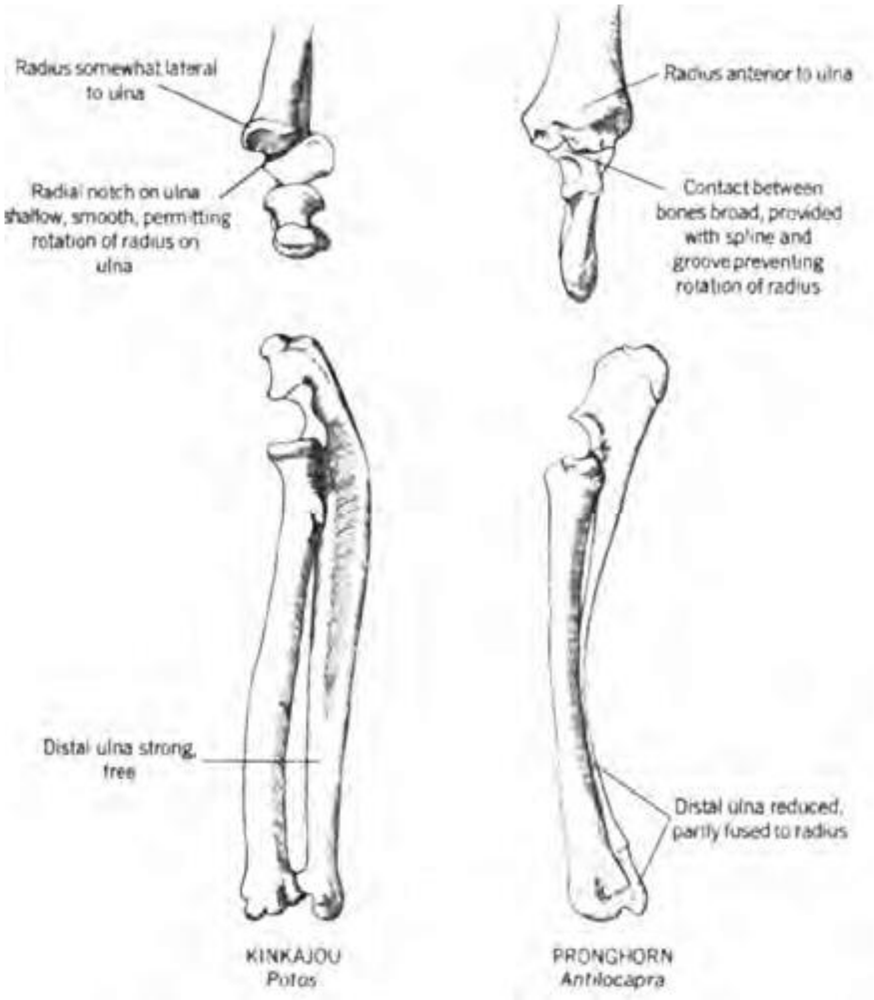

Fig. 2.2.2.1.4: A Kinkajou Forelimb (scansorial locomotion) compared to a Pronghorn Forelimb (cursorial locomotion) (Polly, 2013: 9)

The Encyclopædia Britannica (2013: Locomotion) mentions that in scansorial locomotion a limb will not be moved unless the other three are well anchored. The Encarta Encyclopædia (2009: Sloth) explains that a sloth moves one limb at a time, very slowly and deliberately.

However, in an advanced study on the functional morphology and locomotion of the two-toed sloth, Nyakutara (2010: 159) found that the locomotion of the sloth was no more than an upside down version of cursorial motion.

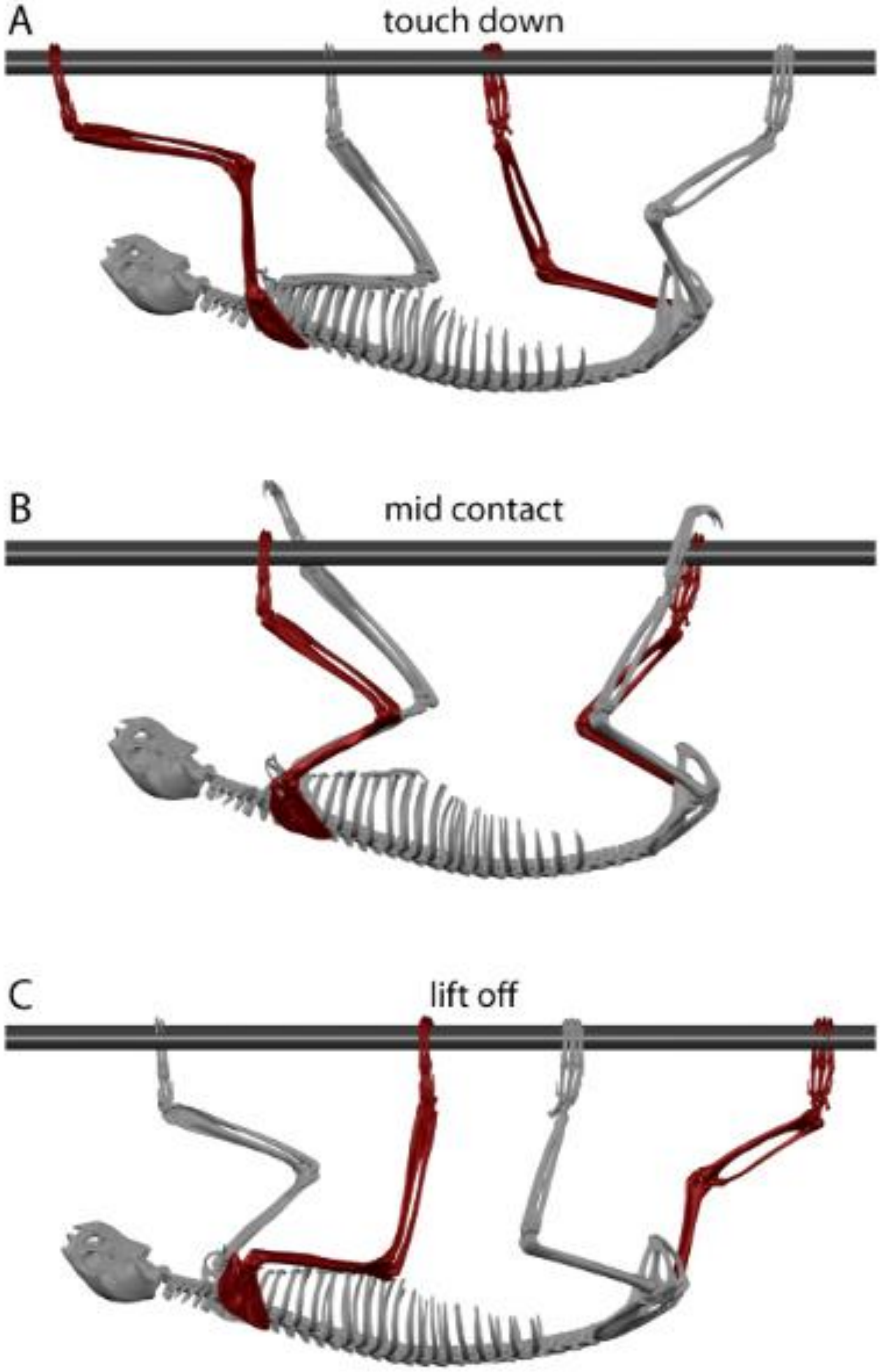

Fig. 2.2.2.1.5: Sloth Limb Movement (Nyakutara, 2010: 137)

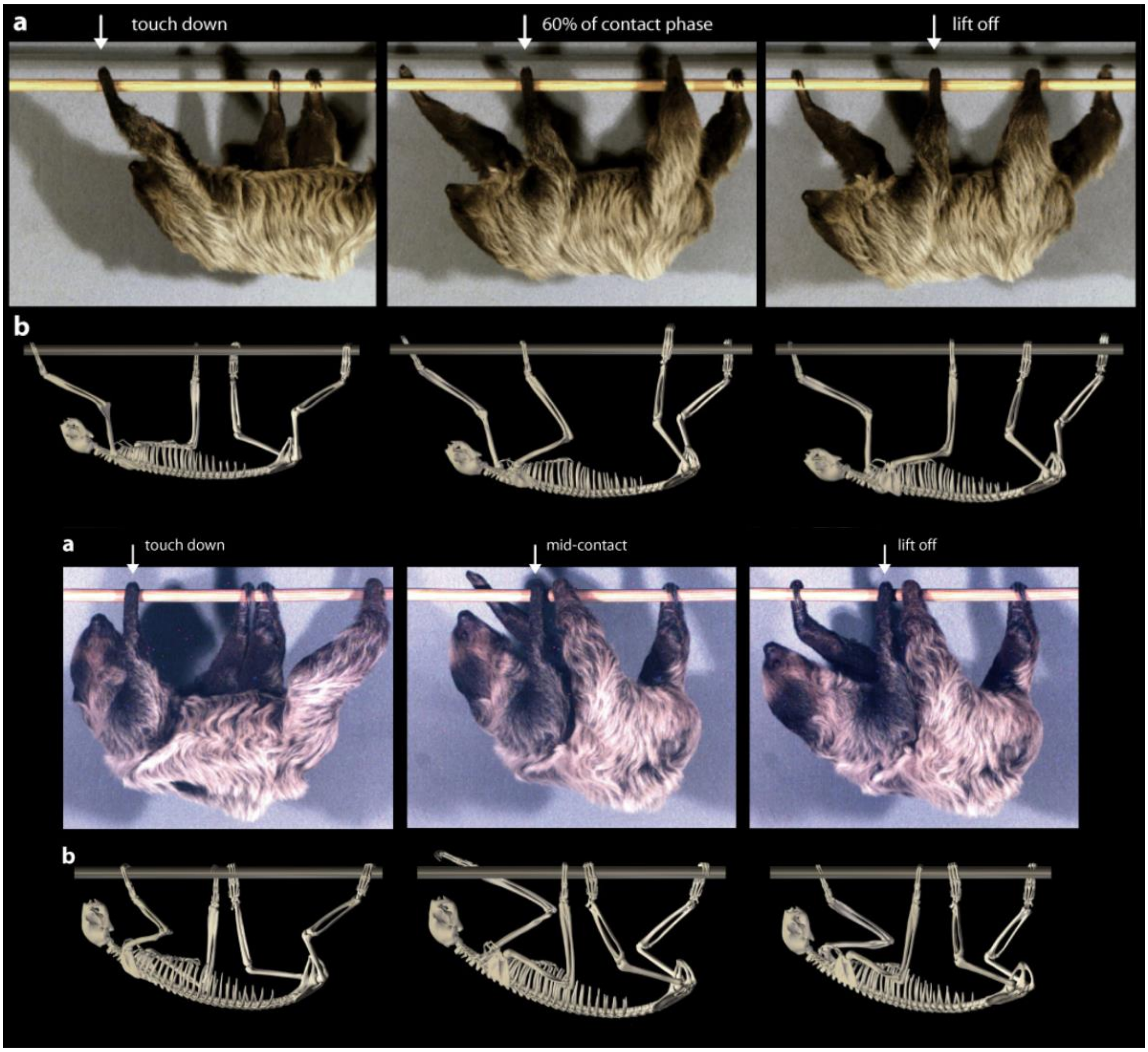

Fig. 2.2.2.1.6: Two-toed Sloth Movement (Nyakutara, 2010: 31, 28)

The images above (see Fig. 2.2.2.1.5 and Fig. 2.2.2.1.6) are screenshots taken by Nyakutara from a video he had made to demonstrate the sloth's movement. It is clear that the sloth moves the front leg forward in conjunction with the opposing hind leg.

2.2.3 The Bird

Birds are unique in that they have feathers, wings and toothless beaks. Although birds are characterised by the possession of wings not all birds are capable of flight (Burton, 2010: 223). Birds are also warm-blooded animals that generate heat internally.

2.2.3.1 The Common Barn Owl

The researcher chose a large bird that employs aerial locomotion and is thus capable of flight. Large predatory birds like vultures and eagles hunt during the day. These birds soar on thermals for most of the time during which they are airborne and on the hunt (Attenborough, 1998). Since owls hunt at night there are no thermals for them to use. Instead they often wait in trees or hover in the air searching for prey (refer to 2.2.3.1 *Motion*).

The researcher chose an owl as it has a more engaged mode of flight than other birds of prey. As mentioned above the majority of birds of prey mostly soar. When a bird soars it spreads its wings and relies on heat thermals to keep it airborne, rarely flapping its wings. This method of locomotion would be pointless to research as there is not much movement involved. The researcher chose the owl because it employs a more active mode of flight when hunting. The researcher specifically chose the common barn owl as it is the most common and well-known owl and there is plenty of information available on it.

Fig. 2.2.3.1.1: Owl Skeleton (De Panafieu and Gries, 2011: 101)

Anatomy

The sternum of the common barn owl is a stretched ‘bony blade’ positioned ventrally to the ribcage. According to De Panafieu (2011: 36) this forms the breastbone, which is the main area of attachment of the bird’s flight muscles.

The paired coracoids (extensions of the shoulder blades), the shoulder blades and the wishbone form the pectoral girdle (see Fig. 2.2.3.1.2) (Bonnan, 2016: 333). The wishbone consists of two clavicles fused at their distal ends (De Panafieu and Gries, 2011: 36). The wishbone is responsible for connecting the shoulder joints with the outer edge of the sternum's keel (Bonnan, 2016: 333). All these physiological structural adaptations are important elements with regard to the bird's ability to fly (De Panafieu and Gries, 2011: 36).

The wing consists of three segments relatively equal in length: 'the arm, the forearm, and the hand' (De Panafieu and Gries, 2011: 294). The elbow and wrist joints are restricted to movement in one plane (Attenborough, 1998: The Mastery of Flight).

The 'hand' of the bird consists of three partially fused digits, called the carpometacarpus, a combination of carpal bones and metacarpal bones fused together, that is a modification for flight (De Panafieu and Gries, 2011: 294). The wrist and elbow joints operate simultaneously as flexing the elbow flexes the wrist (Encyclopædia Britannica, 2013: Bird).

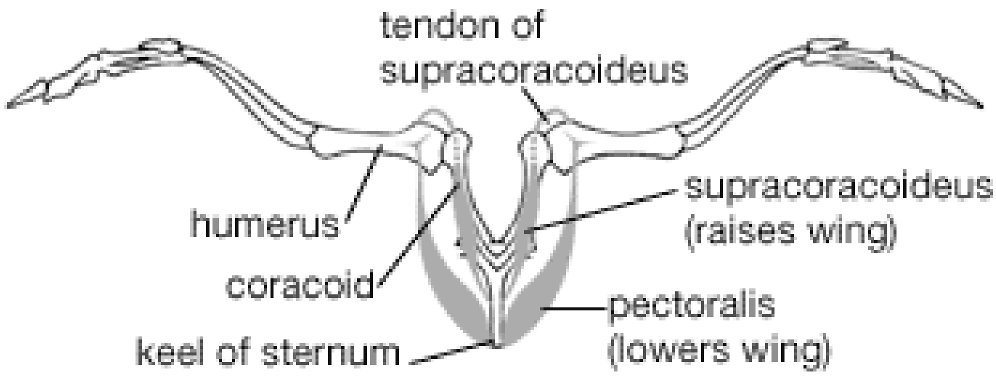

Fig. 2.2.3.1.2: Pectoral Girdle (Encyclopædia Britannica, 2013: Bird)

A bird has a very slim pelvic girdle that is fused to the synsacrum (fusion of part of the pelvis to the lumbar vertebrae) to create a longer and more rigid pelvic girdle. All these elements: the spine, the pectoral girdle, the ribs and the pelvic girdle, form a 'rigid structure', which are further adaptations for flight (De Panafieu and Gries, 2011: 294).

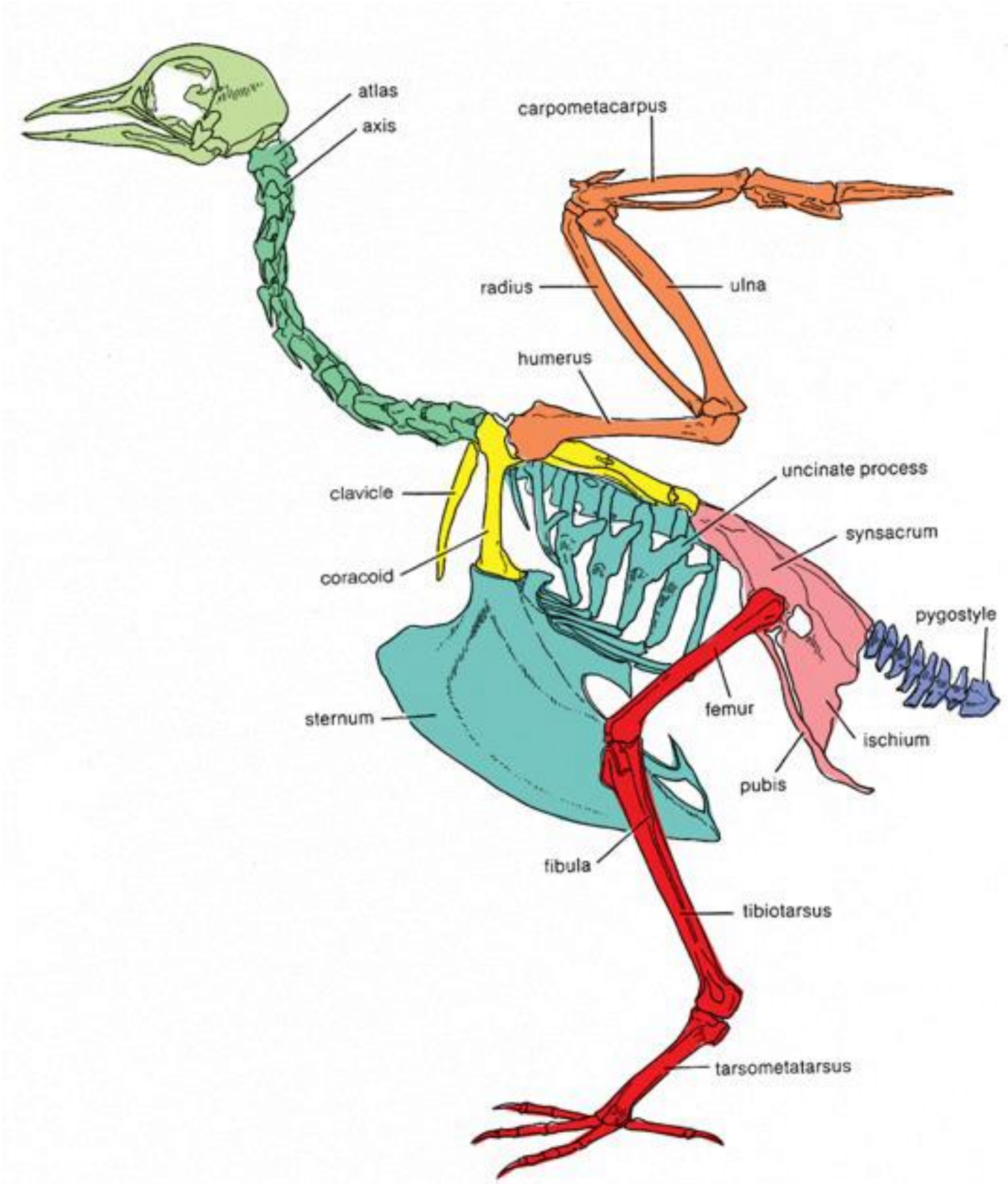

Fig. 2.2.3.1.3: General Bird Skeleton (Polly, 2011b: 6)

Like other birds of prey, owls have three forward-pointing toes with the fourth toe pointing backwards (Microsoft, 2009: Owl). The foot joints of a bird function in a manner similar to their wing movement. When the ankle is bent the toes also bend (see Fig. 2.2.3.1.4), so that a bird may perch without using any muscular effort to hold onto the branch. Its weight will naturally bend its ankle and thus bend its toes. Barn owls have particularly long and slender legs for an owl (Microsoft, 2009: Owl).

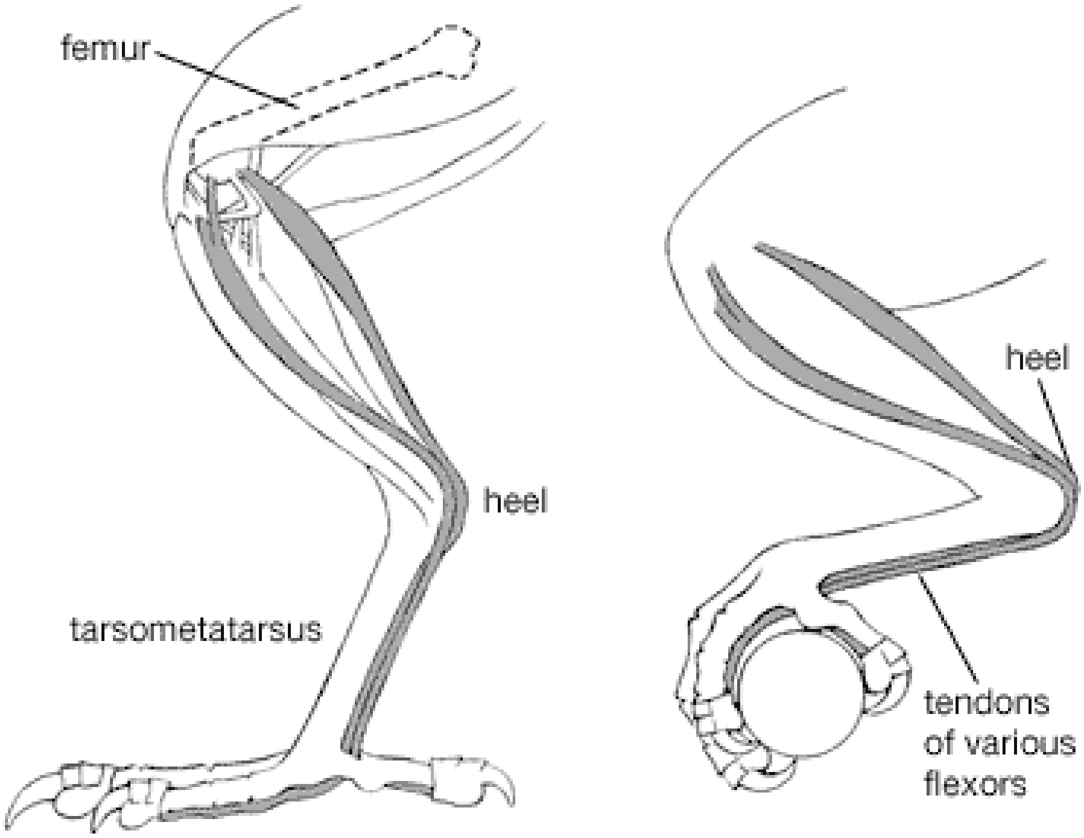

Fig. 2.2.3.1.4: Bird Leg Mechanic (Encyclopædia Britannica, 2013: Bird)

To compensate for their immobile eyes, owls have flexible necks (Encyclopædia Britannica, 2013: Owl) which can turn 270 degrees (Microsoft, 2009: Owl). Their necks consist of fourteen vertebrae (see Fig. 2.2.3.1.5), double the number of vertebrae that mammals have (Mitchinson and Lloyd, 2007: 135).

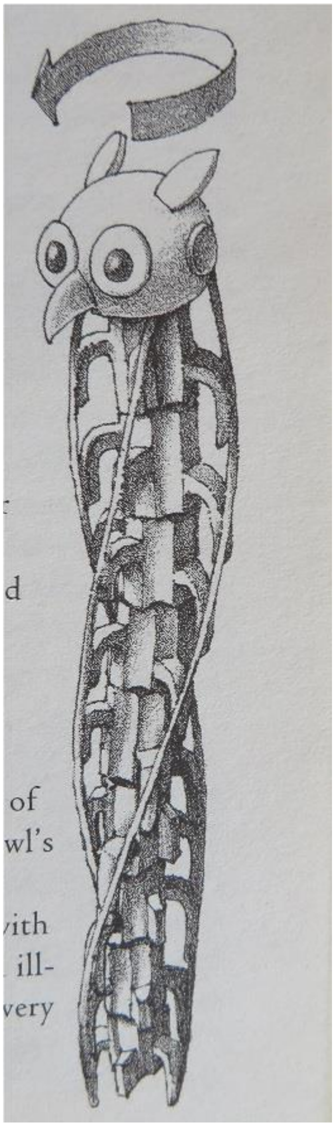

Fig. 2.2.3.1.5: Owl Neck Vertebrae (Mitchinson and Lloyd, 2007: 135)

Motion

De Panafieu (2011: 249) describes flight as a ‘highly efficient means of locomotion’, but both he and Attenborough (1998: The Mastery of Flight) mention that flight is an energy expensive mode of locomotion.

The most exhausting and energy consuming part of flight is becoming air borne (Attenborough, 1998: The Mastery of Flight). The majority of birds jump vertically into the air and, upon leaving the ground, open their wings and push them forward with maximum force, forcing the air downwards. On the second stroke the bird pushes upwards with equal force as it leans forward (Attenborough, 1998: The Mastery of Flight). Doing this requires a lot of effort, which is the reason why birds cannot take off from the ground 'twice in quick succession'.

Airflow is important for flight. Birds create their own flow of air across their wings by flapping. Forward thrust is created by ‘flapping lateral appendages’ (see Fig. 2.2.3.1.6). The right and left wings are simultaneously rotated in either a figure eight or in a circular motion (Encyclopædia Britannica, 2013: Locomotion).

Some birds employ ‘rowing’ through the air by stretching forward and beating down with their wings, half folding them on the upstroke, thereby reducing their surface area and simultaneously reducing resistance (Attenborough, 1998: The Mastery of Flight). During flight a bird keeps its feet against its body to reduce resistance (Attenborough, 1998: The Mastery of Flight).

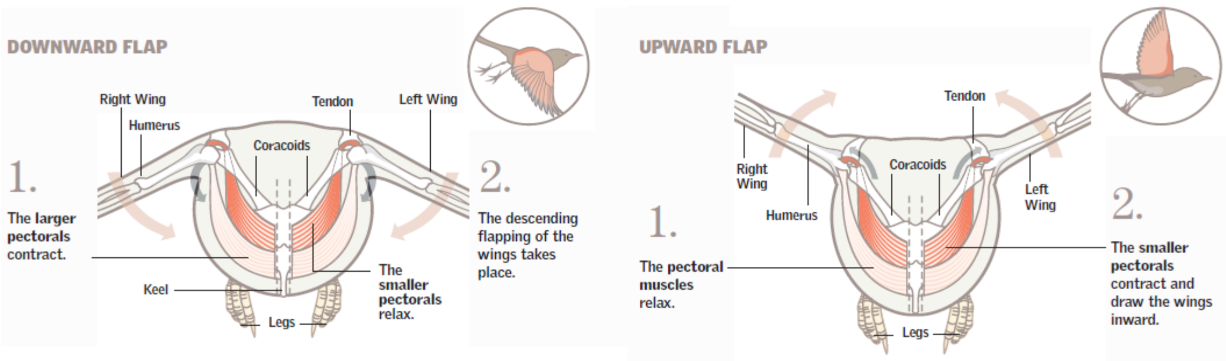

Fig. 2.2.3.1.6: Flapping Mechanics (Britannica Illustrated Science Library, 2008: 13)

Fig. 2.2.3.1.6: Pigeon Flight Sequence (De Panafieu and Gries, 2011: 296, 297)

The common barn owl hunts using sustained flight in open areas where prey hides underground. Its wings are adapted for low-level flight rather than for soaring (Microsoft, 2009: Owl). The owl hovers in the air above its target and then swoops down to make a catch. The owl's wings have a large surface area (refer to 2.2.3.1 *Anatomy*) to give plenty of lift at slow speeds (Attenborough, 1998: The Mastery of Flight). The owl flies along a straight path with steady flapping of the wings, gliding upwards to reduce speed just before perching (Encyclopædia Britannica, 2013: Owl).

2.2.4 The Reptile

Reptiles are cold-blooded animals. Their bodies are covered with scales and scutes, while some have shells. Their feet have claws on their toes as opposed to amphibians that have clawless toes.

2.2.4.1 The Slender-snouted Crocodile

The researcher chose a large terrestrial reptile that employs cursorial locomotion. The crocodile is a large terrestrial and aquatic reptile that employs slow, deliberate cursorial locomotion and natatorial locomotion. It has been mentioned before (refer to section 2.1.1) that the choice of animals in this study was influenced by the locomotion restrictions of animals. Since the fish, which will be discussed later in this study (refer to section 2.2.7), employs natatorial locomotion, the researcher will not discuss the natatorial locomotion of the crocodile but will focus on its cursorial locomotion instead.

To narrow the scope the researcher chose the slender-snouted crocodile. There is not a specific reason for this particular choice as the only characteristic that distinguishes this species from other crocodiles is its slender snout.

Fig. 2.2.4.1.1: Crocodilian Skeleton (De Panafieu and Gries, 2011: 227)

Anatomy

Crocodiles are characterised by powerful jaws with conical teeth that form a single row in the upper jaw and a single row in the lower jaw. Burton (2010: 403) explains that a crocodile has a pointed snout and most of its upper teeth are visible when its' mouth is shut, as opposed to an alligator's snout which shows all the animal's teeth when its jaw is closed (see Fig. 2.2.4.1.1).

The legs of crocodiles are short and their feet are webbed with toes tipped with claws. The design of a crocodile's head allows its eyes, ears and nostrils to be above water while the rest of its body is submerged (Bonnan, 2016: 356). Concerning the skeleton (see Fig. 2.2.4.1.1), the bones are compact and thick. The ribcage is rounded and the spines of the vertebrae are very pronounced, especially the tail vertebrae (Bonnan, 2016: 246).

Fig. 2.2.4.1.2: Crocodile Skull (De Panafieu and Gries, 2011: 225)

Motion

The limbs of most reptilian's project perpendicularly from their bodies, bending at the elbows and knees towards the ground (see Fig. 2.2.4.1.3). This creates an awkward sprawling gait and a sprawled posture that are designed for an energy conserving lifestyle (Polly, 2011c: 20).

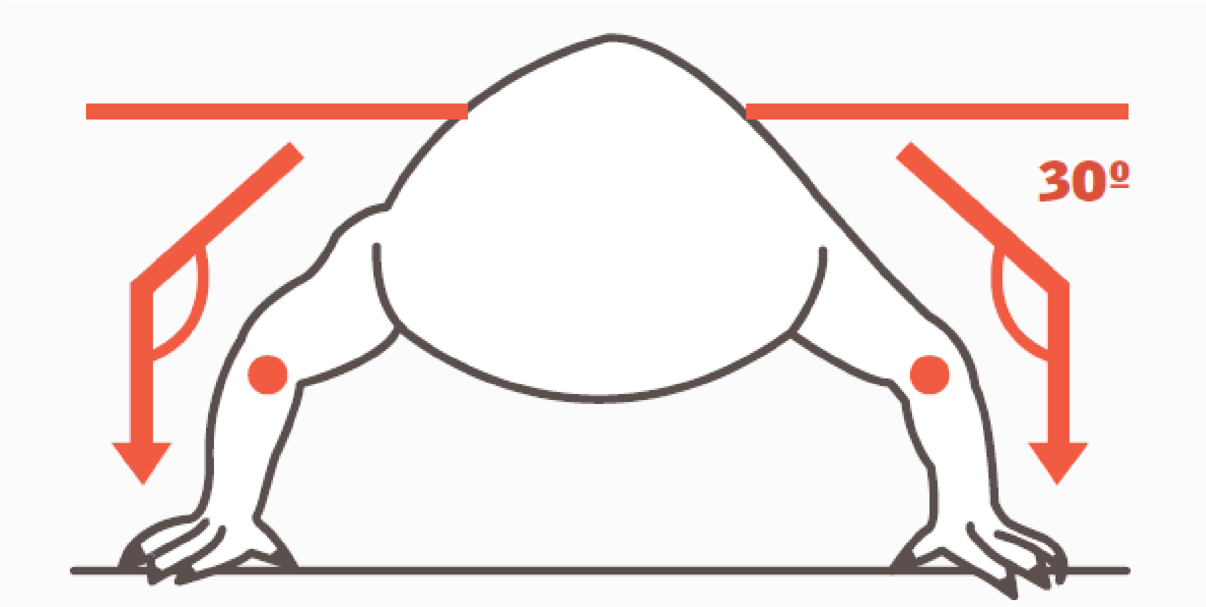

Fig. 2.2.4.1.3: Crocodilian Posture (Britannica Illustrated Science Library, 2008: 57)

The unique body shape of crocodilians is responsible for their appendicular locomotion. Crocodilians are the only reptiles that have a 'vertical limb posture' when walking (Kisia, 2011: 106). When on land, crocodilians hold their bodies high on all fours.

The gait of a crocodile is created by the 'sinusoidal flexure' that is characteristic of their mode of terrestrial locomotion (Encyclopædia Britannica, 2013: Crocodile, Locomotion). The term 'sinusoidal flexure' is simply a flex in the muscles that causes the body to contort into a sine wave or a succession of S-shaped curves (Polly, 2011a: 3).

Additionally, according to De Panafieu (2011: 330), the gait of the crocodile is also referred to as a type of horizontal undulation (wave-like motion) where the 'undulations are synchronised with the movements of the feet'. The gait of a crocodile is produced by moving the front leg forward in conjunction with the opposing hind leg with each step, while the crocodile's 'cantilevered tail' (only supported at one end) provides balance. On land crocodilians are capable of belly crawling, walking and even galloping for short distances (see Fig. 2.2.4.1.4) (Encyclopædia Britannica, 2013: Crocodile).

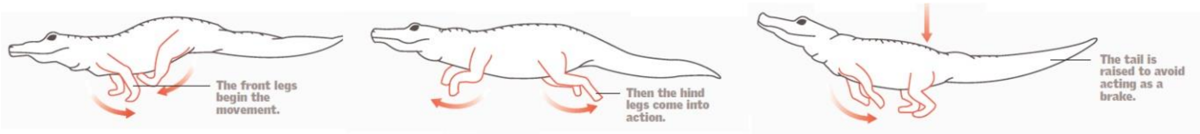

Fig. 2.2.4.1.4: Galloping Crocodile (Britannica Illustrated Science Library, 2008: 57)

In water, a crocodile swims by waving its tail laterally, creating undulatory locomotion, while keeping its legs against the sides of its body (see Fig. 2.2.4.1.5) (Microsoft, 2009: Crocodile).

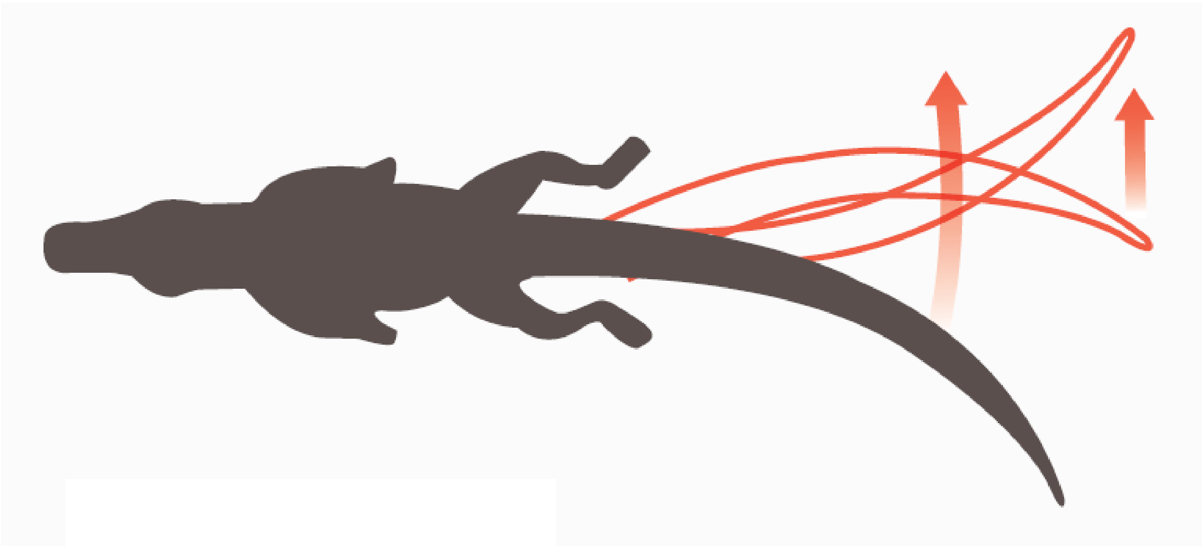

Fig. 2.2.4.1.5: Swimming Crocodile (Britannica Illustrated Science Library, 2008: 57)

2.2.5 The Amphibian

Amphibians are cold-blooded animals with a moist, permeable skin. Their skin is 'naked and glandular', which is related to the damp environments that they prefer. They have clawless toes.

2.2.5.1 The African Bullfrog

The researcher chose a large fossorial amphibian that employs saltatorial locomotion. The frog is known for its impressive leaping (refer to 2.2.5.1 *Motion*). It also has a most peculiar skeleton, especially in respect to its pelvic and pectoral girdle (see Fig. 2.2.5.1.1). The researcher specifically chose the African bullfrog as it is an impressively large frog specimen.

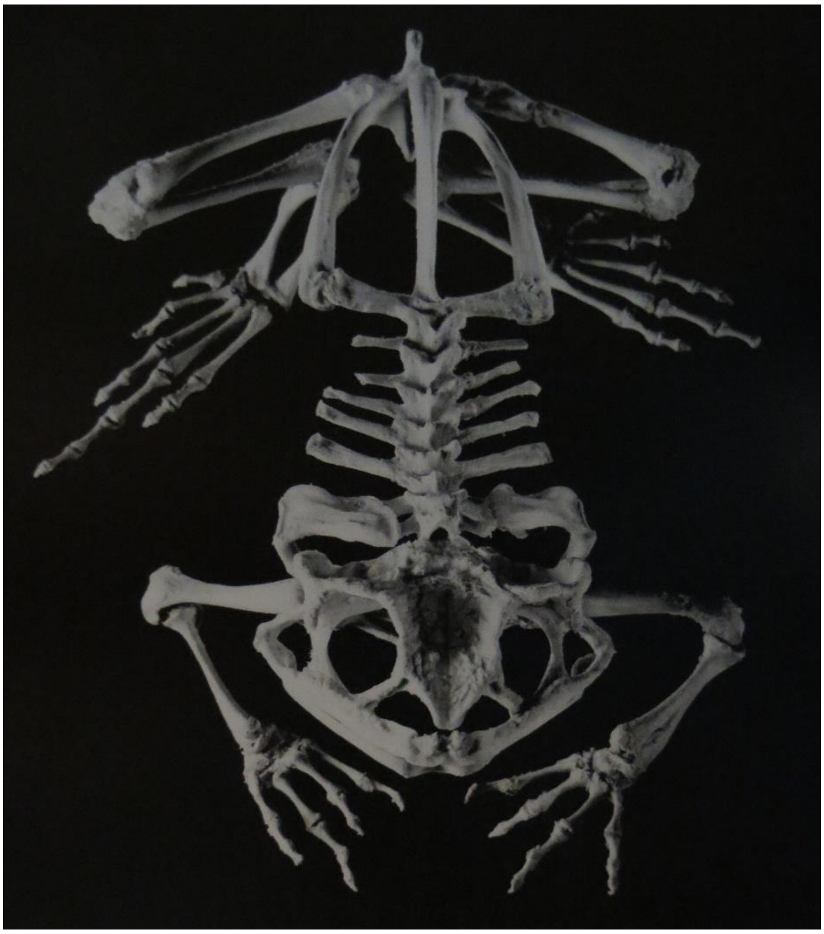

Fig. 2.2.5.1.1: Anuran Skeleton (De Panafieu and Gries, 2011: 82)

Anatomy

Anurans (group name for frogs and toads) have specially designed skeletons to absorb the shock created by landing on the ground after leaping (Bonnan, 2016: 210). Their skulls and vertebral columns are connected to the pectoral girdle by means of an elastic muscular suspension. The tailbone is a stiff rod comprising of fused vertebrae of the lower backbone and it is horizontally flanked by the pelvic girdle (Bonnan, 2016: 210). The pelvic girdle remains in the same plane as the axial skeleton when the animal jumps (Encyclopædia Britannica, 2013: Anura).

The scapulae of the frog form a solid structure. The scapulae connect to the spine and then extend outwards before curving down to connect to the sternum, forming a rectangular shape. The ribs of the frog are also rather odd in that they are just spines projecting from the body instead of forming a barrel shape.

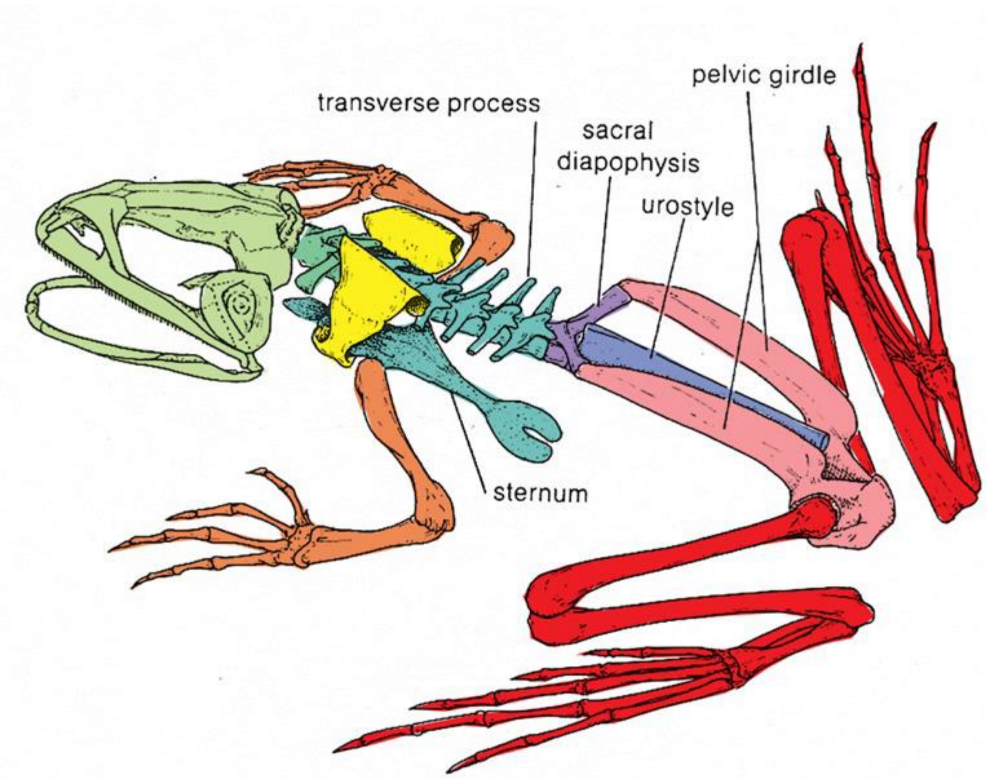

Fig. 2.2.5.1.2: Bullfrog Skeleton (Polly, 2011b: 5)

Motion

Saltation (hopping) in amphibians is possible because their hind legs are almost twice as long as their anterior (front) legs. The tibias and tarsals, being the lower hind limb bones, are more elongated than the femurs (Encyclopædia Britannica, 2013: Locomotion). Saltation is created by retraction and then extension of the hind limbs to create an 'aerial phase of movement' (see Fig. 2.2.5.1.3). The length and height of the jump is dependent on the angle and velocity of take-off. Jumping at an angle of 45° will ensure the longest jump (Bonnan, 2016: 210).

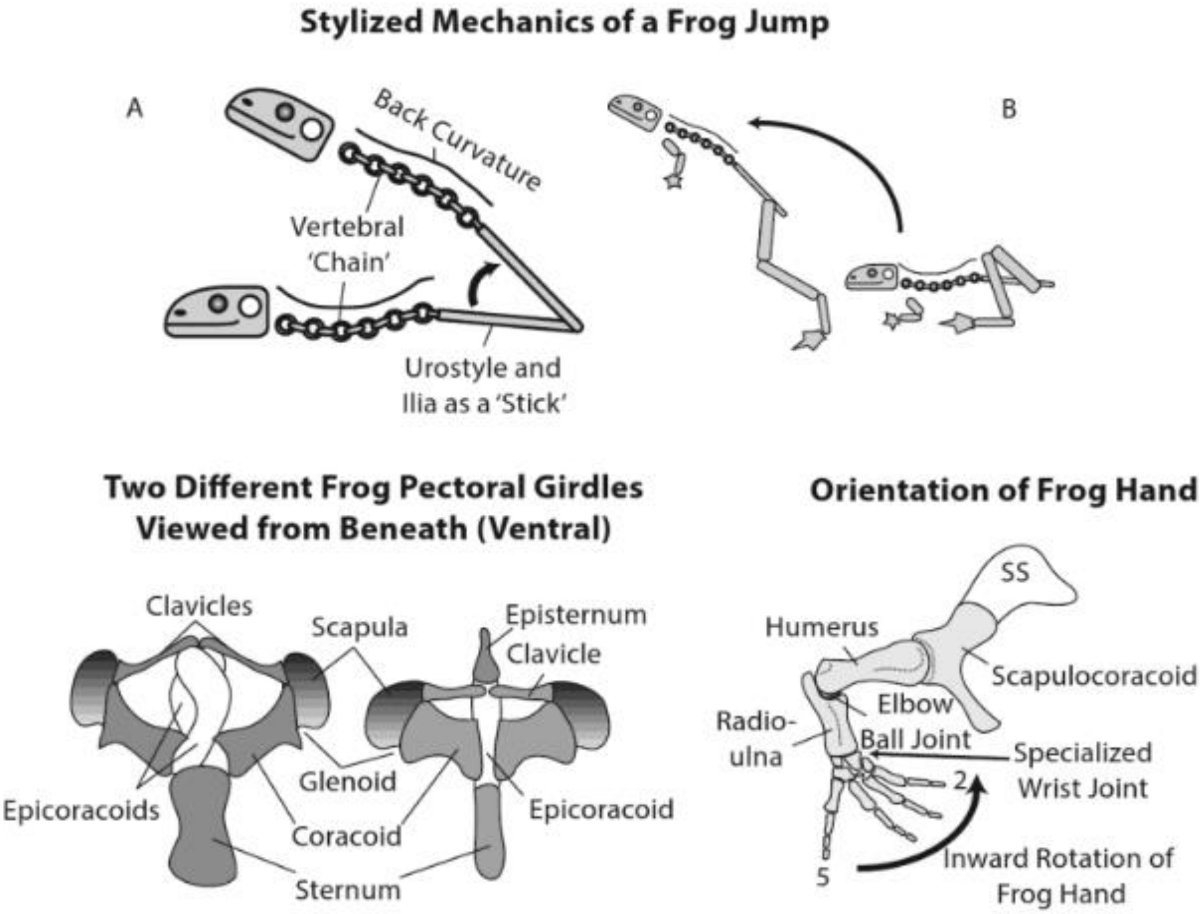

Fig. 2.2.5.1.3: Leaping Frog (Bonnan, 2016: 210)

Frogs are able to leap great distances due to their long and powerful hind legs (Burton, 2010: 420). Their short and relatively thin front legs are for breaking their landing after a jump and for keeping them upright while sitting (Microsoft, 2009: Frog).

In order to jump, the frog flexes its forelegs and arches its back to tilt its body upwards. This moves the lower part of the leg into a vertical position, locking it in place as the femur (thigh) moves into a horizontal position. As soon as the femur is ‘perpendicular to the body’, the knee joint releases, snapping open and sending the frog forward at a 30° to 45° angle (Bonnan, 2016: 210).

The frog lands by extending its forelegs in front of its chest to act as shock absorbers. As the forelegs make contact with the ground, the hind legs are protracted to return to the jumping position in readiness for the next jump (Bonnan, 2016: 210). Jumping is used for escaping predators as it is a fast means of locomotion and slight contact with the ground reduces the scent trail that predators could follow (Microsoft, 2009: Frog).

2.2.6 The Fish

Fish are limited to inhabiting aquatic environments. They are characterised by being covered in scales and are cold-blooded.

2.2.6.1 The Great Hammerhead Shark

The researcher chose a large aquatic fish that employs natatorial locomotion. The shark is one of the largest and best known predatory fish. The researcher specifically chose the great hammerhead shark. The shape of the shark's head is its most recognisable anatomical feature.

Fig. 2.2.6.1.1: Shark Skeleton (De Panafieu and Gries, 2011: 76)

Anatomy

Sharks are predatory cartilaginous fish, meaning that their skeletons are not bone but hard cartilage (De Panafieu and Gries, 2011: 47) (Burton, 2010: 379). This allows for greater freedom of movement than bone because cartilage is an elastic form of tissue (Bonnan, 2016: 99).

Shark tails are muscular and the tip is asymmetrical and upturned (Encyclopædia Britannica, 2013: Chondrichtian). The fins are pointed and both the distinct dorsal fin (back fin) and the lateral fin (fins behind the gills) spines are rigid (Bonnan, 2016: 33).

The hammerhead's head consists of two stalks with an eye at each end. This gives the shark several advantages: improved manoeuvrability, improved smell as the shape of the head allows for the nostrils to be more expanded and improved sight due to the position of the eyes allowing a wider field of view and better depth of perception. Apart from these features hammerheads have been recorded using their heads to ram at and pin large prey (Encyclopædia Britannica, 2013: Hammerhead Shark).

Fig. 2.2.6.1.2: Shark Teeth (De Panafieu and Gries, 2011: 213)

Motion

To be able to locomote in water an animal needs to have control over its buoyancy. It also has to be able to compete with water resistance by means of an effective propulsion system (Kisia, 2011: 138). Thus the fins of fish are primarily used to control forward progress (Polly, 2011a: 28). The dorsal fin (back), caudal fin (near the back of the tail) and the pair of anterolateral fins (near the head and on the sides of the body) aid in steering and stabilisation (Bonnan, 2016: 33). Sharks do not have swim bladders like other fish, therefore their paired fins are set horizontally to help maintain a desired level in the water, sharks must remain in motion to keep from sinking (Starr, Evers and Starr, 2015: 299).

The vertebral column of a fish hinges in such a way that it can only bend sideways, the muscles on either side of these vertebrae shortening alternately (Bonnan, 2016: 105). On the side where the muscles are shortened the body bends inwards, and on the side where they are stretched the body bends outwards (Encyclopædia Britannica, 2013: Skeleton). According to Polly (2011a: 3,4) most sharks employ anguilliform locomotion (see Fig. 2.2.6.1.3). This mode of locomotion is caused by muscle contractions that create undulations. The undulations travel down the entire length of the body, which means that the entire body is used in this type of locomotion. The amplitude of the wave increases in size towards the end of the body, forming the largest wave at the tail (Polly, 2011a: 6).

The vertebral column, axial skeleton muscles, surface of the body and the fin aid in this form of propulsion, which is called caudal propulsion (Encyclopædia Britannica, 2013: Skeleton). The tail fin is the main source of propulsion, while the combination of strong tail muscles and flexible cartilaginous skeleton allows the shark to create powerful yet smooth swimming strokes (Microsoft, 2009: Shark). The head of the hammerhead creates a rudder effect, similar to the rudder of a boat that allows for turning (Encyclopædia Britannica, 2013: Shark). It is therefore more manoeuvrable in water than other sharks (Microsoft, 2009: Shark).

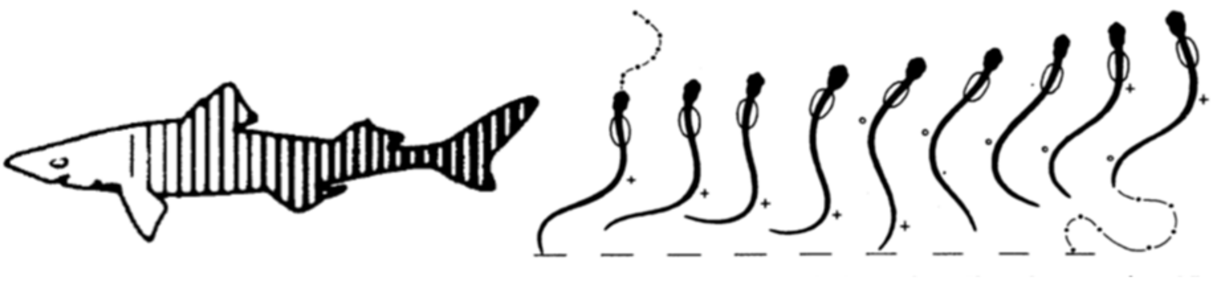

Fig. 2.2.6.1.3: Anguilliform Locomotion (Polly, 2011a: 5,6)

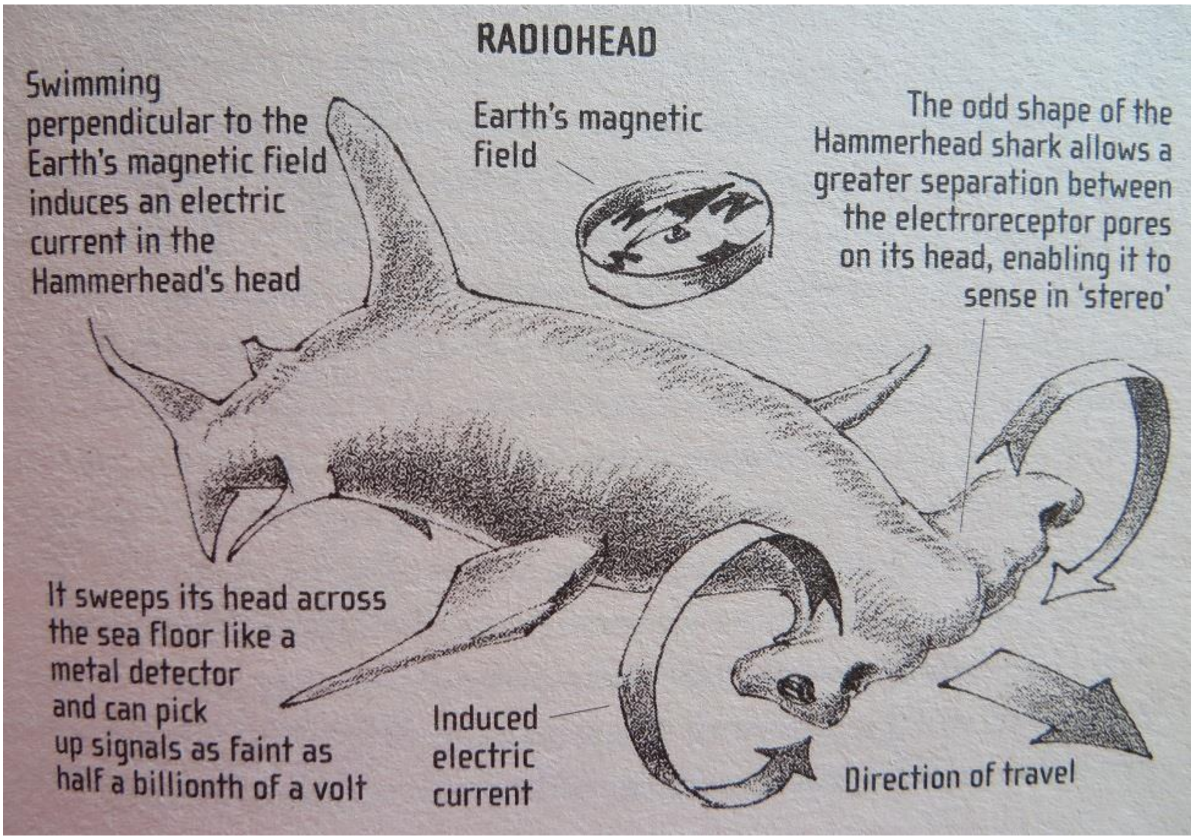

Fig. 2.2.6.1.4: Hammerhead Shark (Mitchinson and Lloyd, 2007: 171)

2.2.7 Joints

Joints (Dorling Kindersley, 1995: 42) are located where two bones meet and are necessary to create movement and maintain stability. Three types of joint are found in humans, namely: the immobile fibrous joint (between skull bones); moveable cartilaginous joints (between vertebrae); and highly moveable synovial joints (in shoulders, elbows, knees etc.). Five types of synovial joint exist in humans: pivot joints; ball-and-socket joints; hinge joints; saddle joints; and plane joints (see Fig. 2.2.7.1). Using the joints of humans as a standard, the joints of the five animals chosen for the study are discussed in this section.

A pivot joint allows one bone to rotate in or against another bone and is usually the joint where the neck and head of a mammal meet. The ball-and-socket joint allows movement in most directions and is usually located where the shoulder and arm meet and where the hip and leg meet. The hinge joint can only bend and straighten and is usually located in the elbows, knees, ankles, fingers and toes. The saddle joint allows forward, backward and left to right movement and is usually located at the base of the thumb. This type of joint is common in arboreal animals as it aids climbing. The plane joint allows gliding movement and is located in the wrist (Dorling Kindersley, 1995: 43).

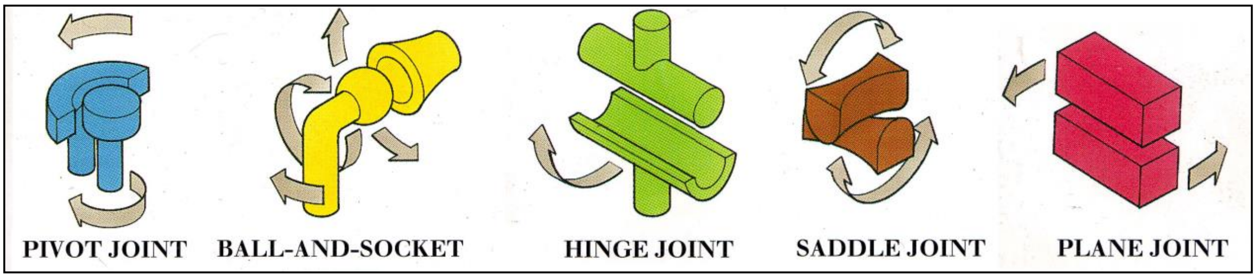

Fig. 2.2.7.1: Types of Joint (Dorling Kindersley, 1995)

2.2.7.1 The Two-toed Sloth

The sloth has ball-and-socket joints in the shoulder and hip. It has a pivot joint where the head and the neck meet as well as hinge joints in its elbows, knees, fingers and toes. The elbow joint is also a pivot joint to allow for pronation and supination. There are plane joints in the wrist and ankles of the sloth (refer to 2.2.2.1 *Anatomy*).

2.2.7.2 The Common Barn Owl

The owl has ball-and-socket joints in the shoulder and hip. It has a pivot joint where the head and neck meet. It has hinge joints in its elbows, knees, wrists, and ankles. The fourteen neck vertebrae are cartilaginous joints (refer to 2.2.3.1 *Anatomy*).

2.2.7.3 The Slender-snouted Crocodile

The crocodile has ball-and-socket joints in the shoulder and hip. It also has a pivot joint where the head and the neck meet. It has hinge joints in its elbows, knees, ankles, fingers and toes. The wrist is made up of plane joints (refer to 2.2.4.1 *Anatomy*).

2.2.7.4 The African Bullfrog

The frog has ball-and-socket joints in the shoulder and hip. It has a pivot joint where the head and neck meet as well as hinge joints in its elbows, knees, fingers and toes. The wrist and ankle is made up of plane joints (refer to 2.2.5.1 *Anatomy*).

2.2.7.5 The Great Hammerhead Shark

The bones of the shark are cartilaginous and therefore all its joints are cartilaginous joints. However, since the spine simulates the movements of a hinge joint, the joints of the shark are basically hinge joints (refer to 2.2.6.1 *Anatomy*).

2.3 Literature Review on Marionette Construction

A brief literature review on marionette construction is important to include in this section. This review is meant to relate the research done above on animal physiology with marionette construction methods.

The materials and methods of four marionette makers will be discussed in this section: D. Currell is a principal lecturer at the University of Roehampton and internationally acknowledged for his knowledge of puppetry. He is also the author of several puppetry books; C. Flower is an Australian artist and puppet maker; A.J. Fortney is an educator at Mount Anthony Union High School in the United States of America. Even though Currell, Flower and Fortney are knowledgeable puppet makers their recommendations for materials and construction techniques are at times dated. This can especially be seen in their recommendations to mostly cover the joints and internal workings of the puppets. The researcher therefore wishes to include the materials and construction techniques of the Handspring Puppet Company especially the work of A. Kohler, the brain behind the realistic movements of the animal puppets. Despite the fact that the Handspring Puppet Company does not make marionettes their views are included because of their modern and experimental puppetry innovations.

A marionette is like a work of art. Each person that creates a marionette puts a bit of themselves into it (Flower and Fortney, 1983: 102). A marionette therefore develops a kind of style and a look unique to its creator. There are many materials and construction techniques, but the artist decides what will work best for a particular project (Flower and Fortney, 1983: 102).

2.3.1 Materials for Constructing Marionettes

The type of material that is chosen for the marionette depends mainly on the budget and the purpose of the marionette. Currell (1992: 46, 46, 58, 63) recommends using papier-mâché, plastic wood, foam rubber or polystyrene for the head of the puppet as a durable and lightweight material.

Materials for that can be used for marionette bodies include tubes of cloth stuffed with cotton (Flower and Fortney, 1983: 104) (refer to Fig. 2.3.1.1), balsa wood (Currell, 1992: 59), papier-mâché or plywood and foam rubber (Currell, 1992: 64).

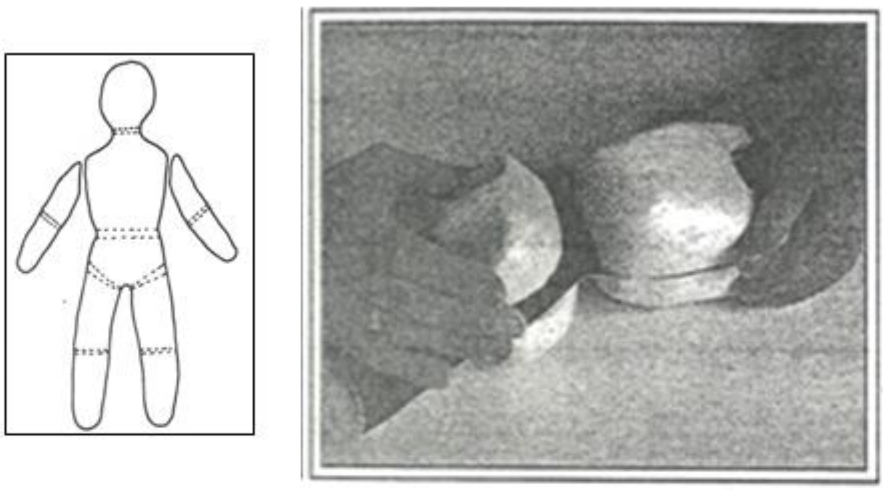

Fig 2.3.1.1: Stuffed Cotton Body (Flower and Fortney, 1983: 104) and Balsa Wood Torso and Pelvis (Currell, 1992: 59)

The materials recommended for the construction of the limbs are similar to the materials recommended for the body. Wooden dowels are used for simple limbs (Flower and Fortney, 1983: 105), for muscle definition the arms and legs can be bulked up with foam rubber (Currell, 1992: 60). The hands and feet of the marionette which is more visible can be constructed from balsa wood (Currell, 1992: 60) (refer to Fig. 2.3.1.2).

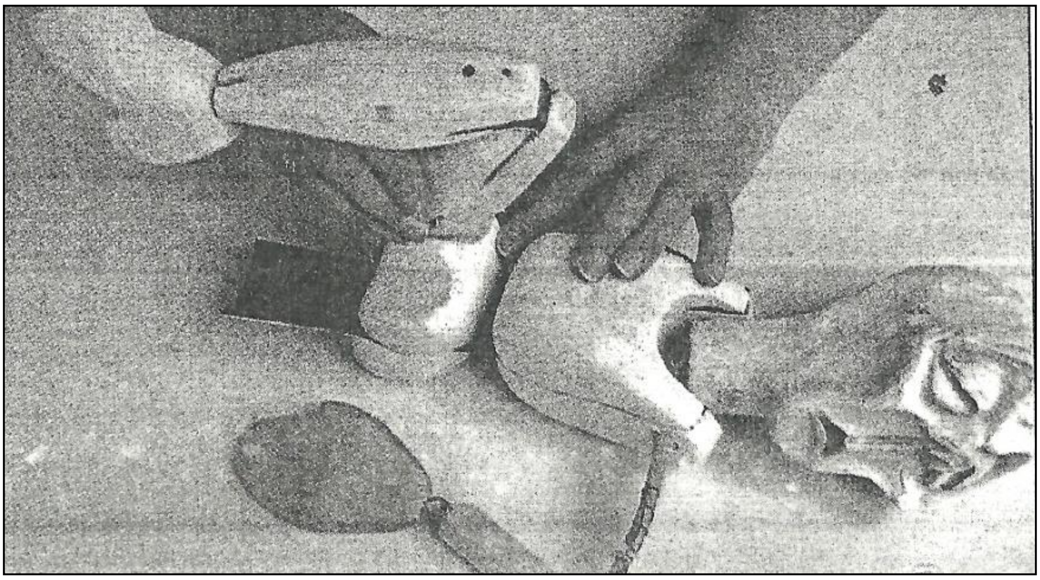

Fig. 2.3.1.2: Balsa Wood Legs and Feet (Currell, 1992: 60)

The joints are more complicated because they must be able to create movement. Usually this is over an extended period of time and the joint must therefore be constructed from durable material to resist wear for as long as possible. The materials used to join the limbs together depend on the type of joint and can be manifold, ranging from rope to leather or wood (Flower and Fortney, 1983: 106).

The type of string depends on the marionette and the type of actions the marionette will perform (Flower and Fortney, 1983: 109). Black string is used most often to hide the strings, although white has been used on occasion to emphasise the fact that the marionettes are puppets controlled by strings. Regardless of the type of string used, both Peake (1986: 118) and Currell (1992: 69) recommend rubbing the string with beeswax to strengthen them.

Flower and Fortney (1983: 102) state that the ideal weight for a puppet should be about 1.8 kg and the ideal height from 30.5 cm to 76.2 cm. If the puppet is too heavy the puppeteer will tire too easily and if the puppet is too light it will be difficult to manipulate. It therefore makes sense that a marionette should be constructed from lightweight, and where necessary hollow, materials but again not too light.

Although not the norm, the Handspring Puppet Company are an example of a more modern puppet making company that prefers to use materials that give a 'raw' natural feel to the puppets. This type of design allows the audience to view the mechanics and inner workings of the puppet.

As can be seen from the following images (refer to Fig 2.3.1.3 and 2.3.1.4) the puppets are made basically made from wood and gauze. With the smaller puppets the heads are masterfully carved from jelutong wood, the body constructed from interlocking plates of plywood, bendable nylon rods and covered with nylon gauze to create the bulk of the body (Taylor, 2009: 109). The limbs are also constructed from layers of plywood and spaced to create bulk.

Fig. 2.3.1.3: The Chimpanzee and Hyena (Taylor, 2009: 25, 77)

For the larger puppets the puppet makers used aluminium frames and limbs made from plywood sowed to cane (Taylor, 2009: 134). However the materials used for such large scale puppets are not practical for constructing marionettes because there are lighter materials to choose from.

Fig. 2.3.1.4: The Framework of the Horse (Taylor, 2009: 135)

2.3.2 Construction Techniques for Marionettes

There are as many methods of assembling the parts of a marionette to form a joint as there are materials to make the joints from. The following figures demonstrate the materials recommended for certain types of joints by the aforementioned puppet makers.

A neck joint is constructed from a horizontal dowel placed in the head of the marionette threaded in the middle on a piece of string. The string is attached to a second dowel that used vertically as the neck of the marionette (refer to Fig. 2.3.2.1) (Currell, 1992: 63). The string that runs through the neck is then attached inside the body to secure the head.

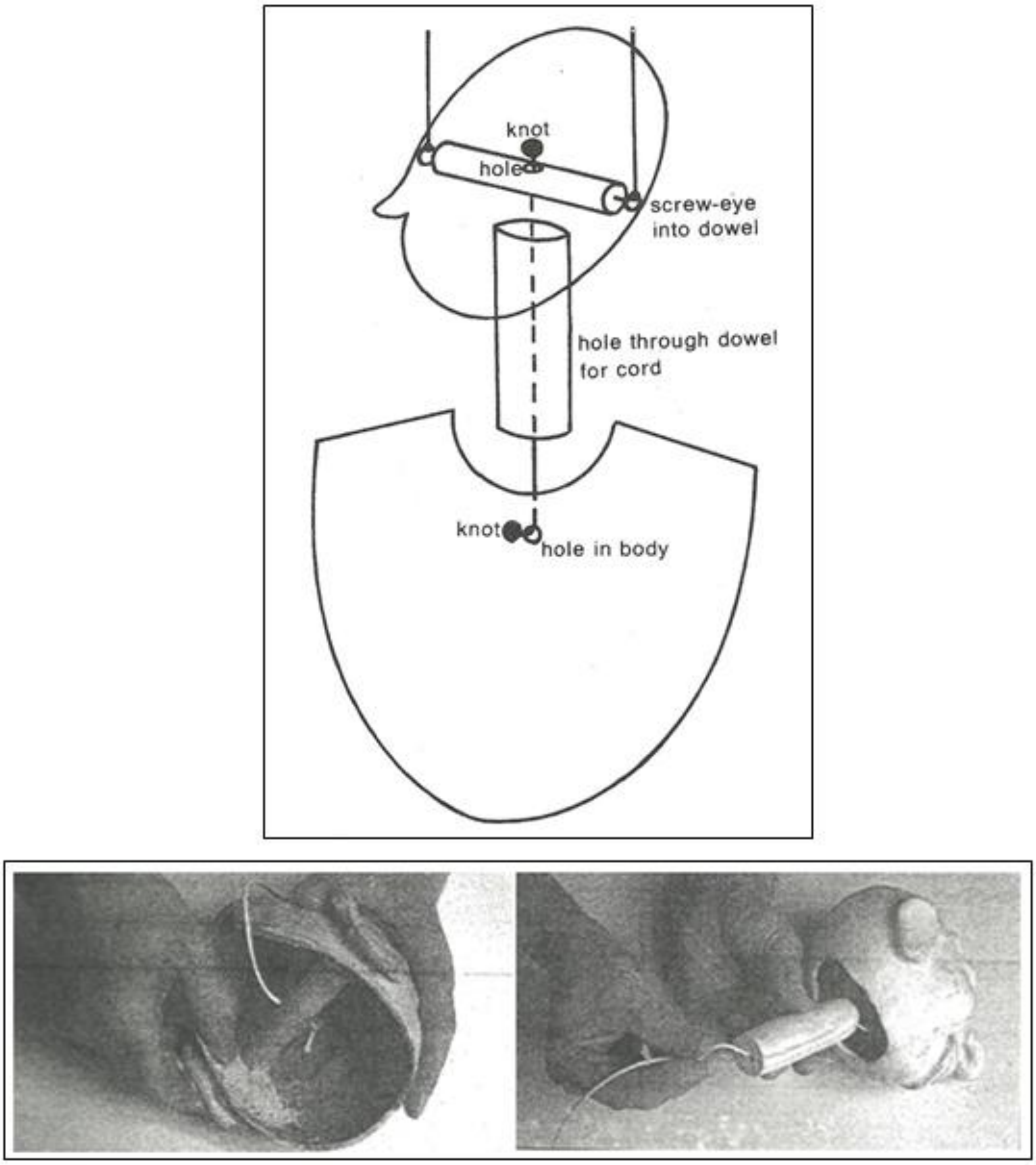

Fig. 2.3.2.1: Dowel and String Neck Joint (Currell, 1992: 63) (Currell, 1980: 85)

Leather loops are attached to the underside of the torso and looped through leather loops attached to the top of the pelvis to create a moveable waist (Flower and Fortney, 1983: 105) (refer to Fig. 2.3.2.2).

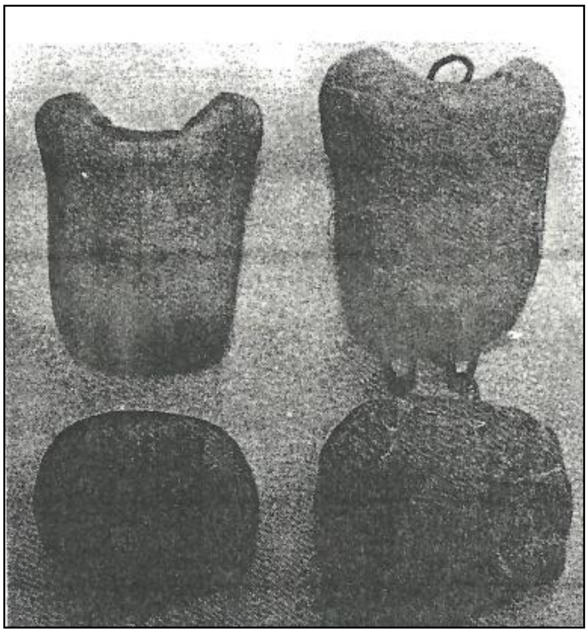

Fig. 2.3.2.2: Papier-mâché Torso attached with Leather Loops to form a Waist Joint (Flower and Fortney, 1983: 105)

The arm is attached to the body via a piece of string threaded through the side of the body (where the shoulder ought to be) and the top of the upper arm (Currell, 1980: 89). The string must be long enough to allow the arm to move naturally (refer to Fig. 2.3.2.3).

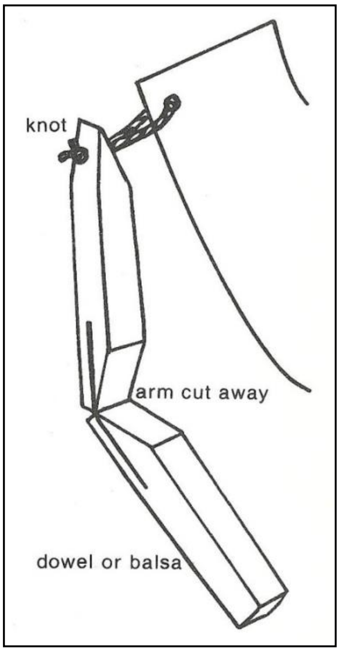

Fig. 2.3.2.3: String Shoulder Joint (Currell, 1980: 89)

The legs can be attached to the pelvis by threading the legs unto a piece of wire that attaches to the pelvis (Currell, 1980: 94, 95). There must be enough space between the legs and the pelvis so that there is no friction and natural movement (refer to Fig. 2.3.2.4).

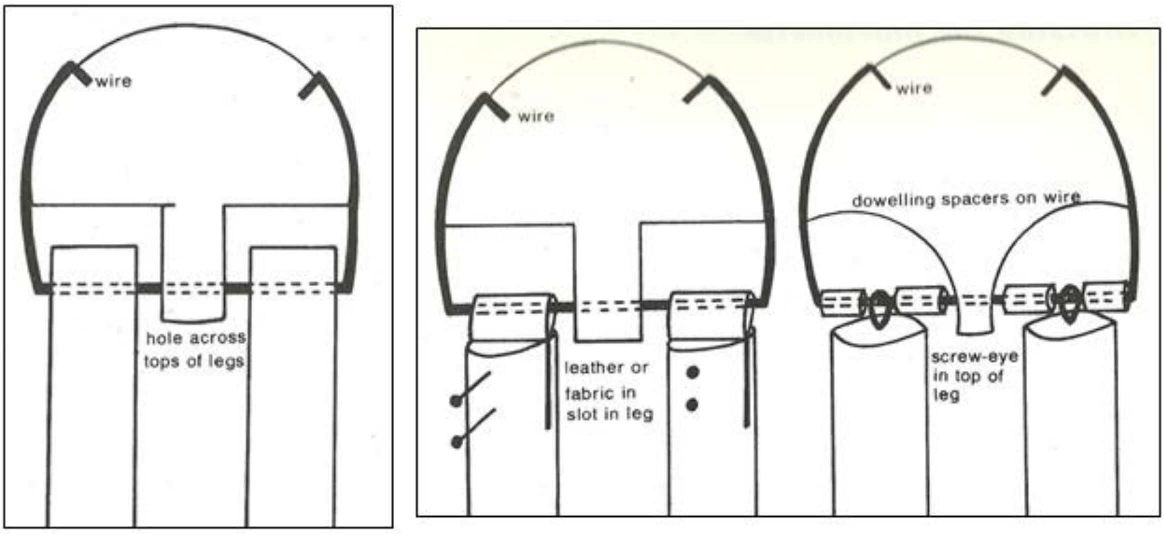

Fig. 2.3.2.4: Various Hip Joints (Currell, 1980: 94, 95)

The majority of limb joints (elbows and knees) are made with a 45˚ angle cut at the back of the joint (the part of the limb that folds inwards) (Flower and Fortney, 1983: 106). The two parts of the limb can then be attached with rope or leather or a tongue and groove joint (refer to Fig. 2.3.2.5).

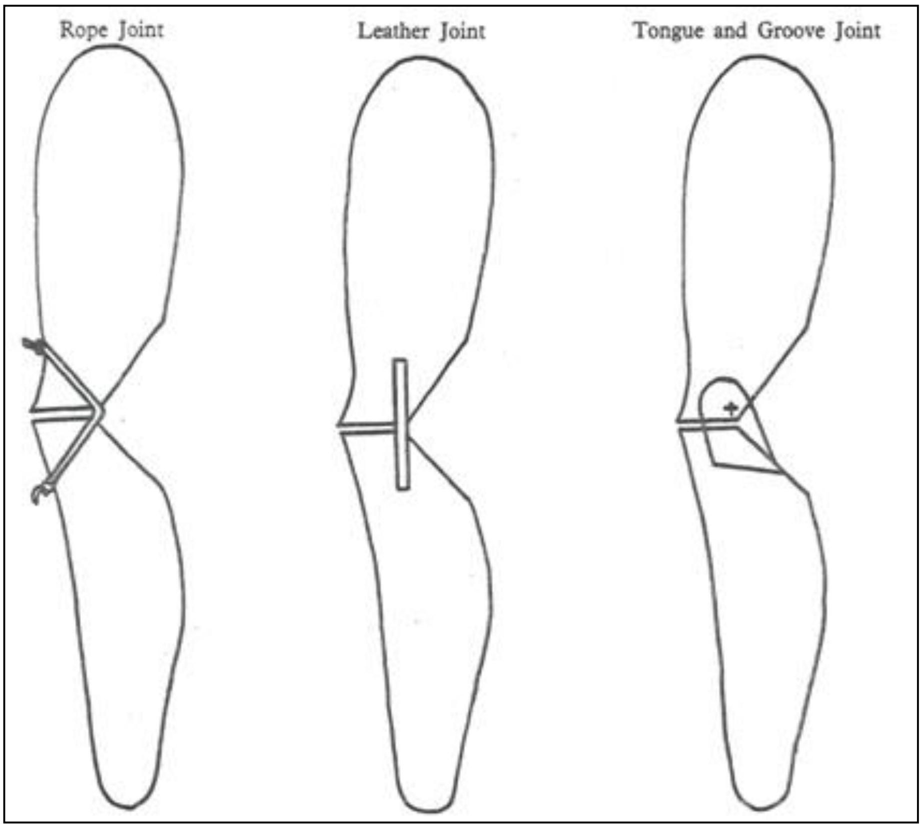

Fig. 2.3.2.5: The Rope Joint, the Leather Joint and the Tongue and Groove Joint (Flower and Fortney, 1983: 106)

The same joint as mentioned above can also be assembled with a screw eye and a nail (Currell, 1980: 92) (refer to Fig. 2.3.2.6).

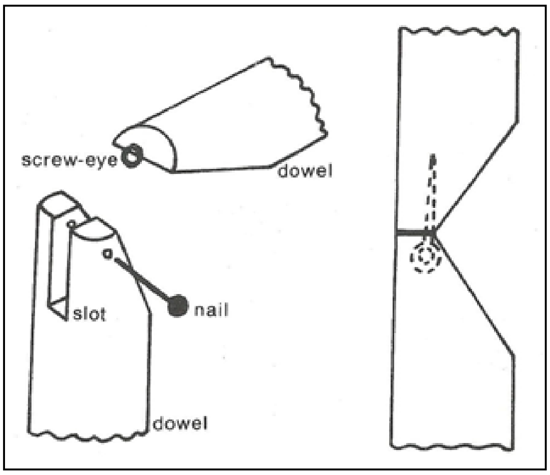

Fig. 2.3.2.6: Screw Eye and Nail Joint (Currell, 1980: 92)

Currell demonstrates a more detailed tongue and groove joint and a lighter three-part tongue and groove joint (Currell, 1992: 65, 67). These are more striking joints because they are more complicated to create (refer to Fig. 2.3.2.7). To make the tongue-and-groove joint, divide the end of each limb (the ends that will be facing each other to form the joint) into three parts. It is recommended that the lines dividing the top of the limb be drawn onto the wood. Making two fairly deep cuts vertically into the end of the limb and removing the wood in the centre of the top section to form a slot. Removing the wood on the sides of the bottom section to form a tongue and positioning the two sections together. Drilling a hole, making sure that the hole is slightly larger than the nail that will keep the two sections together.

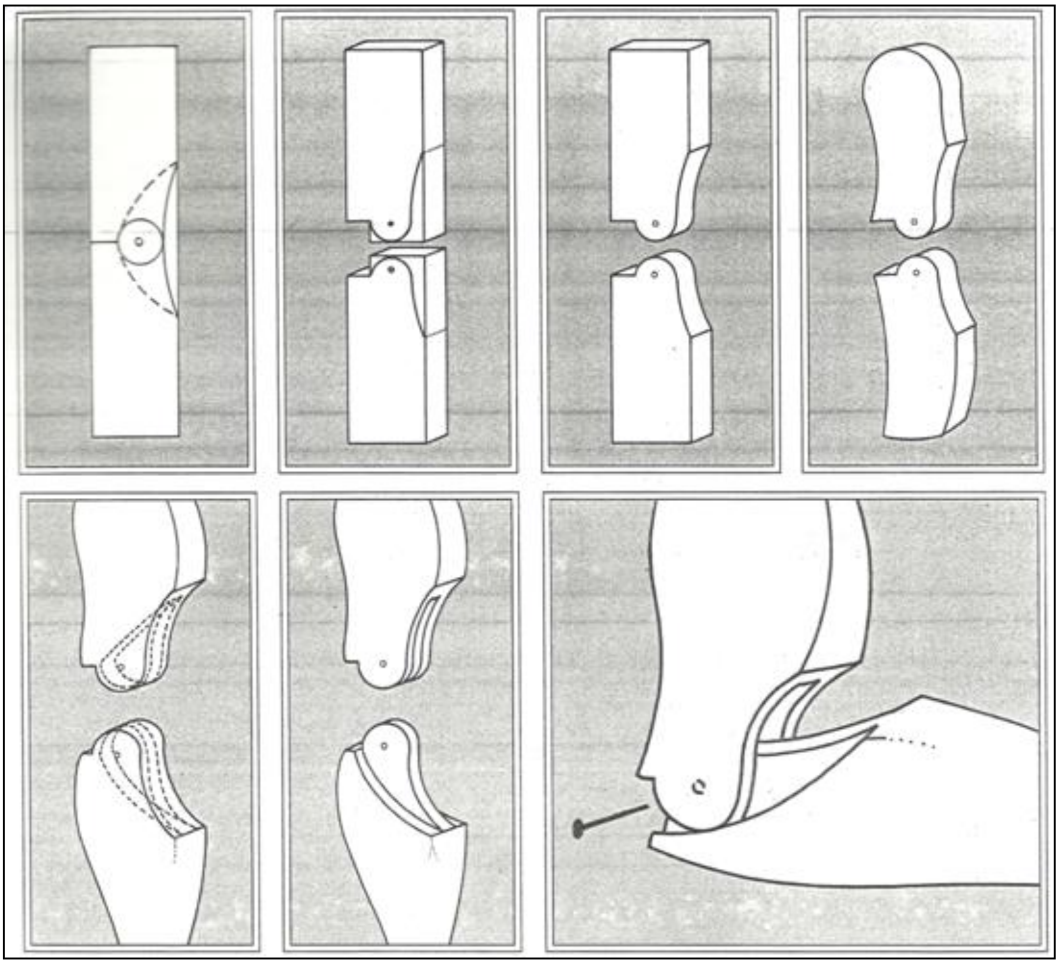

Fig. 2.3.2.7: Detailed Tongue and Groove Joint (Currell, 1992: 65)

To create lighter limbs, the three-part tongue and groove joint is ideal. By drawing three parts of the leg on paper, adding an extra projection for the ankle (refer to Fig. 2.3.2.8). Then transferring the pattern to plywood and cut out the shapes for the lower leg, using slightly thinner plywood. Gluing the three parts of the upper leg together, making sure there is a slot for the top part of the lower leg. Inserting the top of the lower leg into the slot and follow the same steps as mentioned above to ensure mobility of the leg.

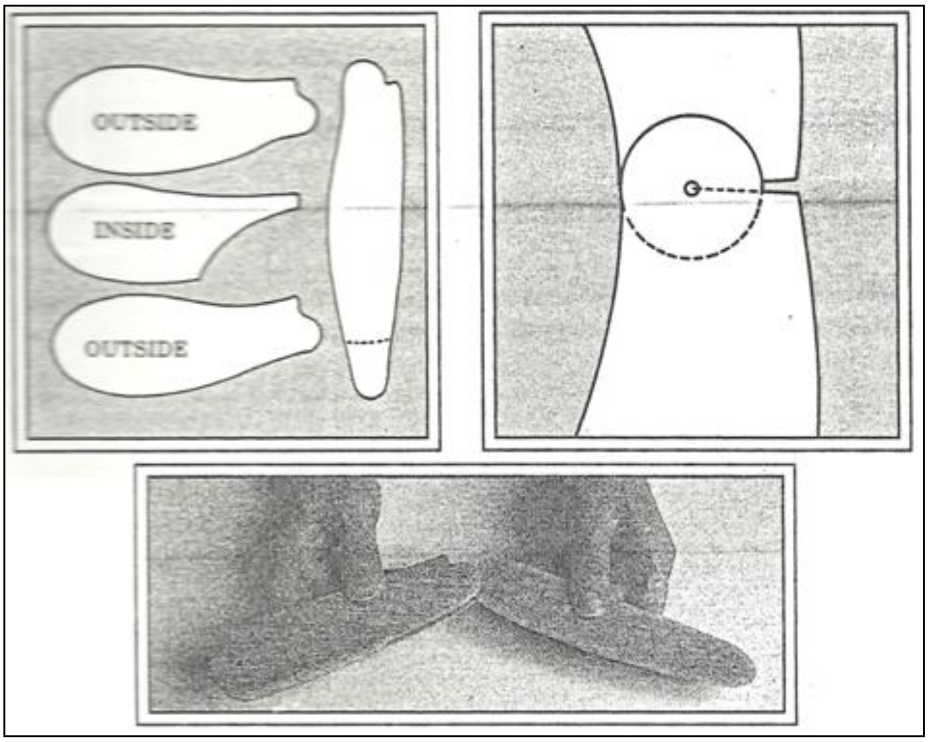

Fig. 2.3.2.8: Three Part Tongue and Groove Joint (Currell, 1992: 67)

Marionette feet and hands can attach to limbs in much the same manner as some of the aforementioned joints. A favourite method used by the specialists is using a screw eye and nail to create the joint (refer to Fig. 2.3.2.9).

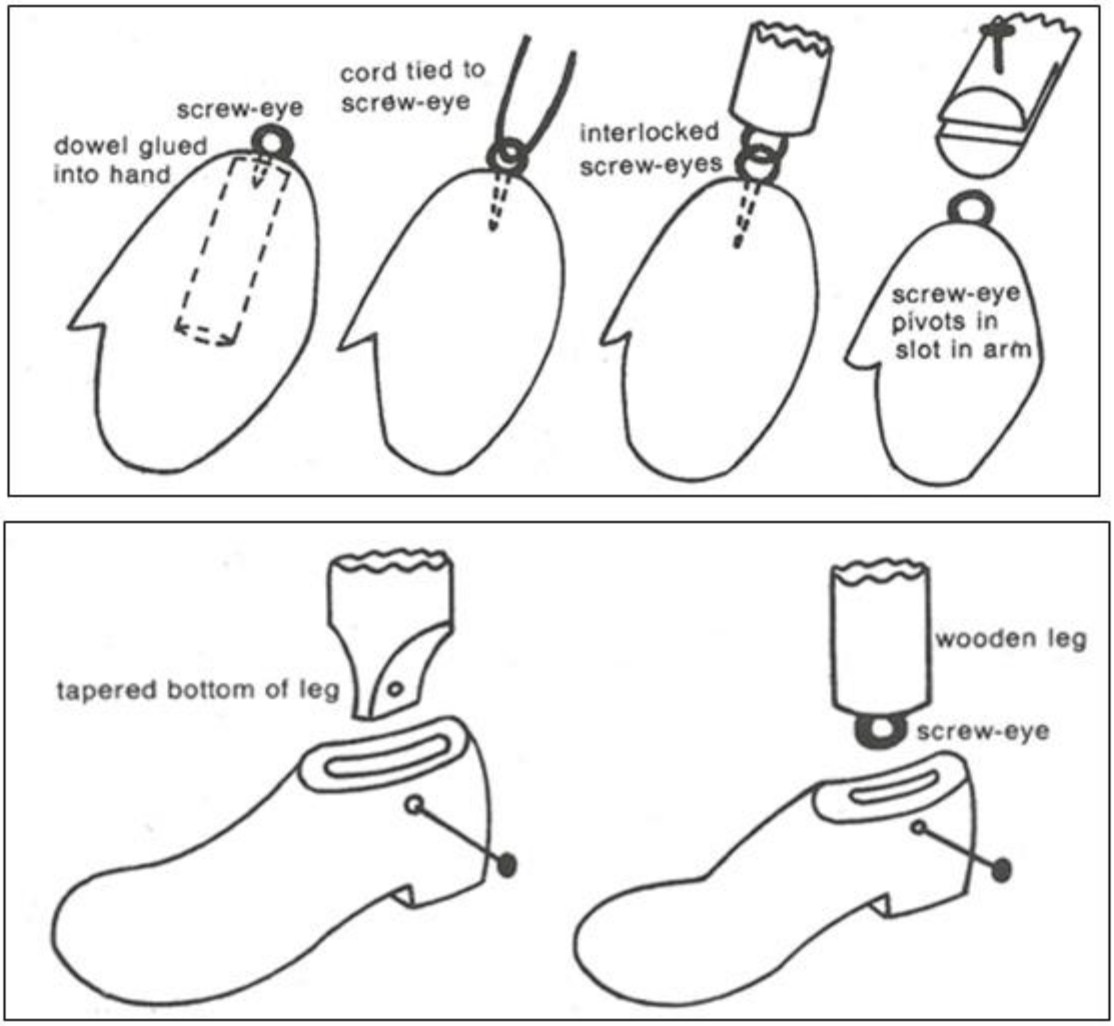

Fig. 2.3.2.9: Ankle and Wrist Joints (Currell, 1980: 91, 93)

2.3.3 Constructing the Controls and Stringing the Marionettes

The simplest human figure marionette requires seven strings to operate: one on either side of the head, one for each hand, one for each foot and one for the back (Flower and Fortney, 1983: 109). The complexity of the puppet determines the number of strings required. There are three types of controls for marionettes: the vertical / upright control, the horizontal / airplane control and the palette control (Flower and Fortney, 1983: 110).

The upright control consists of an upside-down wooden cross with wire controls for the hands and a removable bar for the legs (Currell, 1992: 68) (refer to Fig. 2.3.3.1).

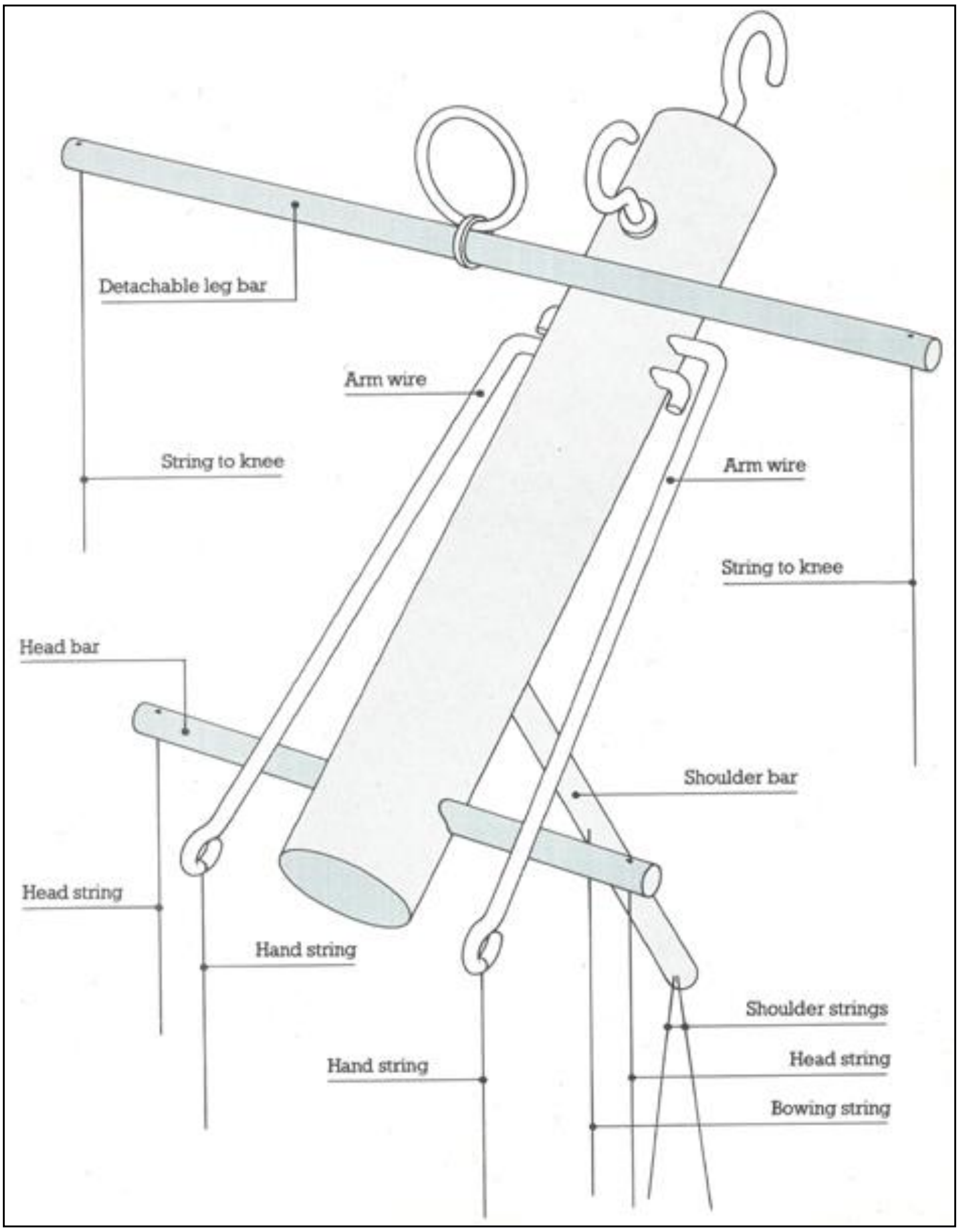

Fig. 2.3.3.1: The Vertical Control (Peake, 1986: 117)

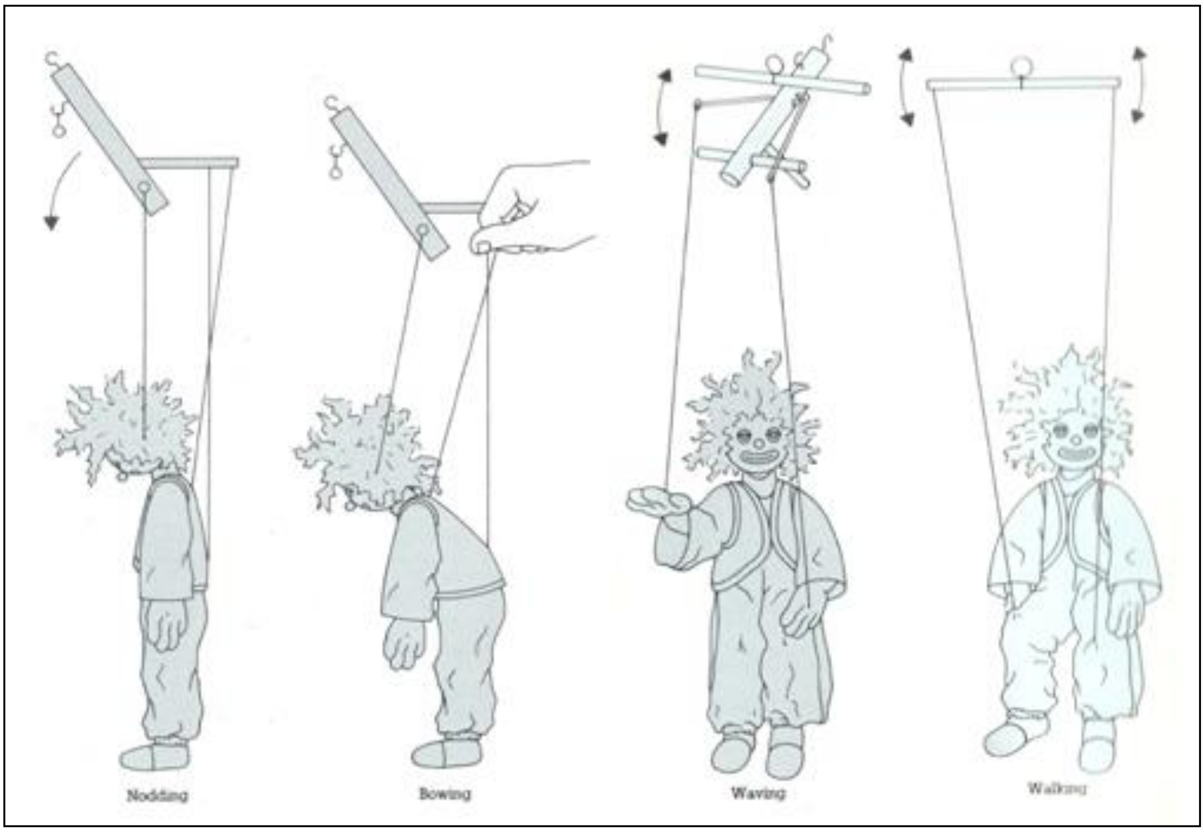

Fig. 2.3.3.2: Nodding, Bowing, Waving and Walking (Peake, 1986: 118,119)

The horizontal control is two flat slats of wood, also joined to form a cross, with an extra loose slat for the legs (Flower and Fortney, 1983: 110) (refer to Fig. 2.3.3.3).

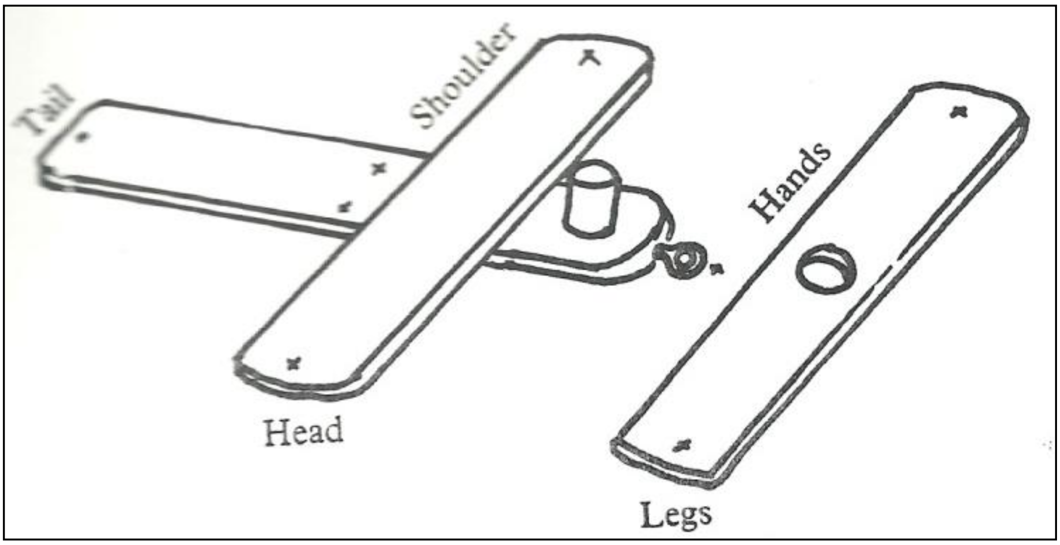

Fig. 2.3.3.3: Horizontal Control (Flower and Fortney, 1983: 110)

Currell (1980: 108) also mentions that the horizontal control can be used for four-legged marionettes (refer to Fig. 2.3.3.4). It is therefore ideal for animal marionettes.

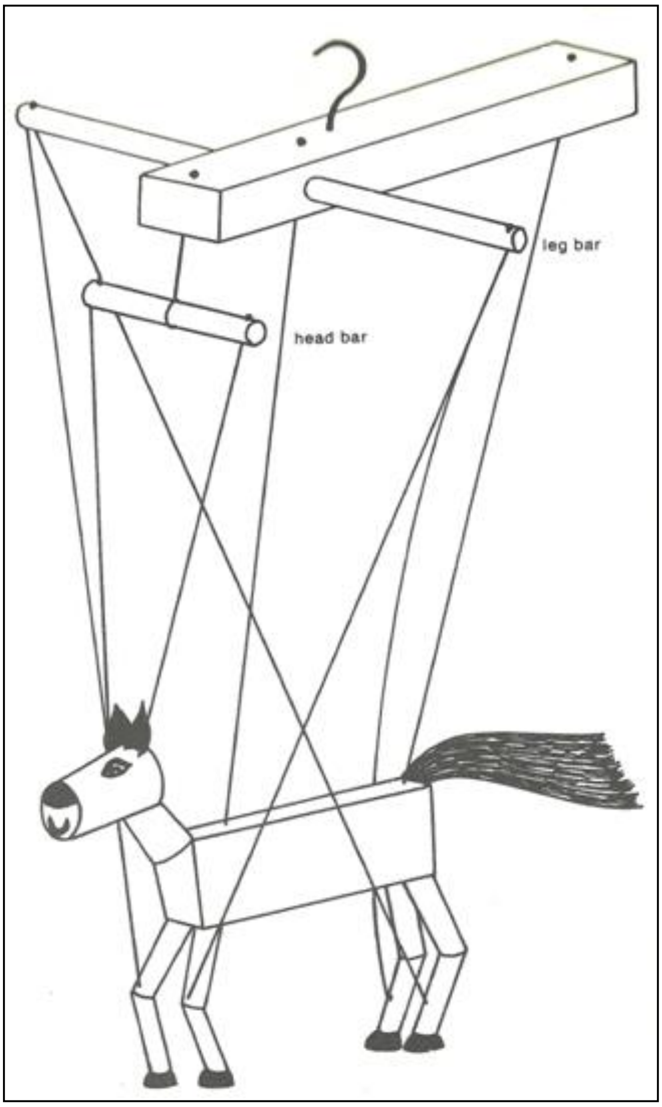

Fig. 2.3.3.4: Horizontal Control for an Animal Marionette (Currell, 1980: 109)

The palette control is for subtle movements in puppets and is shaped like a 'sweep-wing aircraft'. The control is designed to fit in the palm of the controller's hand (Flower and Fortney, 1983: 111).

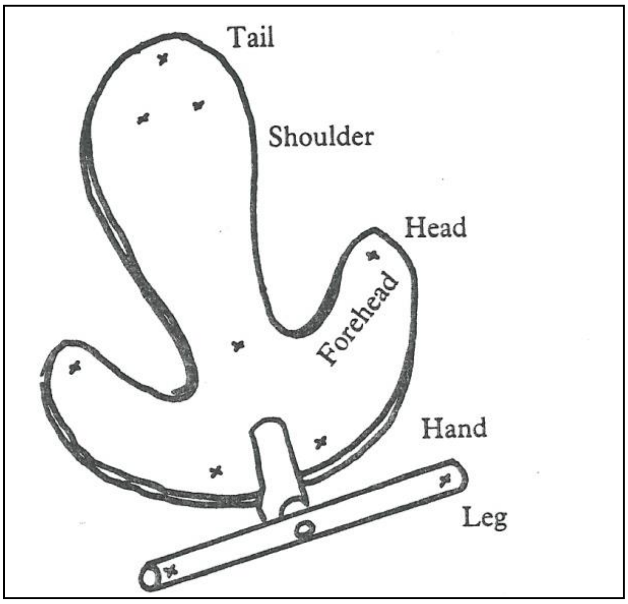

Fig. 2.3.3.5: Palette Control (Flower and Fortney, 1983: 111)

Angling and moving the control naturally tightens and slackens the strings that create interesting movement in the marionette. Flower and Fortney (1983: 102) believe that gravity and momentum are the only forces that should be moving the puppet – the puppeteer is just supposed to hold on. Individual strings can also be manipulated to create specific and controlled movements.

The puppets of the Handspring Puppet Company are not marionettes and therefore their manipulation methods would not be relevant to discuss. There is however one construction that they made that the researcher made use of in her BTech study; a simple yet extremely effective mechanism that could bend the leg of an animal puppet in a most natural and convincing manner.

When an animal walks it bends both its knee and ankle as well as its elbow and knee (refer to Fig. 2.3.3.6). Kohler recreated this double action by linking the knee and ankle as well as the elbow and wrist to create a simultaneous bending action (Taylor, 2009: 77).

Fig. 2.3.3.6: Hyena (Taylor, 2009: 23)

This same mechanism was later used in the legs of the horses of *Warhorse* with the same realistic effect (refer to Fig. 2.3.3.6)

Fig. 2.3.3.7: Horses (Taylor, 2009: 141)

2.4 Conclusion

The data gathered on animal anatomy and locomotion indicates that the movement of animals may not be very easy to replicate in a puppet. An understanding of the types of joint present in the body, where in the body the joints are located and what movements they are capable of is imperative for fully understanding the range of motions an animal can execute.

Concerning the literature review on marionette construction, the researcher is in favour of using select recommendations made by the aforementioned puppeteers that in the researcher's opinion will create the most realistically moving joints. Such as the three-part tongue and groove joint (refer to Fig. 2.3.2.8) as discussed by Currell for the construction of all joints that must perform a simple bending action. It must be noted that Currell's discussion on marionette construction is not focused on realistic movement specifically but just general movement. Other joints the researcher will use is ball-and-socket joint and plane joints (refer to 2.2.7).

The Handspring Puppet Company focused a great deal on the realistic movement of their animal puppets, unfortunately none of which are marionettes. However, the researcher is in favour of using the tendon system of the Hyena puppet to create the double bending action. This is a useful mechanic that has many applications.

Furthermore, the researcher's preferred materials for marionette construction is layers of plywood (as informed by the Handspring Puppet Company), the three-part tongue and groove joint is the ideal type of joint when working with a layered material. Also the use of jelutong wood for the heads of the puppets as used by the aforementioned.

Flower and Fortney (1983: 102) discussed the idea that a marionette is like a work of art. Each person that creates a marionette puts a bit of themselves into it and therefore a marionette develops a kind of style and a look unique to its creator. Despite the many materials and construction techniques available the artist finally decides what will work best for their project. The next chapter details the design and construction process of the five animal marionettes.

CHAPTER 3: Animal Marionette Construction

3.1 Introduction

This section details the process the researcher followed to first design and then to construct the animal marionettes. The design and construction were closely informed by the study and mastery of animal physiology as outlined in the previous chapter. Each animal marionette is discussed separately under the headings 'Design', 'Construction', 'Marionette Control' and 'Analysis of Marionette'.

The discussion under the heading 'Design' describes the design process of the puppet with reference to the information gathered on the physiology of the animal the puppet is based on.

The researcher's design methodology was as follows:

- Create a skeletal drawing of the animal
- Do a motion study drawing of the animal
- Make a construction drawing noting the types of movement necessary and the relevant joints

The discussion under the heading 'Construction' details the construction process of each marionette. It deals with the types of joint utilised, the movement of the marionette before it is strung, the construction of the control, the stringing of the marionette and the movement of the strung marionette in its final form.

The discussion under 'Marionette Control' details the design and construction of the marionette control mechanism. Under the heading 'Analysis of Marionette' the researcher analyses the complete marionette.

In her B Tech study (Van Zyl, 2013: 300, 301) the researcher found that plywood is the best medium for her method of marionette body and limb construction. For this study the researcher used 4mm and 6mm plywood for the construction of the marionettes. The 6mm plywood was mostly used for the puppet parts, while 4mm plywood was used for more delicate features.

The B Tech study advocates the use of balsa wood for puppet heads, but the researcher has since found through personal experience that jelutong wood is more durable. The marionettes used in this study were not built to the same scale as they were meant to be viewed individually.

3.2 The Two-toed Sloth Marionette

The following section describes the design, construction, control and analysis of the two-toed sloth marionette.

3.2.1 Design

3.2.1.1 Skeletal Analysis

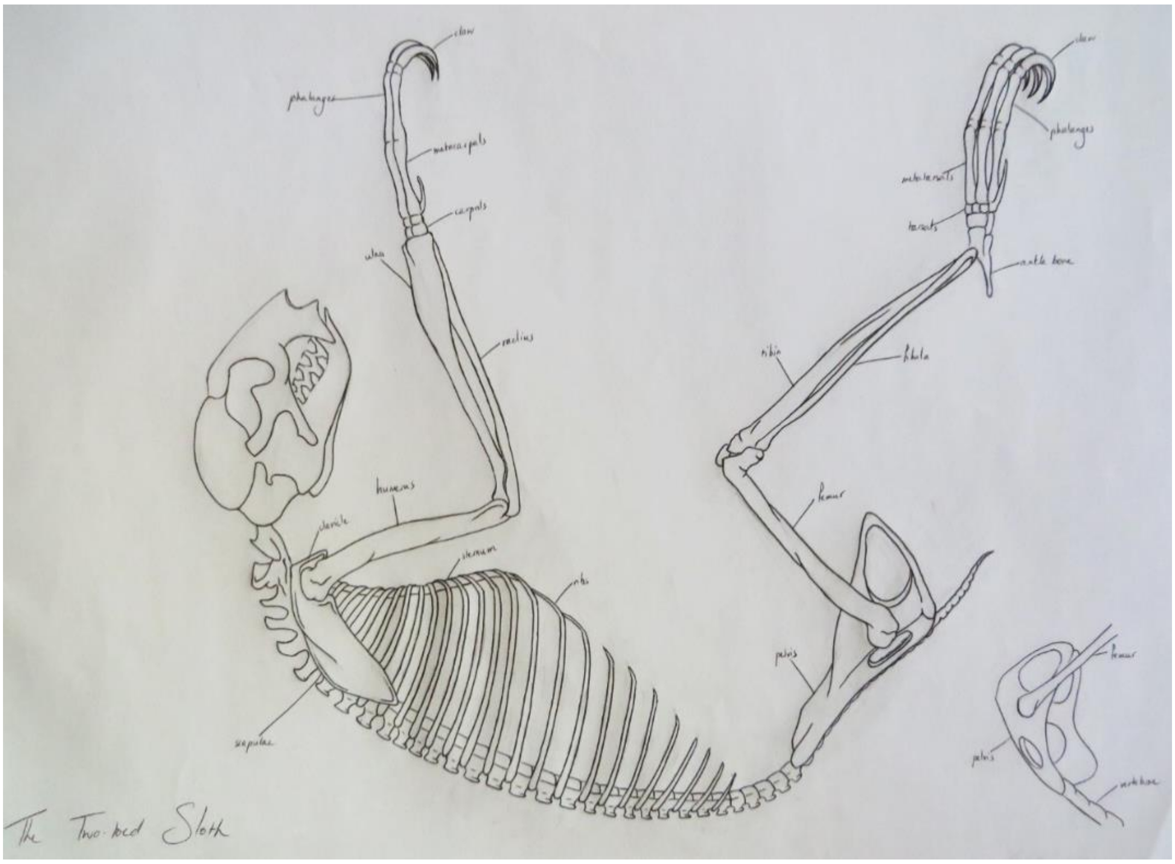

Fig. 3.2.1.1.1: Two-toed Sloth Skeleton Drawing (Van Zyl: 2014)

Applying the data gathered and discussed in Chapter two the researcher made a skeletal drawing of the two-toed sloth. From the skeletal drawing the following prominent features are apparent (refer to 2.2.2.1 *Anatomy*):

- The ribcage is elongated and the sternum has a concave shape.
- The front limbs are longer and more developed than the hind limbs.

- The two claws on the front paw are longer than the three claws on the hind paw.
- The legs are adapted for suspension as opposed to support.

3.2.1.2 Motion Analysis

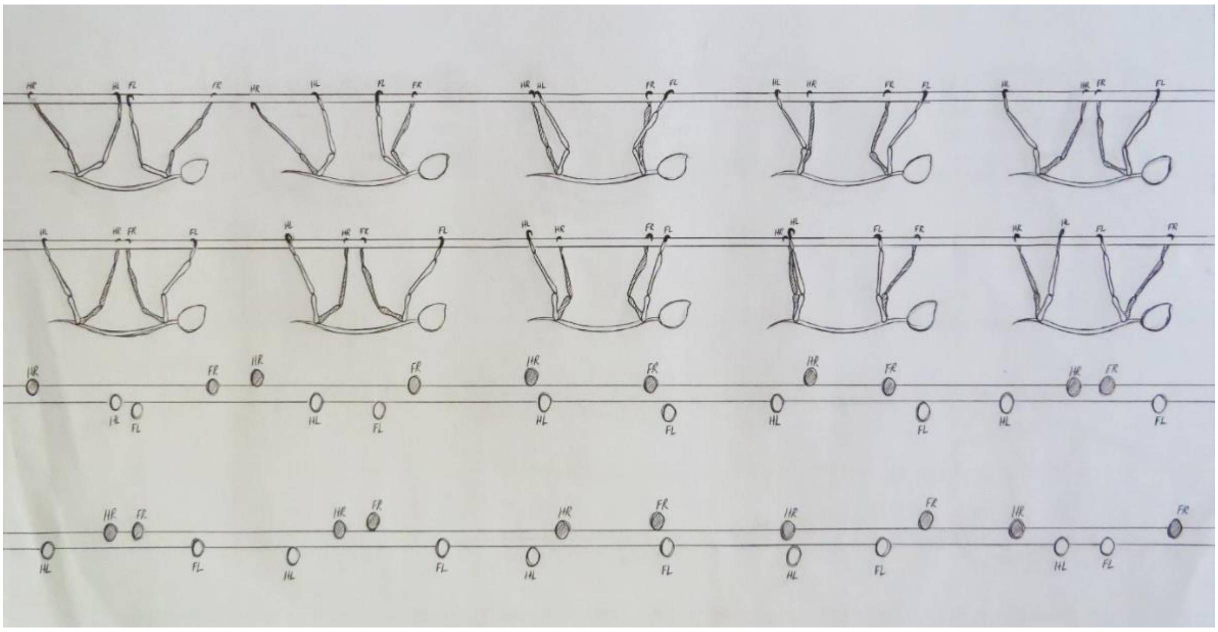

Fig. 3.2.1.2.1: Two-toed Sloth Locomotion Study (Van Zyl: 2014)

The researcher also conducted a study of the locomotion method employed by the two-toed sloth as discussed in Chapter two. The researcher subsequently made a locomotion study drawing of the two-toed sloth. From the drawing the following prominent features are apparent (refer to 2.2.2.1 *Locomotion*):

- The two toed sloth employs scansorial locomotion that resembles upside down cursorial locomotion.
- One front limb is moved forward in conjunction with the opposing hind limb, while the other two limbs hold on to the branch.
- There is a slight tilt of the shoulders and pelvis as the perpendicular limbs are stretched out.

3.2.1.3 Sloth Marionette Design

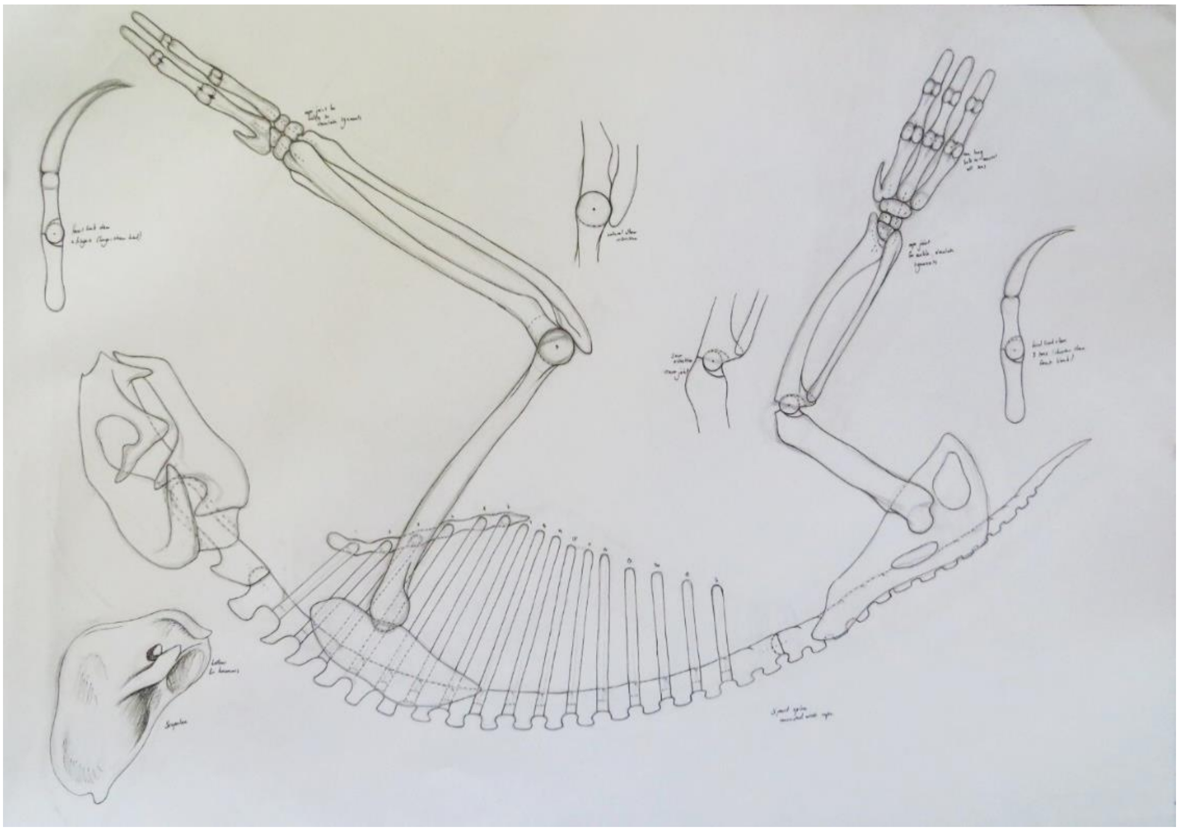

Fig. 3.2.1.3.1: Two-toed Sloth Construction Drawing

The design of the marionette is reflected in the construction drawing. The design allows for rotational movement in the shoulder and pelvis joints, as well as in specific areas of the spine: between the head and ribcage; and between the ribcage and pelvis. The pelvis joint is a deep ball-and-socket joint, while the other rotational joints are shallow ball-and-socket joints. The elbows, knees, fingers and toes are hinged joints to allow for simple bending movements. Although the fingers and toes of the two-toed sloth are comprised of three digits and therefore two joints, the marionette has two digits and one joint to simplify construction. This allows for easier movement of the fingers and toes. To replicate the pronation and supination movement (refer to section 2.2.2.1) the wrists and ankles are designed to rotate.

3.2.2 Construction

3.2.2.1 Construction of Parts

Paper patterns were made from the construction drawing and transferred to 6mm pine plywood. The patterns were cut from the plywood with a jigsaw and the layers glued together. Once dry, the glued pieces were carved with a rotary tool. What follows are photographs of the process:

Fig. 3.2.2.1.1: Marionette Parts Transferred to Plywood

Fig. 3.2.2.1.2: Marionette Parts Glued Together

Fig. 3.2.2.1.3: Carved Parts

3.2.2.2 Assembly of Parts

Axial Skeleton

The ribcage was made by cutting indents into the spine and slotting the ribs into the indents. The ribs were strengthened by gluing the distal ends of the ribs to the sternum to provide support. The pelvis was glued to the lower part of the spine and strengthened by small dowels inserted into the underside of the pelvis. The shoulders were attached to the ribcage using string. The shoulder blades were not glued in order to allow a slight degree of movement, mimicking the slight degree of movement that a natural shoulder blade exhibits in a living creature.

The head of the sloth was carved from jelutong wood. The head resembled the skull of a two-toed sloth (see Fig. 3.2.2.2.2).

Appendicular Skeleton

The shoulder ball-and-socket joint was constructed by making a rounded indent in the front part of the shoulder blade and drilling a small hole through it. Another small hole was drilled through the top of the upper arm and one end of a piece of string was glued into this hole, leaving the other end free. The entire rounded top of the upper arm was then covered with a layer of glue and left to dry. The layer of glue simulates the synovial joint fluid of a living creature, allowing for smoother rotational movement.

Once dry, the end of the string sticking out of the top of the upper arm was threaded through the small hole in the shoulder blade and tied between the ribs. The same method was used to create the ball-and-socket joint of the pelvis.

Simple tongue-and groove joints were constructed to create hinge joints for the knee and elbow joints and the finger and toe joints.

The wrists and ankles were made from small plywood ellipses threaded with string to allow a great degree of freedom of movement. The plywood ellipses simulate plane joints (refer to section 2.2.7), allowing the pronation and supination movement that is important in scansorial locomotion.

Fig. 3.2.2.2.1: Assembled Body of Sloth Marionette

Fig. 3.2.2.2.2: Head of Sloth Marionette

3.2.2.3 Movement Assessment before Stringing

The researcher found that the shoulder blade did not have the slight degree of movement that was intended. The joint of the shoulder was so flexible that the shoulder blade itself did not have to move. To rectify this problem the researcher re-attached the shoulder blades to the ribcage with glue to ensure a sturdier frame.

The researcher also noticed that the fingers and toes moved too freely, which would be difficult to control. The researcher subsequently glued the two fingers of each front paw and the three toes of each hind paw together at the proximal end of the digits to restrict excessive movement. The marionette's other joints moved without the aid of strings in the usual manner.

3.2.3 Marionette Control

3.2.3.1 Design

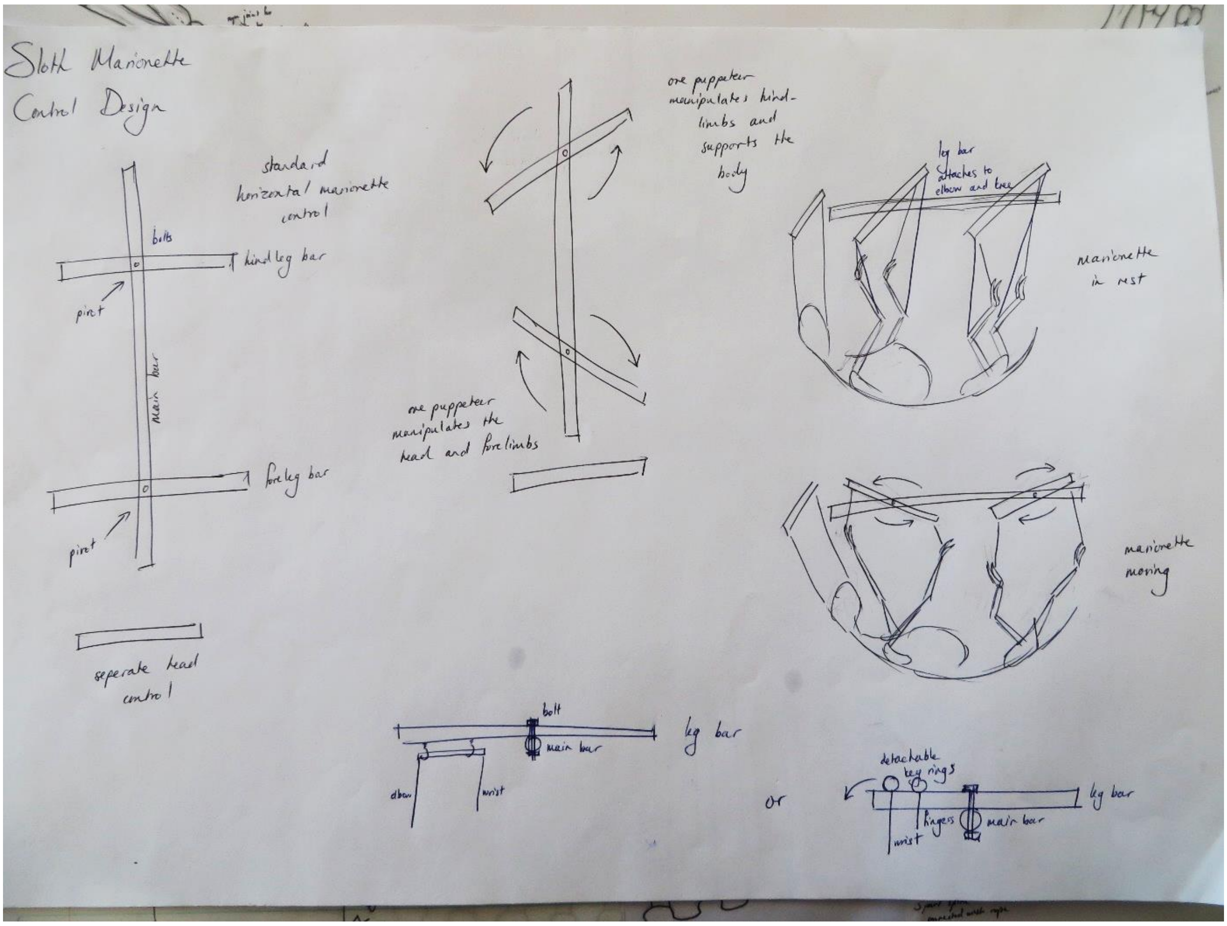

Fig. 3.2.3.1.1: Sloth Marionette Control Design

The control is based on the common horizontal marionette control most often used for animal marionettes. The two leg bars were built with a pivot joint to allow the bars to rotate (see Fig. 3.2.3.1.1). This allowed the legs of the sloth to be pulled forward and backward in conjunction, thereby replicating the upside down cursorial motion or otherwise scansorial motion of the two-toed sloth.

The researcher added key rings to the front limbs to allow for more articulated movement by attaching a key ring to the wrist of each forepaw. The key rings are detachable from the leg bars to allow greater freedom of movement of the puppet and therefore create more realistic movement.

The head bar is also detachable to create realistic head movement.

3.2.3.2 Construction

The control of the sloth marionette consists of a 12mm dowel as the main bar, two 8mm dowels as the leg bars and a 12mm dowel for the head bar. The head bar is detachable for more articulated movement of the marionette's head.

The leg bar for the front limbs is longer than the leg bar for the hind limbs, because the sloth marionette has longer forelimbs compared to the hind limbs. The front leg bar has detachable key rings for each forepaw to allow for more articulated movement of the front limbs.

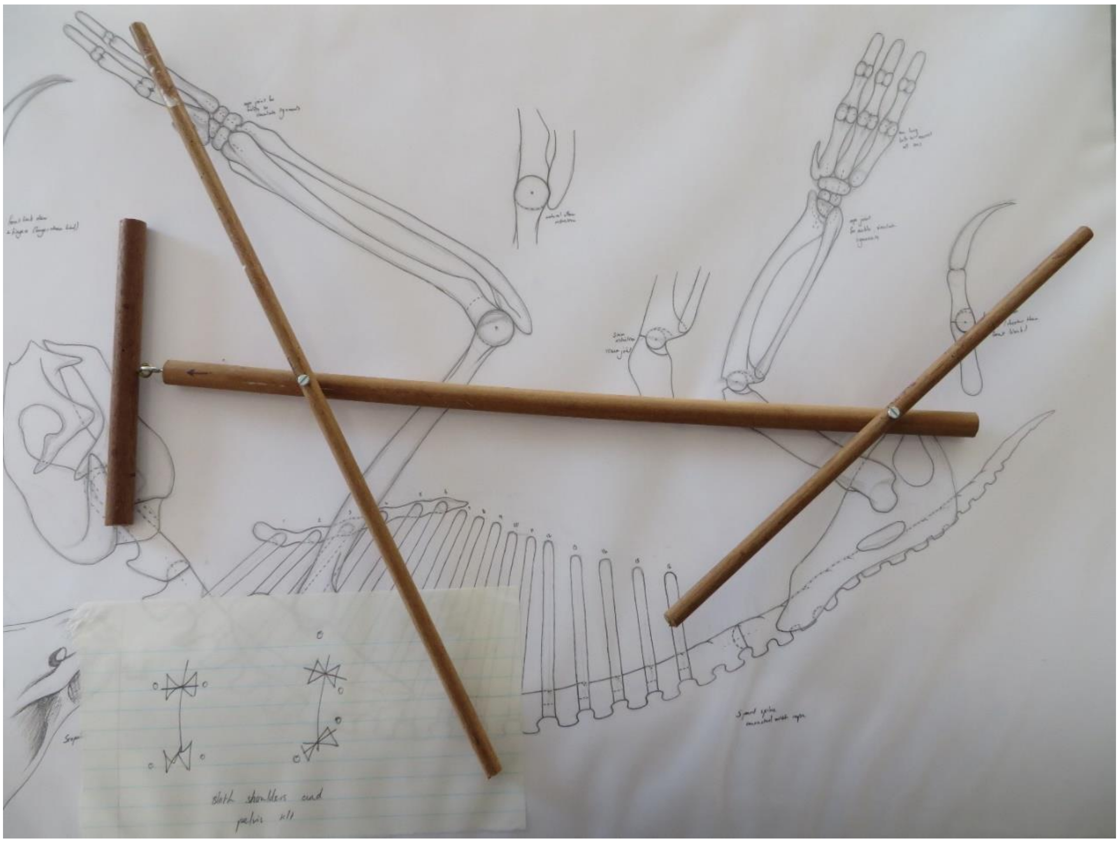

Fig. 3.2.3.2.1: Sloth Marionette Control

Fig. 3.2.3.2.2: Completed Sloth Marionette Control

3.2.4 Analysis of Marionette

In the opinion of the researcher the two-toed sloth is a convincing marionette in terms of movement because it replicates the movement discussed in Chapter two. The sloth can be manipulated to perform accurate scansorial locomotion as well as upside down cursorial locomotion.

The detachable head control and forelimb control allow for more delicate movements while retaining a sense of realistic motion.

Fig. 3.2.4.1: Completed Two-toed Sloth Marionette I

Fig. 3.2.4.2: Completed Two-toed Sloth Marionette II

Fig. 3.2.4.3: Completed Two-toed Sloth Marionette (Scale)

3.3 The Common Barn Owl Marionette

The following section describes the design, construction, control and analysis of the common barn owl marionette.

3.3.1 Design

3.3.1.1 Skeletal Analysis

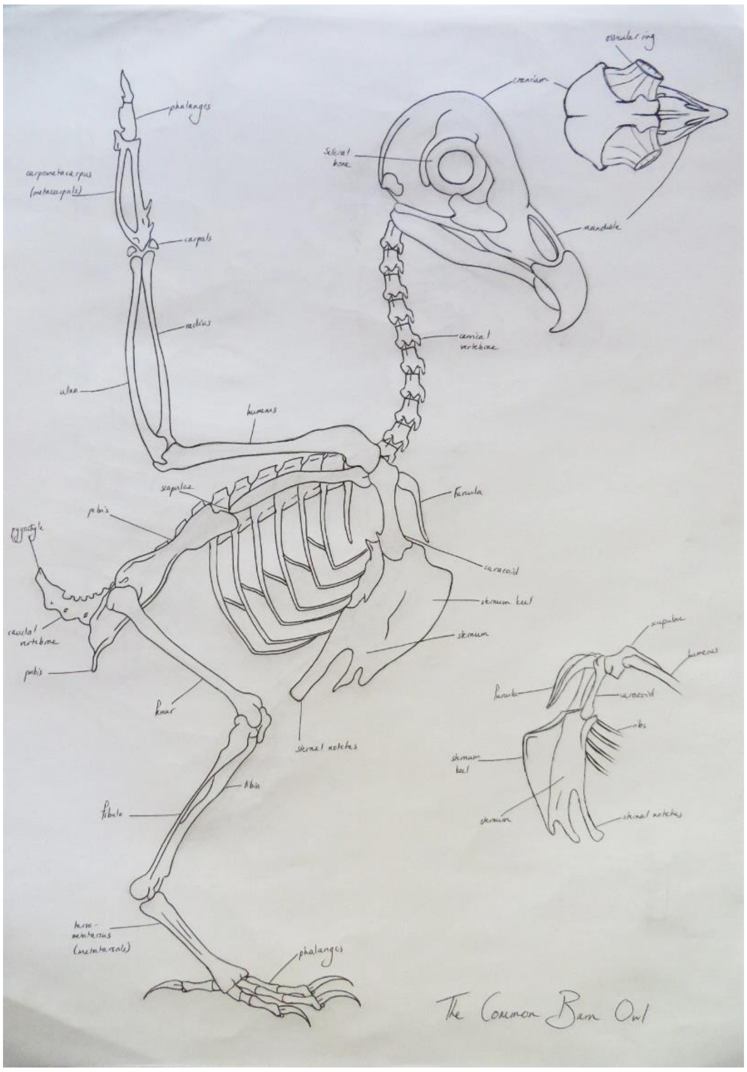

Fig. 3.3.1.1.1: Common Barn Owl Skeleton Drawing (Van Zyl: 2014)

Applying the data gathered and discussed in Chapter two the researcher made a skeletal drawing of the barn owl. From the skeletal drawing the following prominent features are apparent (refer to 2.2.3.1 *Anatomy*):

- The head is large in comparison to the body.
- The eye sockets protrude from the skull at a 45º degree angle to the beak.
- The ribs connect to the sternum, which is large and flat, but thicker where the ribs attach.
- The pelvis is small and follows the line of the tailbone.
- The wings and legs consist of three parts each.
- The foot has three forward pointing toes and one smaller toe pointing backwards.

3.3.1.2 Motion Analysis

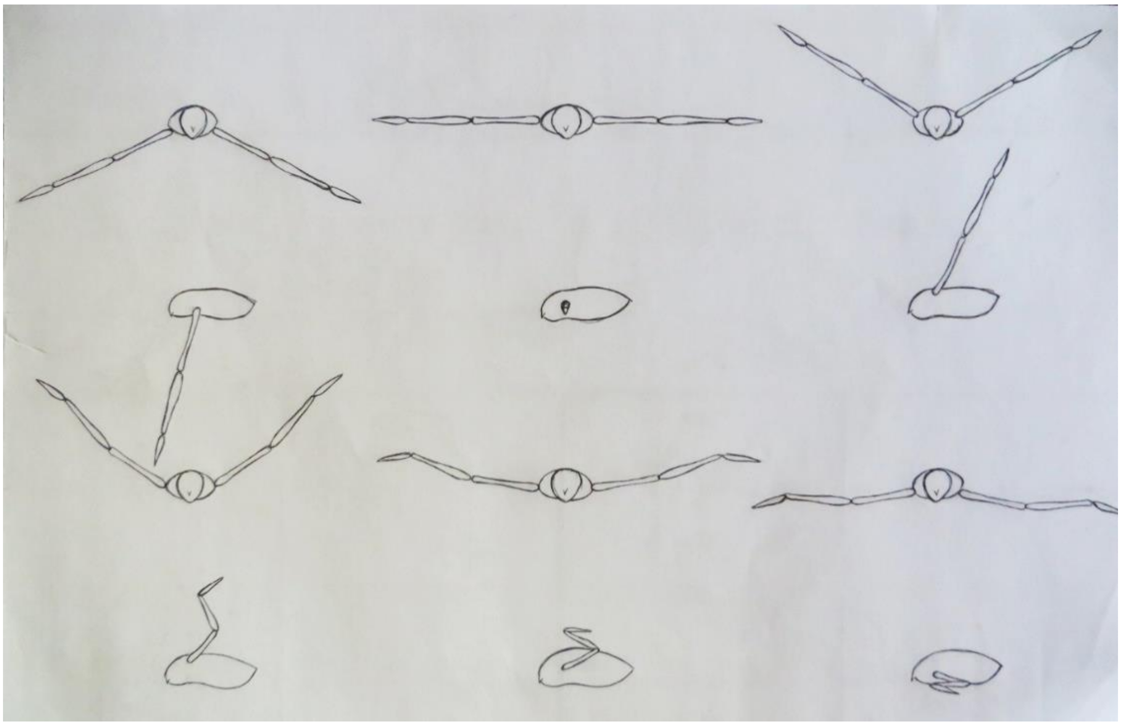

Fig. 3.3.1.2.1: Common Barn Owl Locomotion Study (Van Zyl: 2014)

Fig. 3.3.1.2.2: Common Barn Owl Motion Study (Van Zyl: 2014)

The researcher also conducted a study of the locomotion method employed by the barn owl as discussed in Chapter two. The researcher subsequently made a locomotion study drawing of the barn owl. From the drawing the following prominent features are apparent (refer to 2.2.3.1 *Locomotion*):

- The owl employs aerial locomotion and periods of stationary flight when hunting.
- The wrist and elbow movement is restricted to one plane and the two joints operate simultaneously.
- The toe and ankle joints also operate simultaneously.
- As the bird lifts its wing during flight on the upstroke, it half folds its wing.
- When flapping down the wings push downwards and forwards.

3.3.1.3 Owl Marionette Design

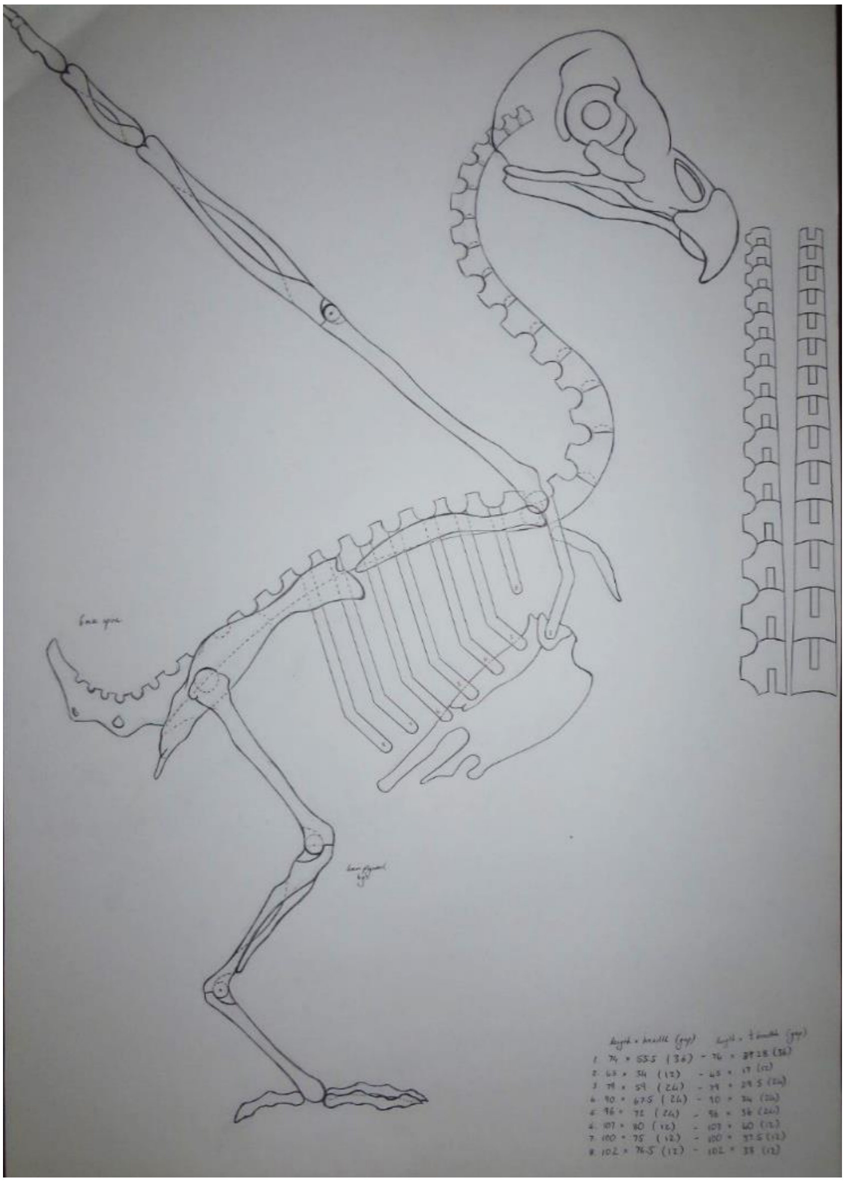

Fig. 3.3.1.3.1: Common Barn Owl Construction Drawing

The construction drawing of the owl is similar to that of the sloth. The shoulder and pelvis joints were designed to have rotational movement. The elbow, knee and ankle joints were designed as hinge joints. The toes and the wrists were designed as plane joints. The spine is rigid, but the neck was designed to consist of fourteen individual pieces to allow for flexible neck movement. The vertebrae are linked with very shallow ball-and-socket joints.

3.3.2 Construction

3.3.2.1 Construction of Parts

Paper patterns were made from the construction drawing. These paper patterns were transferred to pine plywood. The patterns for the body and toes were transferred to 6mm pine plywood, while the patterns for the neck and limbs were transferred to 4mm pine plywood. The reason for this is that the limb bones and vertebrae of an owl skeleton are more delicate than the bones of the body. The patterns were cut from the plywood with a jigsaw and the layers glued together. Once dry, the glued pieces were carved with a rotary tool. The following are photographs of the construction process:

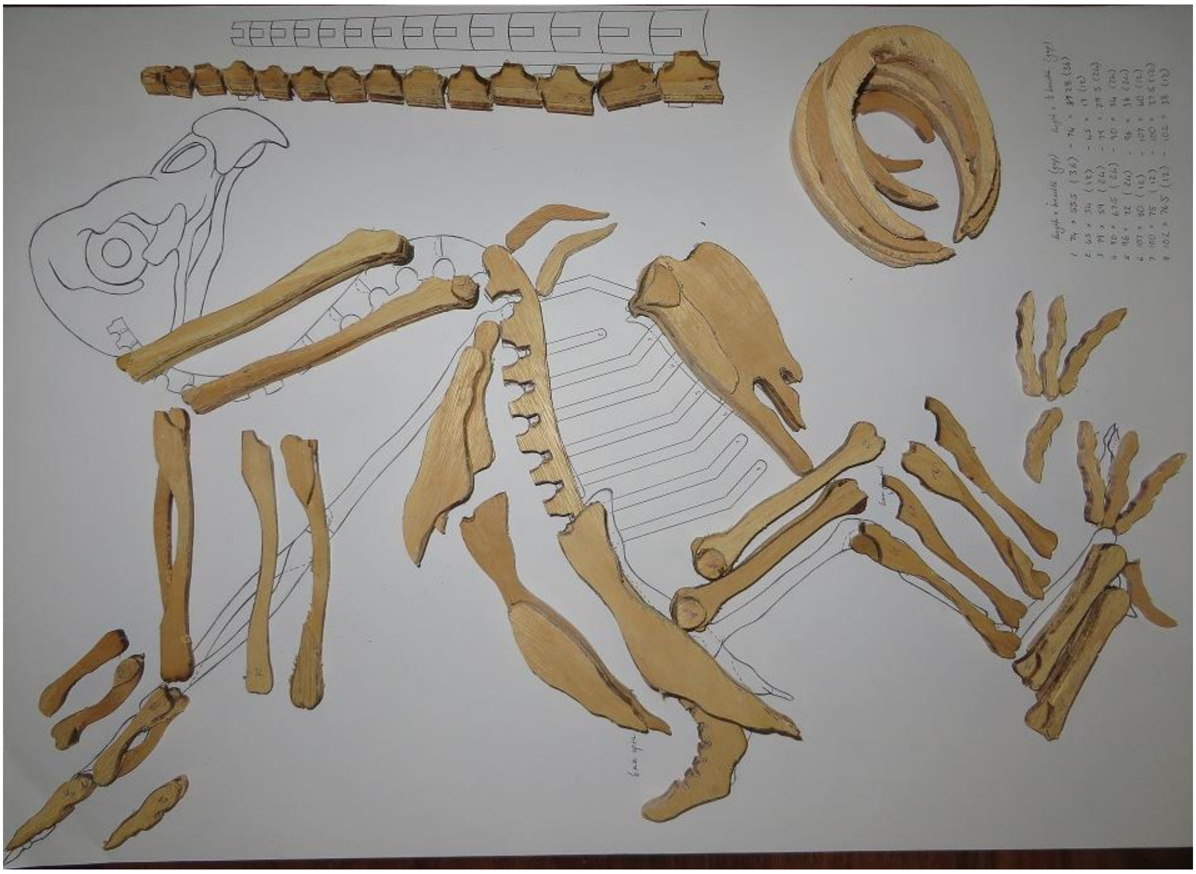

Fig. 3.3.2.1.1: Marionette Parts Glued Together

Fig. 3.3.2.1.2: Carved Parts

3.3.2.2 Assembly of Parts

The Axial Skeleton

The axial skeleton of the owl was assembled in exactly the same manner as the sloth (refer to section 3.2.2.2), although the neck consists of fourteen individual pieces that gradually become larger progressing from the head to the body. Each piece consists of two interlocking plates. These pieces were threaded onto a piece of string that attaches to the main part of the spine. This allows for realistic and flexible movement of the owl's neck.

The head of the owl was carved from jelutong wood. The head resembles the skull of a common barn owl (see Fig. 3.3.2.2.2).

The Appendicular Skeleton

The shoulder and pelvis joints are similar to the ball-and-socket joints used in the sloth marionette (refer to section 3.2.2.2). The elbows, knees and ankles are also the same tongue-and-groove joints used for the sloth (refer to 3.2.2.2). The digits of the owl's 'fingers' consist of two pieces threaded onto a piece of string, which is similar to the technique used for the construction of the owl's neck, to simulate plane joint movement.

The toes were threaded through the distal end of the leg. The intention behind this is to use gravity to slacken the toes while the owl is airborne, as well as to simulate a plane joint. This is meant to mimic the movement of bird feet during flight (refer to 2.2.3.1 *Motion*).

Fig. 3.3.2.2.1: Assembled Body of Owl Marionette

Fig. 3.3.2.2.2: Head of Owl Marionette

3.3.2.3 Movement Assessment before Stringing

The attachment of the head to the neck made the neck appear unnaturally long. The weight of the head and the effect of gravity on such a long neck complicated its movement. The researcher therefore removed two neck vertebrae to make the neck appear more natural and to make the movement more controlled.

Furthermore, the stringing of the neck vertebrae using only one piece of string caused some of the vertebrae to misalign. To rectify this problem the researcher threaded a second piece of string along the top of all fourteen vertebrae to keep them in place. This does not affect the freedom of movement that the neck is supposed to have.

The toes of the owl were initially threaded separately onto the string that attaches the toes to the distal ends of the leg. This however allowed the toes too much movement, causing the toes to stick up at odd angles when the owl was held in an airborne position. To address this problem the researcher glued the fore toes and the string the toes are threaded on, together. This allows the fore toes to slacken as a unit to assume the desired position, being the position that a real owl's toes assume when it hunts.

The remaining joints of the owl marionette can be manipulated to move without strings as intended.

3.3.3 Marionette Control

3.3.3.1 Design

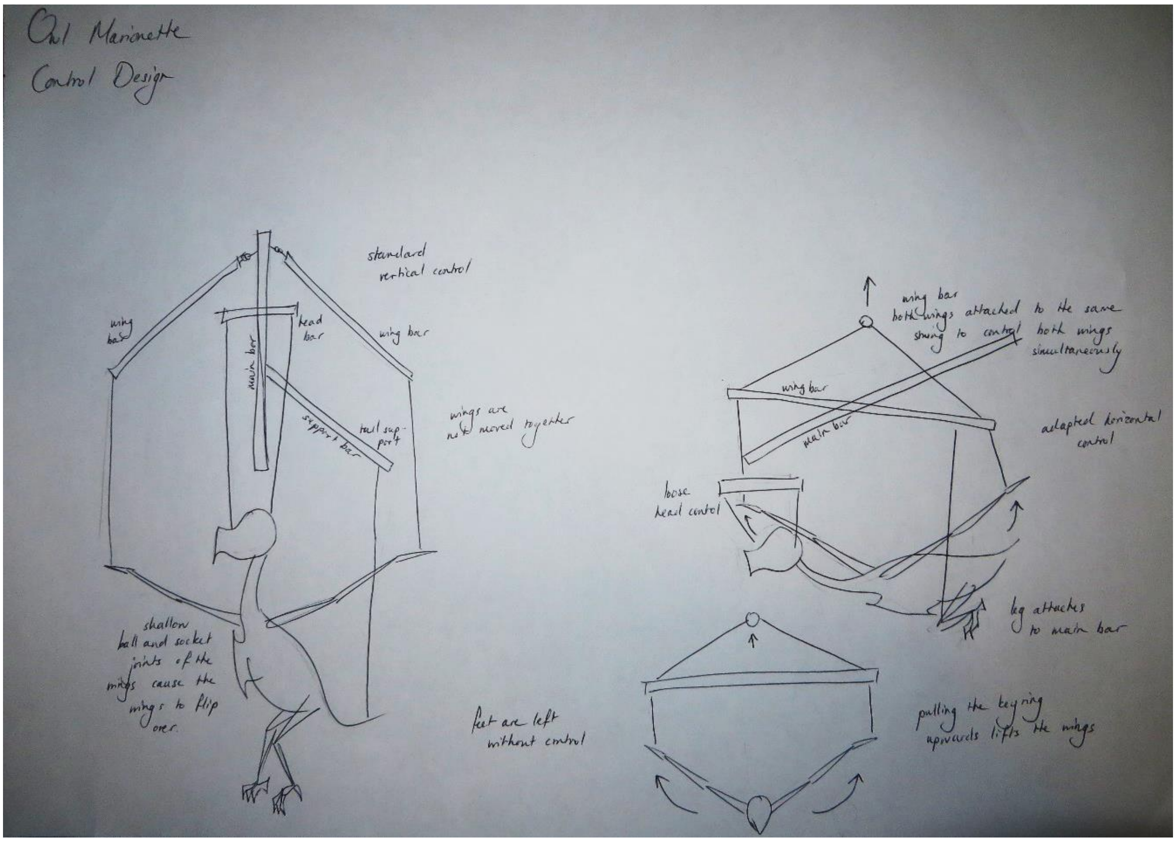

Fig. 3.3.3.1.1: Initial Owl Marionette Control Design

Recreating realistic flight movement is complicated. The researcher initially wanted to use a variation of the vertical control that would allow simultaneous movement of the wings (see Fig. 3.3.3.1.1). This control design however limited the capabilities of the puppeteers as they had to concentrate solely on realistic wing motion at the expense of head and feet movement.

Therefore the researcher had an informal discussion with a mechanical engineer who recommended the use of cams (refer to Fig. 3.3.3.1.2). A cam is a rotating body/shape used to transform 'rotary motion into linear motion or vice versa' (Snyders, 2015). This type of mechanic creates a controlled reciprocating motion. A version of a cam was created and the movement of flight was tested and two problems arose. The first problem that arose from the cam was that for the size of the owl marionettes wingspan the cam had to be very large. This is a complication for the puppeteer who would then have to struggle to carry the weight of both the cams and the marionette and rotate the cams at the same time.

The second problem was that a cam can only create one type of movement at a time. The movement of a bird is twofold (refer to 2.2.3.1 *Motion*), there is rotational movement in the shoulder and simultaneous bending movement in the elbow and wrist. These movements together create a flapping motion. Two cams or a cam and another control would be required to create the twofold flapping movement, which also further complicates the weight the puppeteer must bear and the amount of movement the puppeteer must control.

Instead the researcher settled on using the same mechanics as is used in the ribs of an umbrella (refer to Fig. 3.3.3.1.2). The ribs of an umbrella bend and extend in the same manner that a bird's wing does and furthermore it can be rotated at its proximal end. Thus accurately simulating the twofold flapping movement of a wing. The researcher constructed an umbrella mechanic for each wing using layers of plywood and bolts (refer to Fig. 3.3.3.1.2).

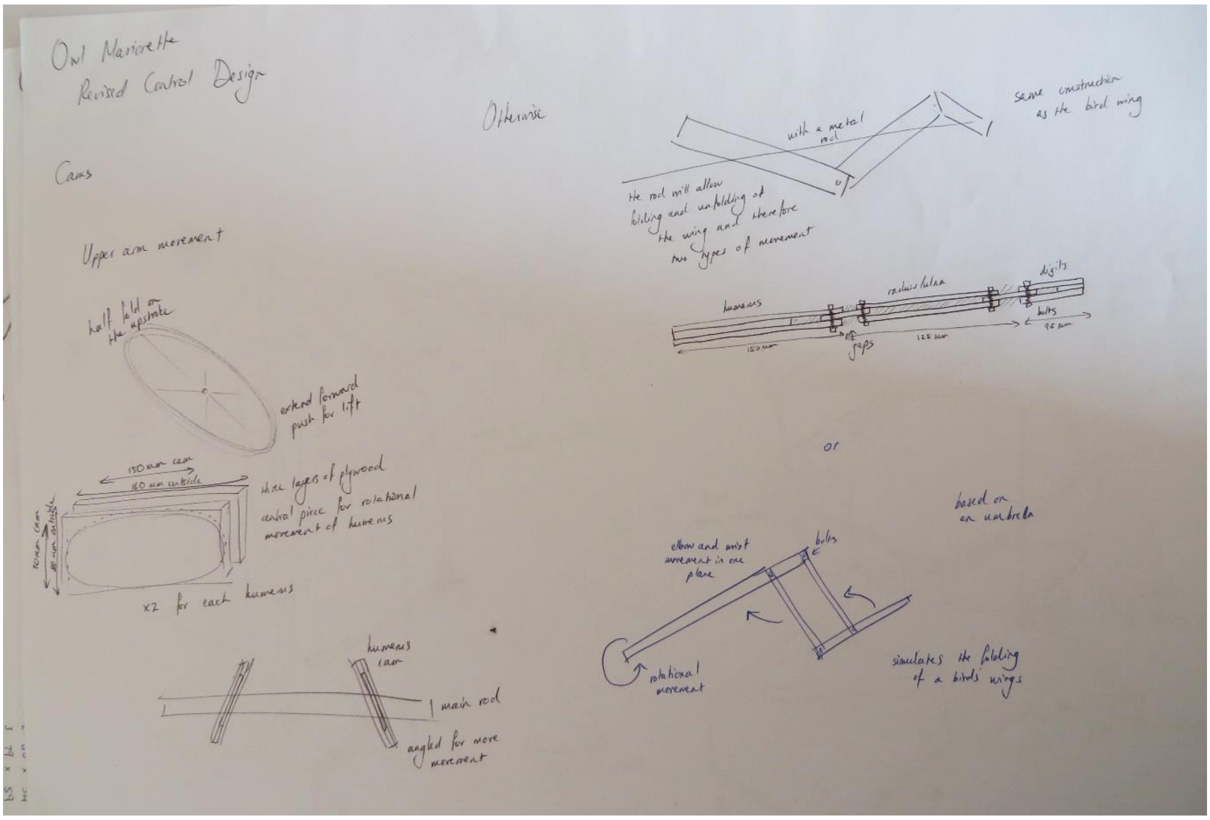

Fig. 3.3.3.1.2: Owl Marionette Control Design

3.3.3.2 Construction

The control of the owl consists of a 12mm dowel as the main bar and two 8mm dowels for the head and leg bars. The wing controls were constructed from 4mm plywood strips and attached with bolts and nuts. The wing controls were attached to the main bar with leather strips.

The parts of the control that manipulate the wings are imitations of bird wings. Therefore, merely operating the controls correctly simulate bird wing movement, not requiring any further effort from the puppeteers to achieve a realistic flying motion.

The only problem is that a single puppeteer would not be able to control the wings and bear the weight of the puppet, resulting in the owl being the only marionette that requires two puppeteers to manipulate.

The main rod is meant to support the weight of the bird. There is a leg rod towards the back of the control to support the legs and to allow the legs to be lifted during flight and lowered when the owl lands. The wing controls are not connected to each other as this allows the puppeteers to move the wings individually. Although this complicated the construction of the control, the resulting motion is more lifelike and truer to the movement of a real owl. The head bar is detachable from the main bar to allow the head to be manipulated.

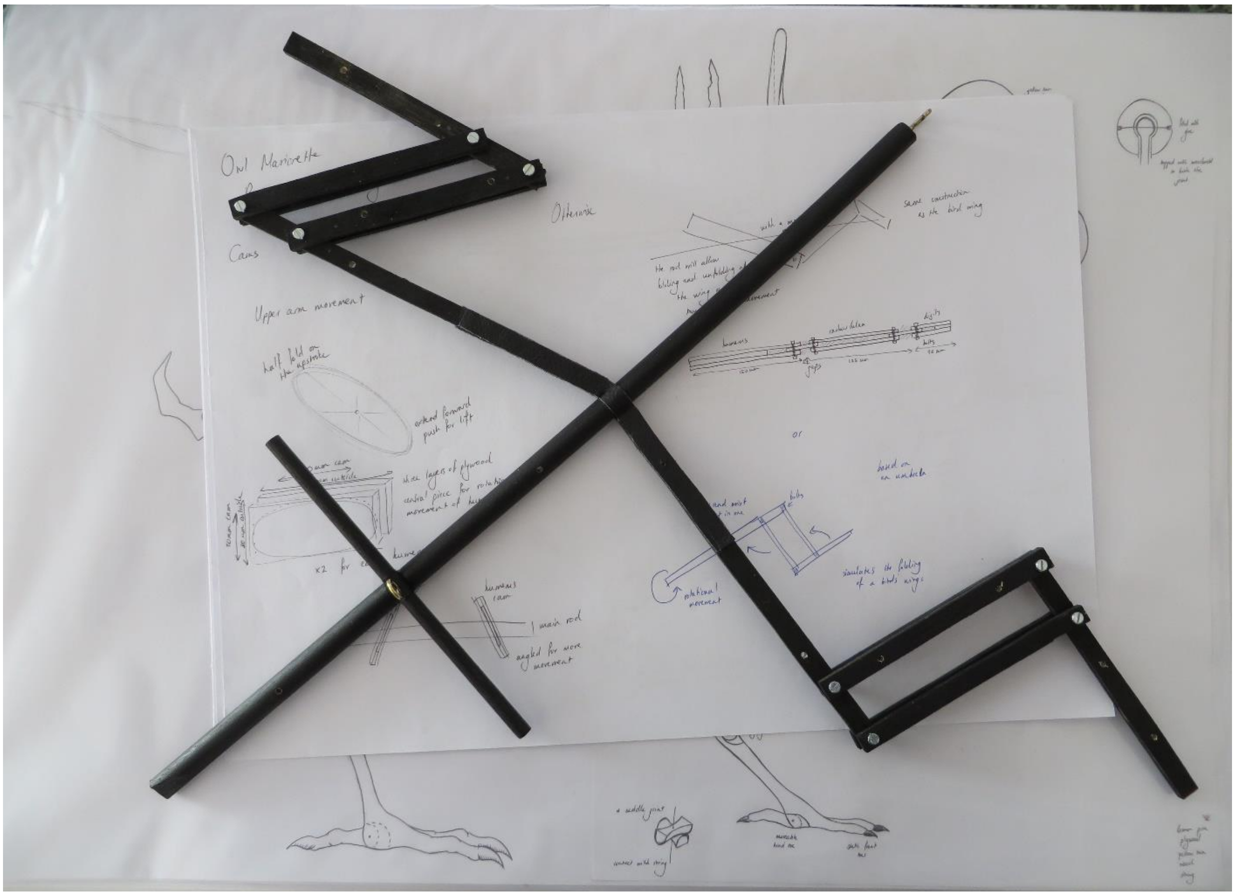

Fig. 3.3.3.2.1: Owl Marionette Control

Fig. 3.3.3.2.2: Completed Owl Marionette Control

3.3.4 Analysis of Marionette

The motion of flight is difficult to recreate. As is apparent from the motion study of the owl, a bird does not simply flap its wings up and down. On the upstroke a bird half-folds its wings to reduce air resistance. A bird wing in flight exhibits two very specific types of motion. The first motion is the movement of the humerus (upper arm bone), which draws an angled ellipse pattern throughout a bird's flight sequence. The second motion is the bending and extending of the wrist and elbow joints. These two motions in combination create the movement of a bird's wing during flight.

The flying motion is quite complex and requires both hands of one puppeteer, leaving the weight of the marionette unattended. A second puppeteer is therefore necessary to support the weight of the marionette while the first puppeteer controls the wings.

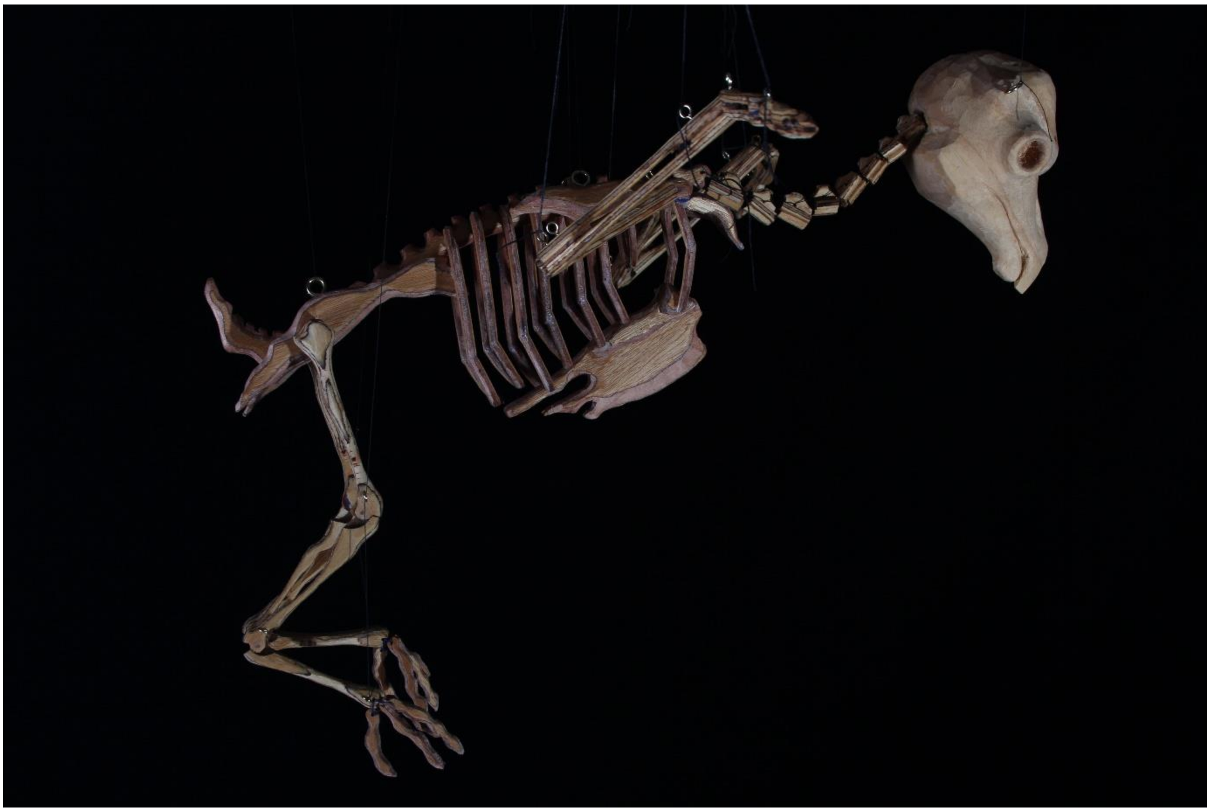

Fig. 3.3.4.1: Completed Common Barn Owl Marionette I

Fig. 3.3.4.2: Completed Common Barn Owl Marionette II

Fig. 3.3.4.3: Completed Common Barn Owl Marionette (Scale)

3.4 The Slender-snouted Crocodile Marionette

The following section describes the design, construction, control and analysis of the slender-snouted crocodile marionette.

3.4.1 Design

3.4.1.1 Skeletal Analysis

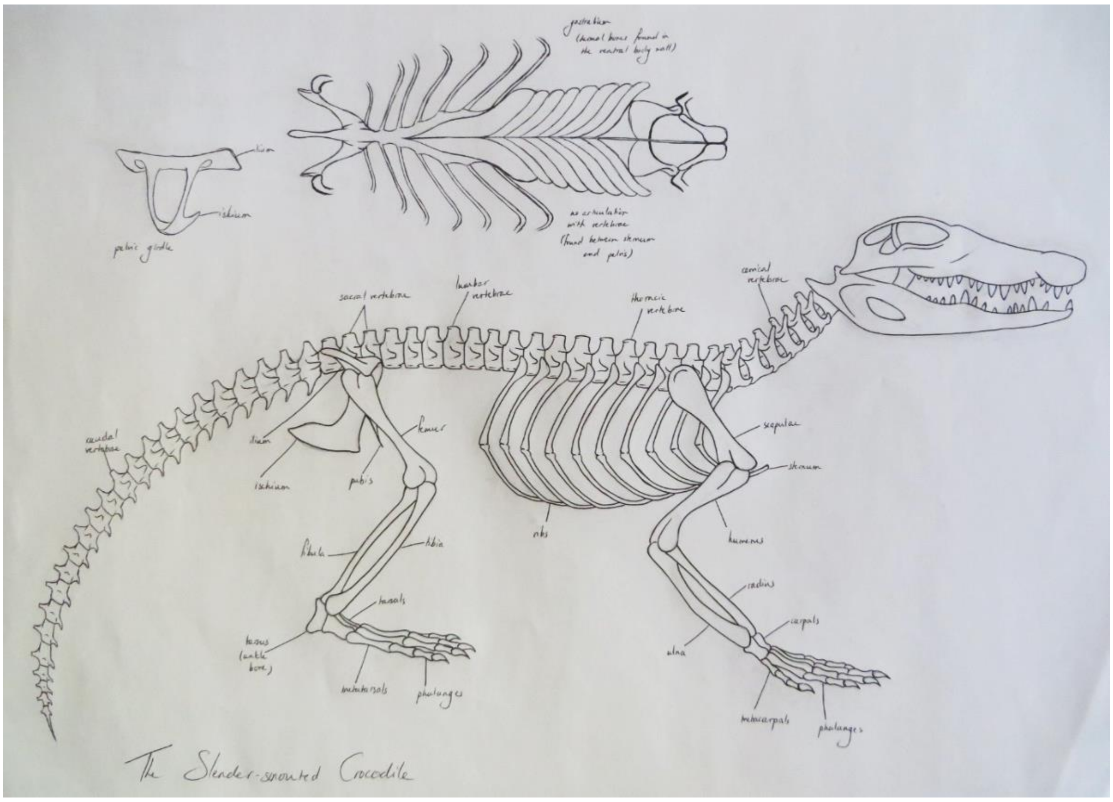

Fig. 3.4.1.1.1: Slender-snouted Crocodile Skeleton Drawing (Van Zyl: 2014)

Applying the data gathered and discussed in Chapter two, the researcher made a skeletal drawing of the slender snouted crocodile. From the skeletal drawing the following prominent features are apparent (refer to 2.2.4.1 *Anatomy*):

- The snout of the crocodile is pointed and the jaw is lined with conical teeth.
- The eye sockets and nostril passages are situated on top of the head.
- The ribcage is large and barrel-shaped with a delicate, elongated sternum.

- The pelvis is V-shaped. The legs of the crocodile are short and the toes have claws at the tips.

3.4.1.2 Motion Analysis

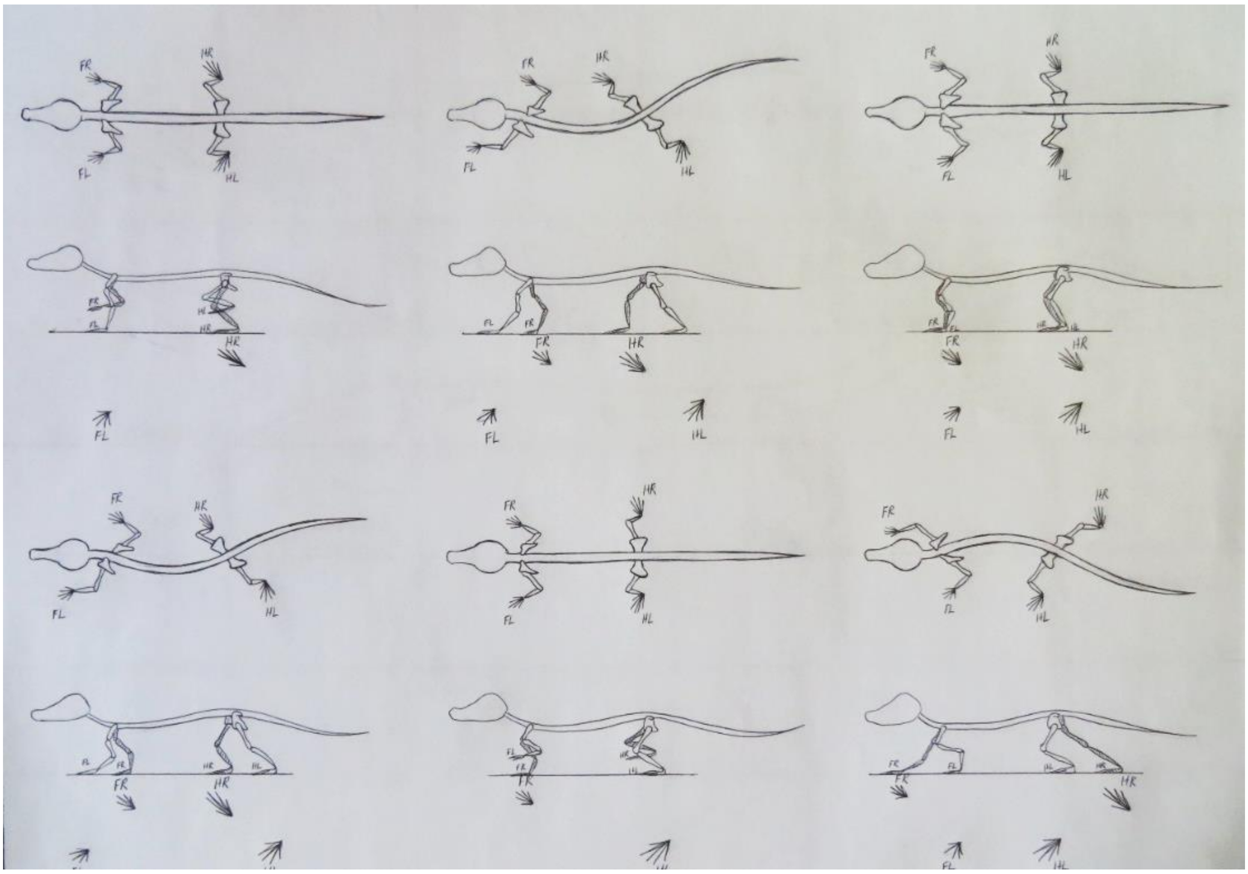

Fig. 3.4.1.2.1: Slender-snouted Crocodile Locomotion Study (Van Zyl: 2014)

The researcher also conducted a study of the locomotion method employed by the slender-snouted crocodile as discussed in Chapter two. The researcher subsequently made a locomotion study drawing of the slender-snouted crocodile. From the drawing the following prominent features are apparent (refer to 2.2.4.1 *Locomotion*):

- The limbs project perpendicularly from the body with the elbows and knees bending towards the ground.

- This posture creates a sprawling gait.

- The terrestrial locomotion of the crocodile creates a sinusoidal flexure of its body during locomotion as the front leg moves in conjunction with the opposing hind leg.
- The crocodile employs cursorial locomotion.

3.4.1.3 Crocodile Marionette Design

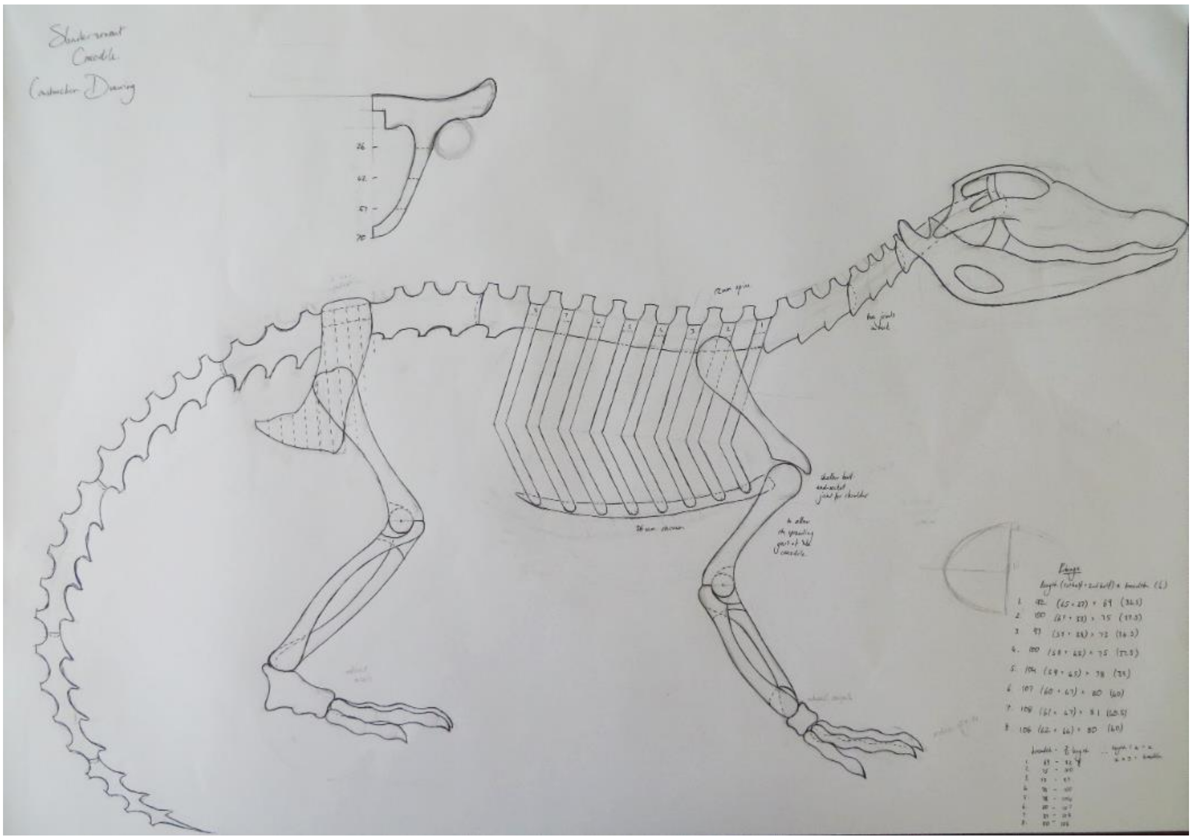

Fig. 3.4.1.3.1: Slender-snouted Crocodile Construction Drawing (Van Zyl: 2014)

The construction drawing of the crocodile is similar to that of the sloth. The shoulder and pelvis joints were designed for rotational movement, while the elbow and knee joints were designed to be hinge joints. There are also several shallow ball-and-socket joints in the spine (see Fig. 3.3.3.1) to allow for the undulation movement that is created when the crocodile locomotes.

3.4.2 Construction

3.4.2.1 Construction of Parts

Paper patterns were made from the construction drawing. The paper patterns were transferred to 6mm oak plywood. The patterns were cut from the plywood with a jigsaw and the layers glued together. Once dry, the glued pieces were carved with a rotary tool. The following are photographs of the process:

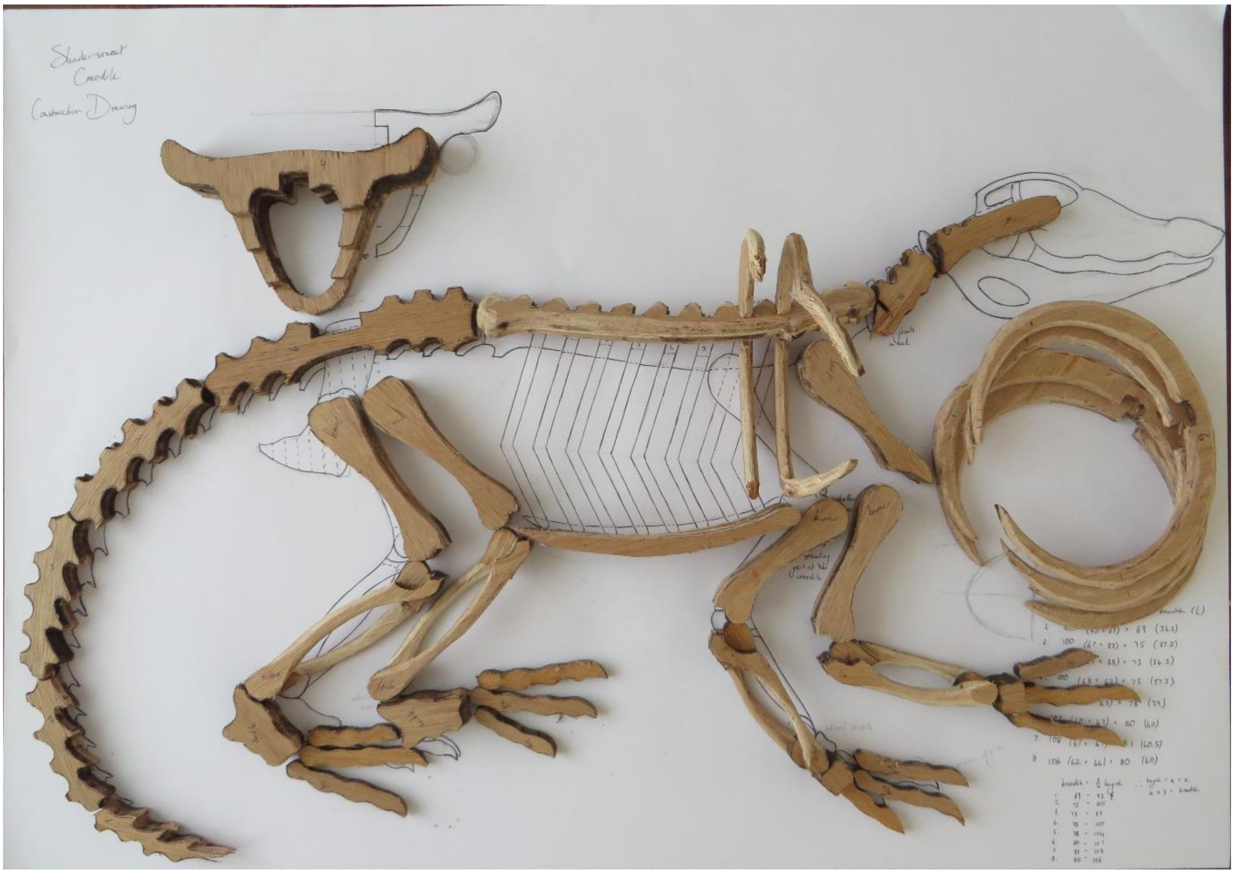

Fig. 3.4.2.1.1: Marionette Parts Glued Together

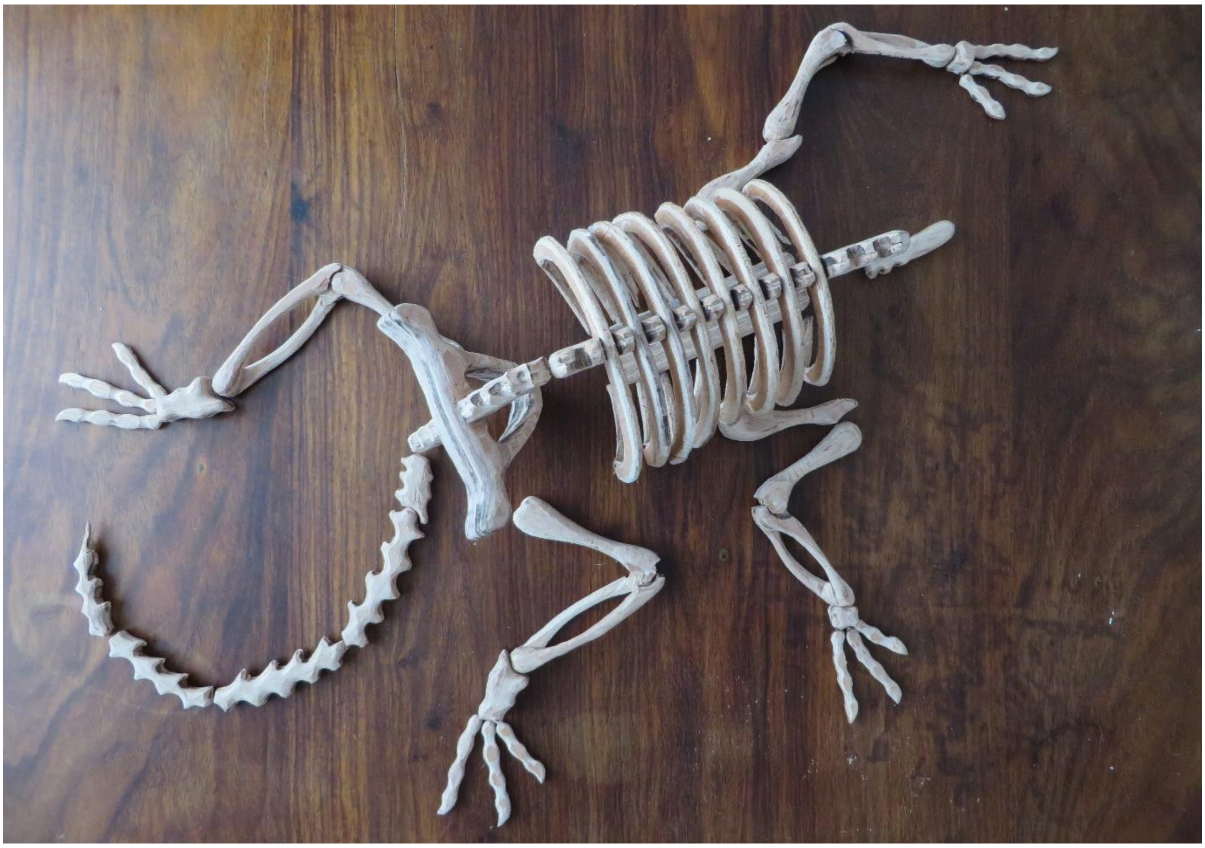

Fig. 3.4.2.1.2: Carved pieces

3.4.2.2 Assembly of Parts

The Axial Skeleton

The axial skeleton of the crocodile was assembled in the same manner as the sloth (refer to section 3.2.2.2). The pelvis however was designed as a single unit and attached to an indent in the spine in the same manner that the ribs were attached to indents in the spine. The sternum of the crocodile is too delicate and complicated to recreate. Since it does not contribute to the crocodile's movement, a simplified version of the sternum was designed (see Fig. 3.4.2.1.1). Like the spine of the sloth, the spine of the crocodile was divided into seven sections that are linked with ball-and-socket joints.

The head of the crocodile was carved from jelutong wood. The head resembles the skull of a slender-snouted crocodile to some degree (see Fig. 3.3.2.2.2).

The Appendicular Skeleton

The shoulder and pelvis joints are similar to the ball-and-socket joints used in the sloth marionette (refer to section 3.2.2.2). The shoulder joint however is a little different because of the elongated scapulae of the crocodile (see Fig. 3.4.2.1.1). The elbows and knees are also similar to the tongue-and-groove joints used for the elbows and knees of the sloth (refer to 3.2.2.2). The ankle and wrists are plywood ellipses. The ellipses, simulating plane joints, were inserted between the distal ends of the limbs and the proximal ends of the toes and threaded with string to attach it (refer to 2.2.7).

The fingers and toes were glued together at their proximal ends to restrict the movement of the toes to make manipulation of the marionette easier.

Fig. 3.4.2.2.1: Assembled Body of Crocodile Marionette

Fig. 3.4.2.2.2: Head of Crocodile Marionette

3.4.2.3 Movement Assessment before Stringing

There were no complications with the movement of the crocodile prior to being strung. The joints of the crocodile marionette could be manipulated to move without strings as intended.

3.4.3 Marionette Control

3.4.3.1 Design

The control for the slender-snouted crocodile marionette is based on the control for the two-toed sloth. The only variation is in the elevation of the leg bars. The researcher elevated the leg bars by using bolts and beads, which allows the puppeteer to slightly angle the bars during locomotion. This slight angling of the bars imitates the motion of a crocodile, allowing the marionette to lift its feet as it locomotes.

Apart from the main bar, the leg bars and the head bar, the control mechanism also includes a tail bar to allow for the simulation of the cantilevered tail during locomotion (refer to 2.2.4.1 *Motion*).

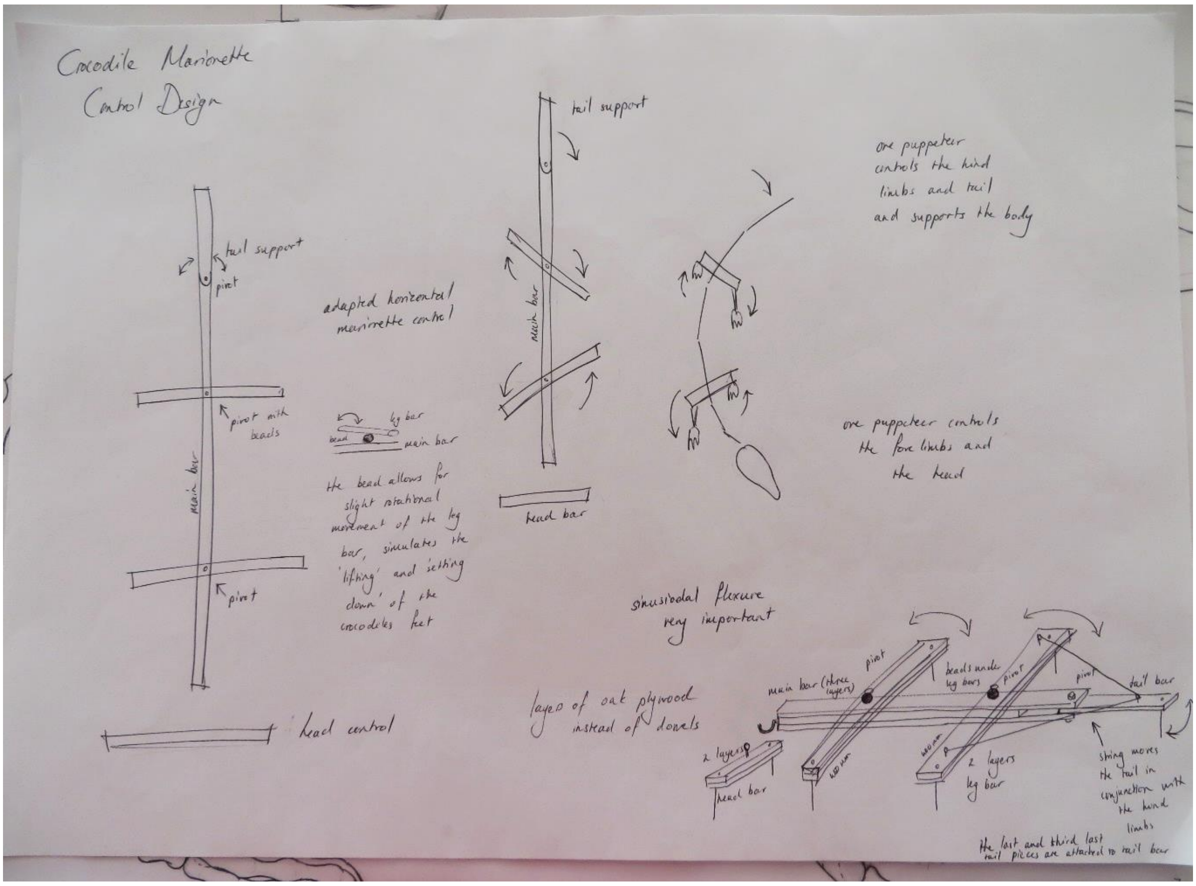

Fig. 3.4.3.1.1: Crocodile Marionette Control Design

3.4.3.2 Construction

The control was constructed from layers of 6mm plywood. The researcher decided on plywood bars for the control instead of dowels because of the angling movement required of the leg bars. Flat pieces of plywood work better for this type of motion than dowels.

The leg bars were attached to the main bar with bolts and beads.

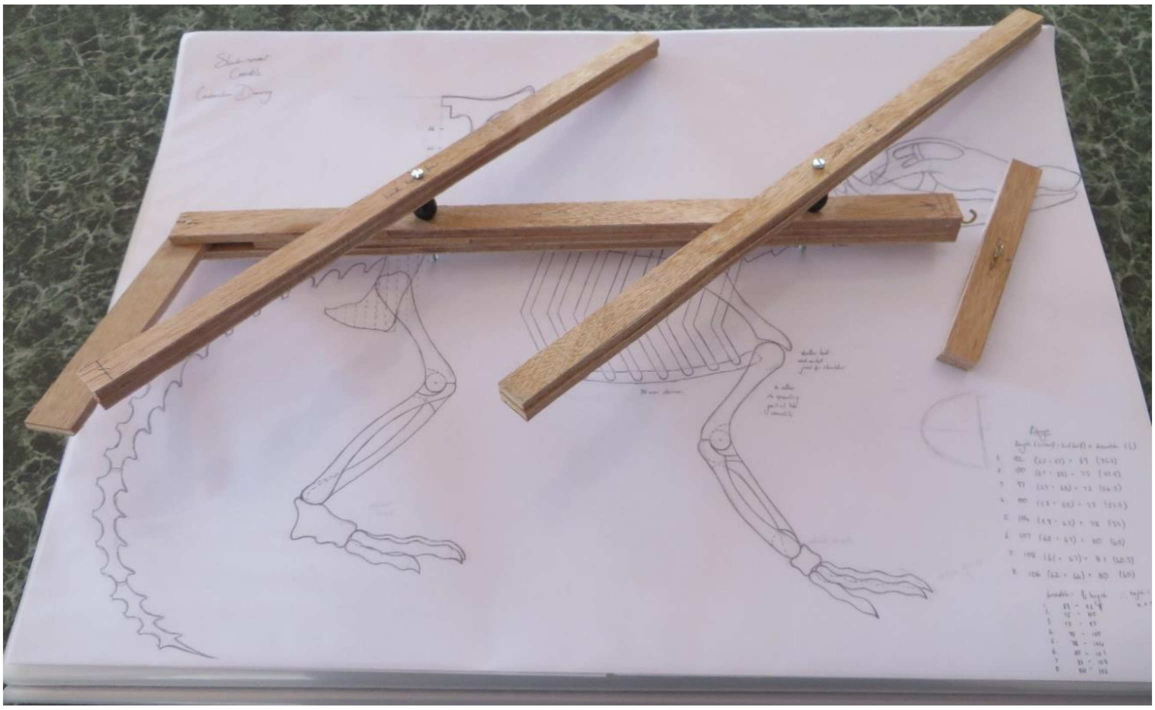

Fig. 3.4.3.2.1: Crocodile Marionette Control

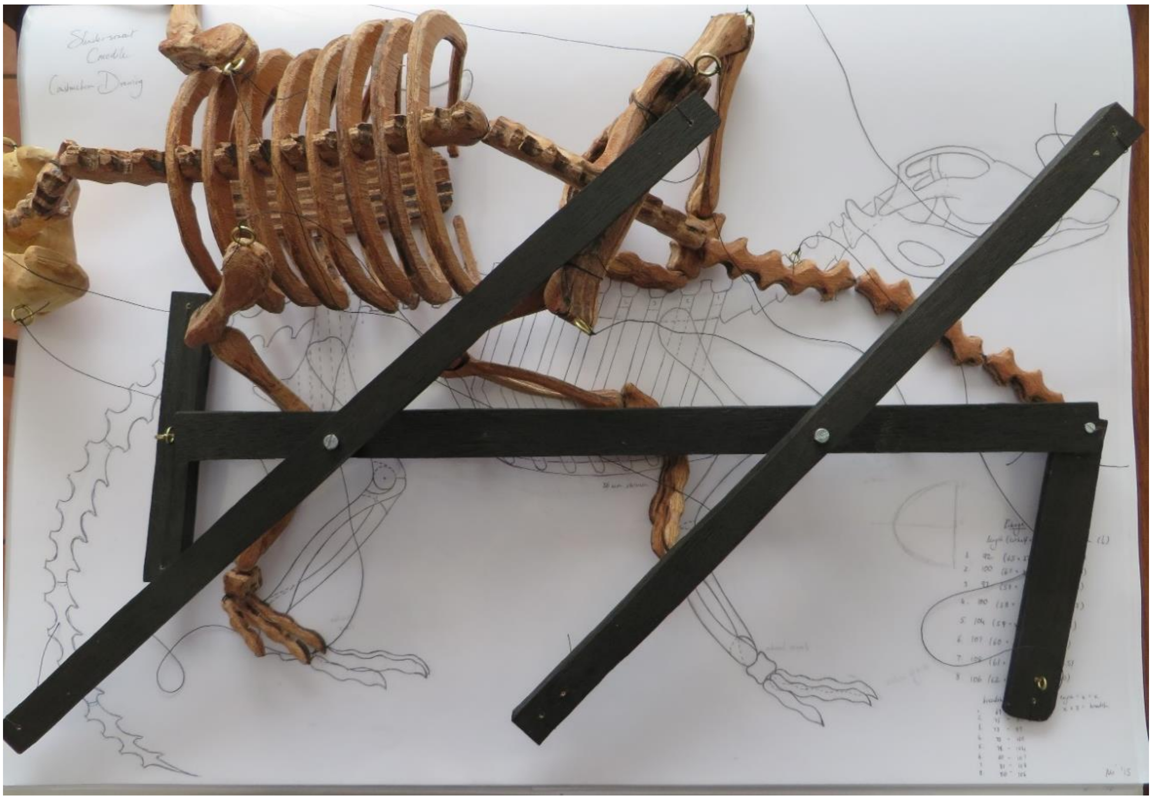

Fig. 3.4.3.2.2: Completed Crocodile Marionette Control

3.4.4 Analysis of Marionette

The motion of the crocodile is consistent with the motion determined in 2.2.4.1 *Motion*. The angled leg bars lift the feet of the crocodile as it locomotes and this contributes greatly to effective movement. The crocodile's ankles and wrists had to be glued to remain at an angle, because the loose wrists and ankles initially made it seem like the crocodile was walking on its toes.

The crocodile performs accurate cursorial locomotion. The movement of the tail in conjunction with the hind limbs to simulate the motion of a cantilevered tail creates an effective atmosphere around the movement of the crocodile.

Fig. 3.4.4.1: Completed Slender-snouted Crocodile Marionette I

Fig. 3.4.4.2: Completed Slender-snouted Crocodile Marionette II

Fig. 3.4.4.3: Completed Slender-snouted Crocodile Marionette (Scale)

3.5 The African Bullfrog Marionette

The following section describes the design, construction, control and analysis of the African bullfrog marionette.

3.5.1 Design

3.5.1.1 Skeletal Analysis

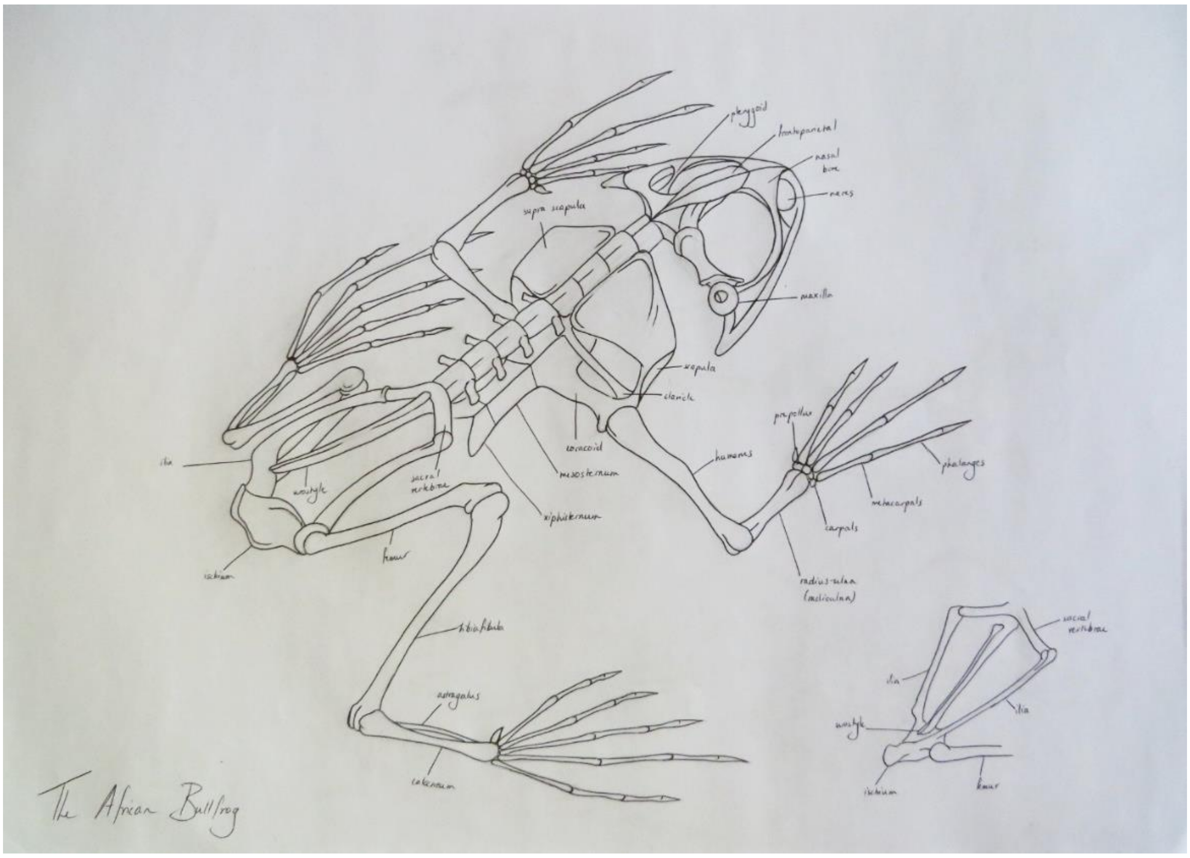

Fig. 3.5.1.1.1: African Bullfrog Skeleton Drawing (Van Zyl: 2014)

Using the data gathered and discussed in Chapter two, the researcher made a skeletal drawing of the African bullfrog. From the skeletal drawing the following prominent features are apparent (refer to 2.2.5.1 *Anatomy*):

- The spine is short with a very short neck and no tail vertebrae.
- The skull of the frog is almost as broad as its body.

- The scapulae are rectangular in shape and are fused to the sternum.
- The toes of the frog are clawless.
- The hind limbs are nearly twice as long as the forelimbs with the lower hind leg bone making up most of the length.

3.5.1.2 Motion Analysis

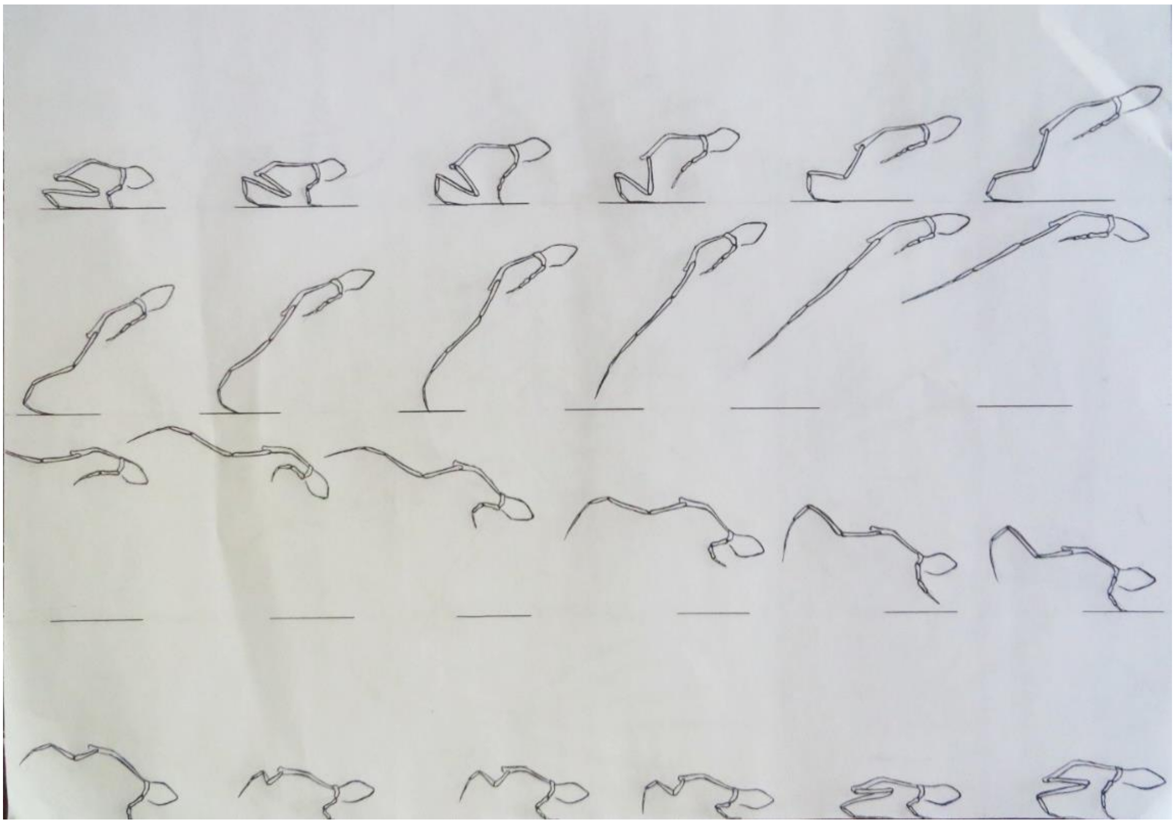

Fig. 3.5.1.2.1: African Bullfrog Locomotion Study (Van Zyl: 2014)

The researcher also conducted a study of the locomotion method employed by the African bullfrog, as discussed in Chapter two. The researcher subsequently made a locomotion study drawing of the African bullfrog. From the drawing the following prominent features are apparent (refer to 2.2.5.1 *Locomotion*):

- The frog employs saltatory locomotion, meaning it hops or leaps.
- As the frog positions itself to jump, it flexes its forelegs and arches its back.

- The thigh bone is moved into a horizontal position, while the ankle is moved into a vertical position.
- The frog leaps forward at a 30° to 45° angle, landing with its forelegs to absorb the shock.
- As the forelegs absorb the shock the hind legs return to their starting position in preparation for the next jump.

3.5.1.3 Frog Marionette Design

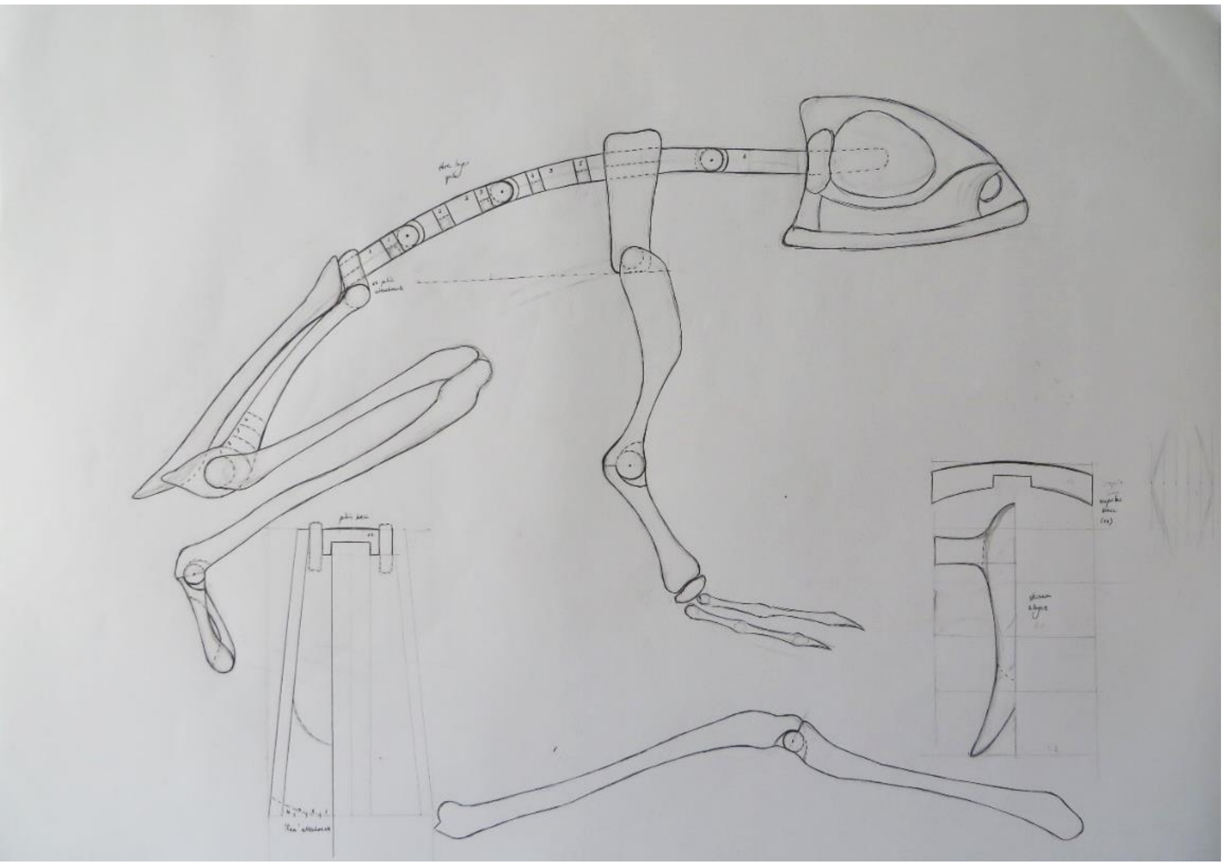

Fig. 3.5.1.3.1: African Bullfrog Construction Drawing

The construction drawing was designed to allow rotational movement in the shoulder and pelvic joints. The spine was designed to consist of four parts, linked with hinge joints. These hinge joints are intended to simulate the movement of the frog as it prepares to jump (refer to 2.2.4.1).

The elbow, knee and ankle joints were designed to be tongue-and-groove joints to allow bending. The design of the wrist and ankle joints is similar to the wrist and ankle joint designs of the sloth and the crocodile, employing plywood ellipses and string to simulate plane joints.

3.5.2 Construction

3.5.2.1 Construction of Parts

Paper patterns were made from the construction drawing. These paper patterns were transferred onto 4mm and 6mm pine plywood. The middle layer of each part of each joint was made from 4mm plywood. This was done to make the limbs of the frog marionette thinner and more delicate, replicating the limbs of a real frog. The patterns were cut from the plywood with a jigsaw and the layers glued together. Once dry, the glued pieces were carved with a rotary tool. The following are photographs of the process:

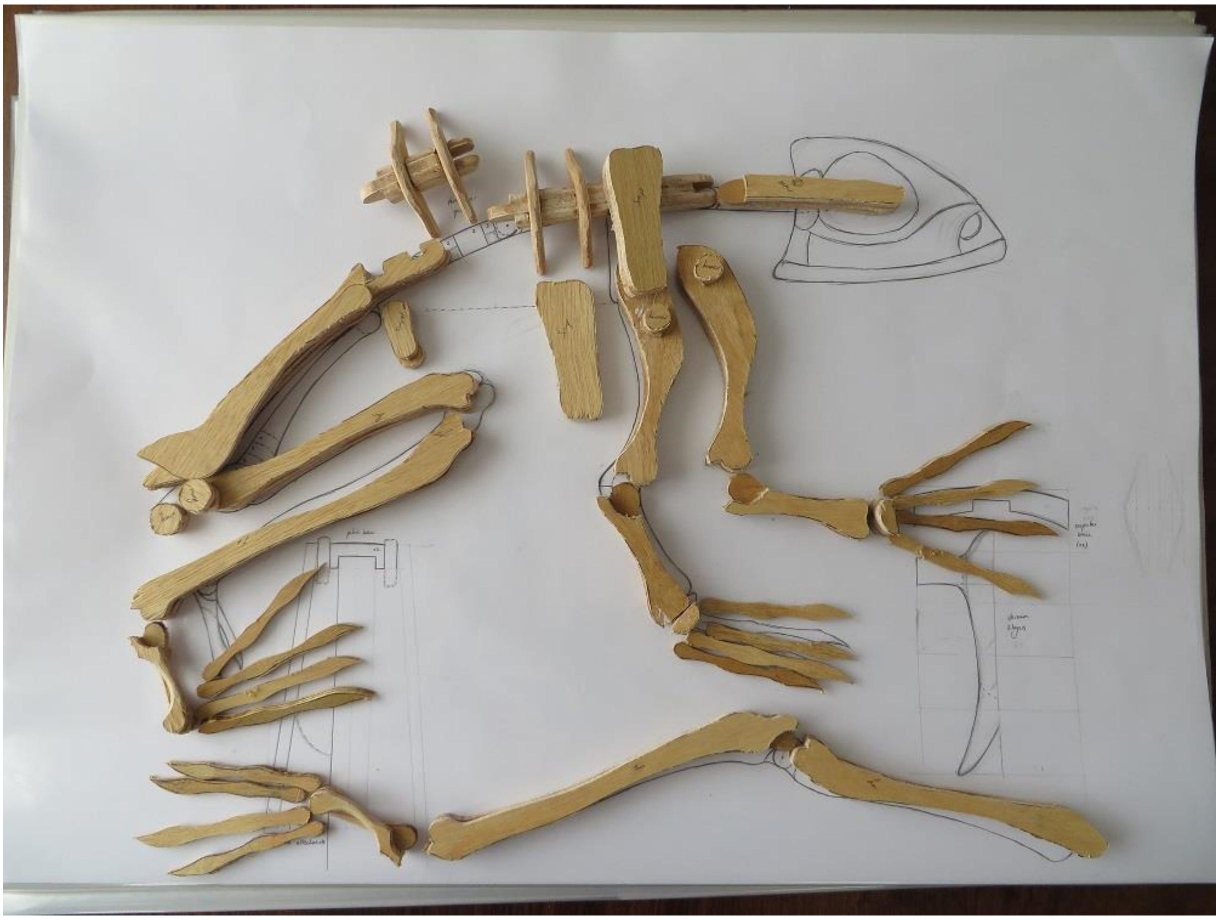

Fig. 3.5.2.1.1: Marionette Parts Glued Together

Fig. 3.5.2.1.2: Carved Parts

3.5.2.2 Assembly of Parts

Axial Skeleton

A frog does not have a rib cage like other animals. Its ribs are just short projections on either side of the spine (refer to section 2.2.4.1), unlike the animals that served as models for the previous three marionettes. . The frog marionette's ribs are attached to indents in the spine. The spine itself consists of four parts linked with hinge joints. Both the scapulae and the pelvis are rather complicated. These parts were constructed meticulously to faithfully replicate the actual frog's scapulae and pelvis. The natural rectangular shape of the scapulae and pelvis, which is similar to an actual frog skeleton, provides good support.

The head of the frog was carved from jelutong wood. The head resembles the skull of an African bullfrog (see Fig. 3.4.2.2.2).

Appendicular Skeleton

The shoulder joints and upper leg joints were made in the same manner as the sloth's ball-and-socket joints. The elbows, knees and ankles are tongue-and-groove joints, allowing a bending movement. The wrist and ankle joints were constructed from plywood ellipses and threaded with string to allow a great degree of freedom of movement. The plywood ellipses simulate plane joints (refer to section 2.2.7). In order to allow a degree of rotational movement, the fingers and toes were attached to their respective limbs with string, which was then threaded through the plywood ellipses. The fingers and toes were glued together at their proximal ends to restrict the movement thereof in order to make manipulation of the marionette easier.

Fig. 3.5.2.2.1: Assembled Body of Frog Marionette

Fig. 3.5.2.2.2: Head of Frog Marionette

3.5.2.3 Movement Assessment before Stringing

There were no complications with the movement of the frog prior to being strung. The joints of the frog marionette could be manipulated without strings as intended.

3.5.3 Marionette Control

3.5.3.1 Design

The frog control design initially consisted of a main bar constructed of layers of plywood, but with slots in two specific areas for the insertion of the limb bars. The limb bars consisted of a vertical bar of plywood, the top of which was loosely bolted to the main control. This vertical bar could be moved forwards and backwards. At the distal end of the vertical bar was a hole with a dowel through it. The legs of the frog were attached to the ends of the dowels. The dowels could be rotated within the vertical bar.

With the vertical bars being able to move forwards and backwards and the dowels being able to rotate within the vertical strip, the leaping movement of a frog could be recreated.

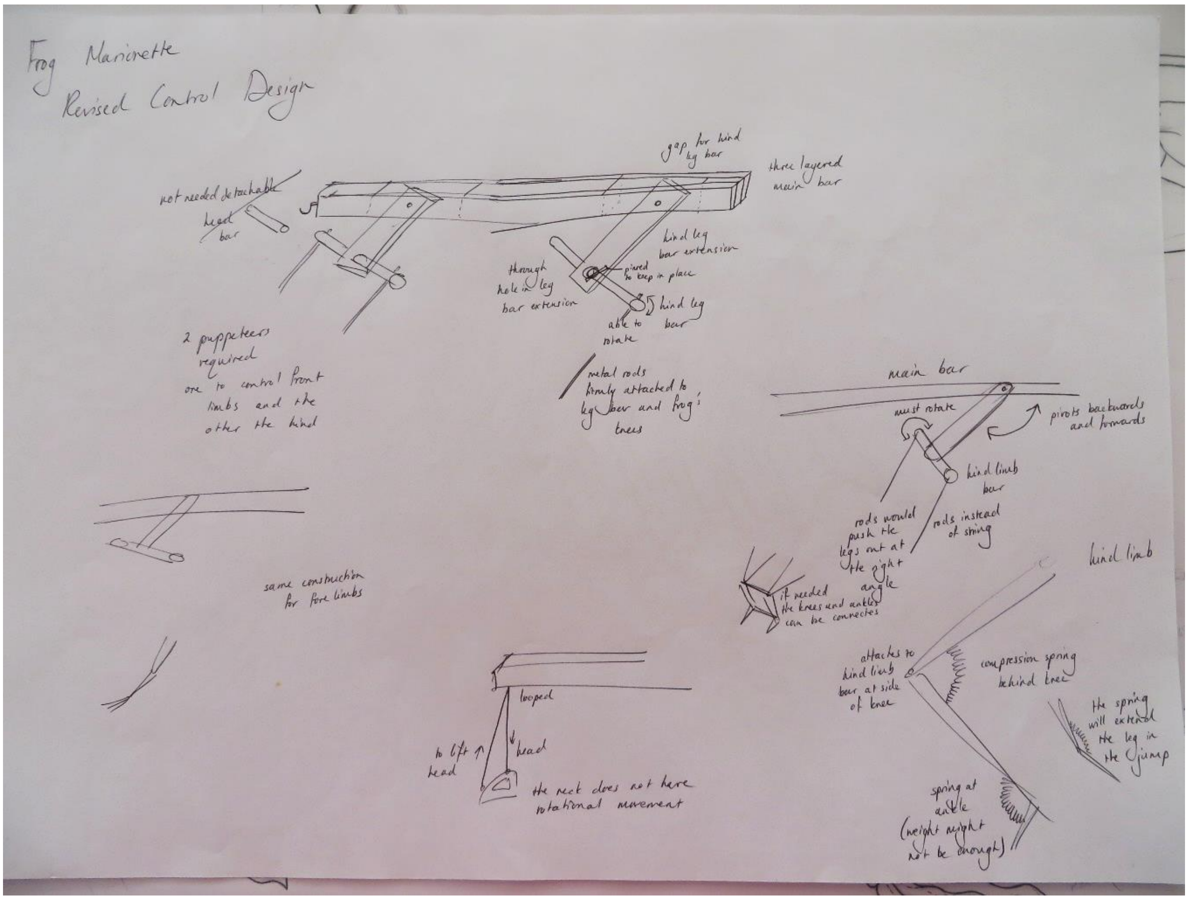

Fig. 3.5.3.1.1: Frog Marionette Control Design

3.5.3.2 Construction

The control of the frog marionette was initially constructed from 6mm plywood for the main bar and two 8mm dowels for the limbs. However, when the researcher tested the locomotion of the frog it became apparent that the movement of the frog, like the owl, is extremely complex due to the different actions of the two pairs of limbs.

Each pair of limbs extends and bends at different times during the jump sequence, while the spine performs a complicated bending and stretching motion. There are therefore three different sets of movement to recreate: the forelimbs, the hind limbs and the spine. It became apparent that the control could either: control the limbs and omit the spine; or control the spine and omit the limbs.

The solution that the researcher came up with was to use the control to support the body of the frog and to let the puppeteer manipulate the frog's hind limbs by controlling the motion of the frog's pelvis with his hand. The hind limbs therefore are the driving force behind the frog's movement, while gravity allows the forelimbs to move in a natural manner.

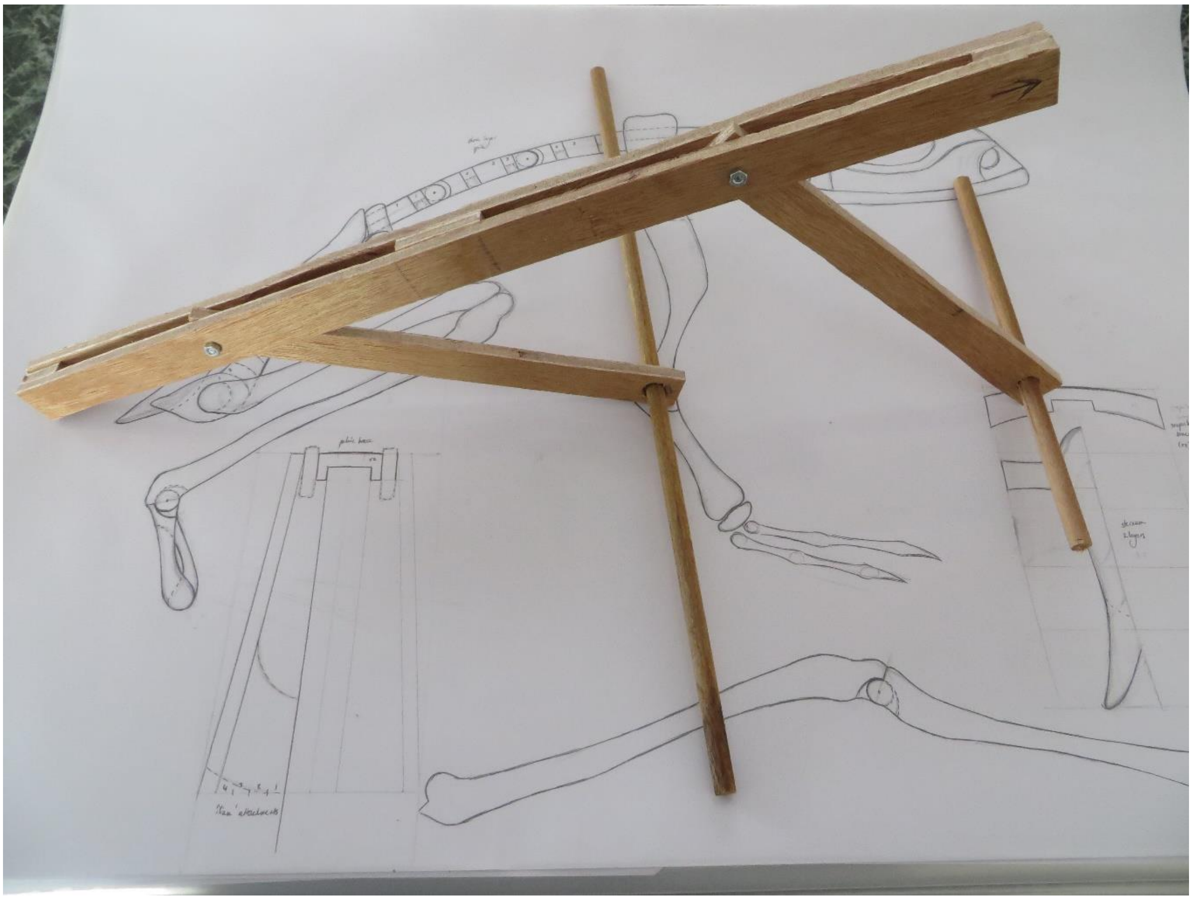

Fig. 3.5.3.2.1: Frog Marionette Control

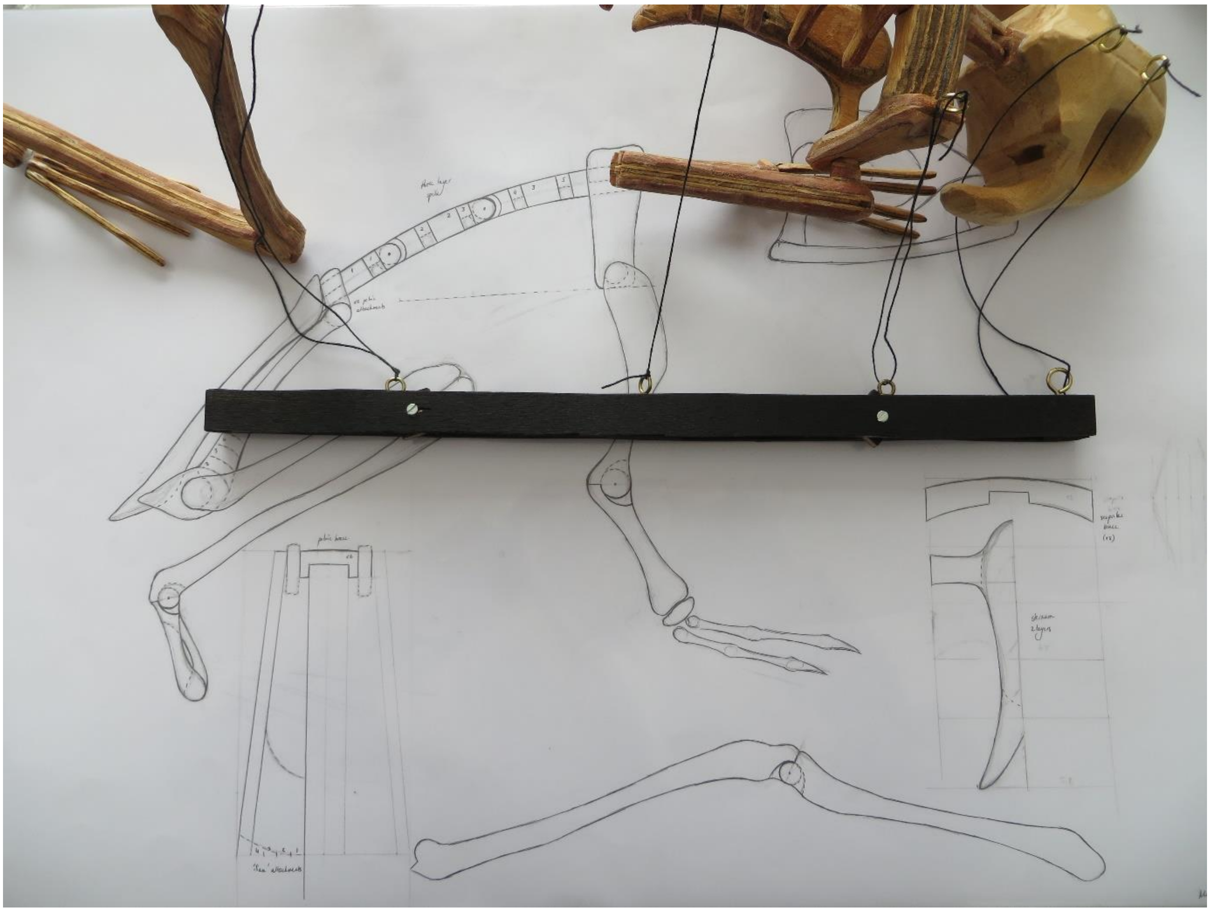

Fig. 3.5.3.2.2: Complete Frog Marionette Control

3.5.4 Analysis of Marionette

The motion of the frog is relatively convincing. The marionette is able to perform accurate saltatory locomotion, but this locomotion is not wholly created through the use of strings. With the puppeteer controlling the pelvis of the frog directly and not with strings, the frog is no longer a true marionette. This however was the only way to achieve the correct and realistic motion of a frog's saltatory locomotion.

Fig. 3.5.4.1: Completed African Bullfrog Marionette I

Fig. 3.5.4.2: Completed African Bullfrog Marionette (Scale)

Fig. 3.5.4.3: Completed African Bullfrog Marionette II

3.6 The Great Hammerhead Shark Marionette

The following section describes the design, construction, control and analysis of the great hammerhead shark marionette.

3.6.1 Design

3.6.1.1 Skeletal Analysis

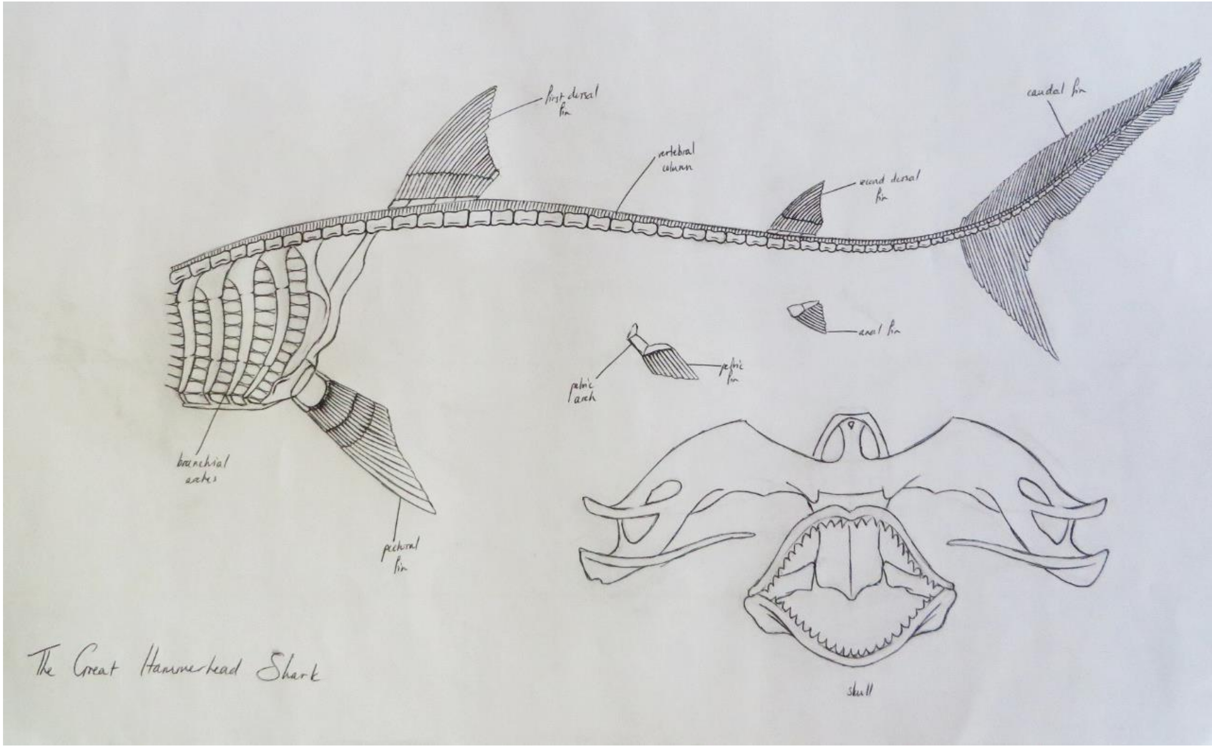

Fig. 3.6.1.1.1: Great Hammerhead Shark Skeleton Drawing (Van Zyl: 2014

Using the data gathered and discussed in Chapter two, the researcher first made a skeletal drawing of the hammerhead shark. From the skeletal drawing the following prominent features are apparent (refer to 2.2.6.1 *Anatomy*):

- The shark has three pairs of horizontal fins that become smaller down the length of the body.
- The front fin pair attaches to the ribcage-like structure that contains the shark's gills.

- The tail is upturned and asymmetrical.
- The shark has two pointed fins on its back, the front fin being larger than the hind fin.
- The shark has a ‘double-headed’ head with an eye on each end of a stalk.

3.6.1.2 Motion Analysis

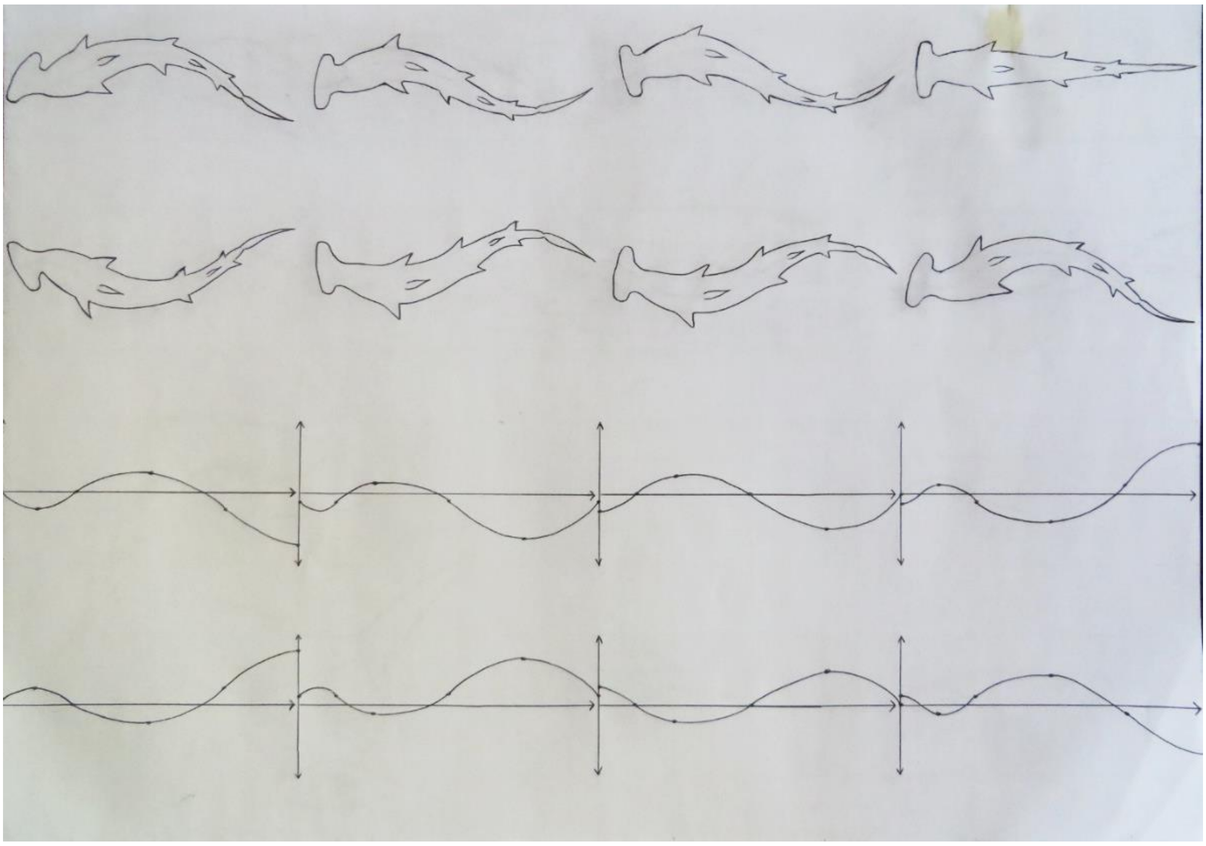

Fig. 3.6.1.2.1: Great Hammerhead Shark Locomotion Study (Van Zyl: 2014)

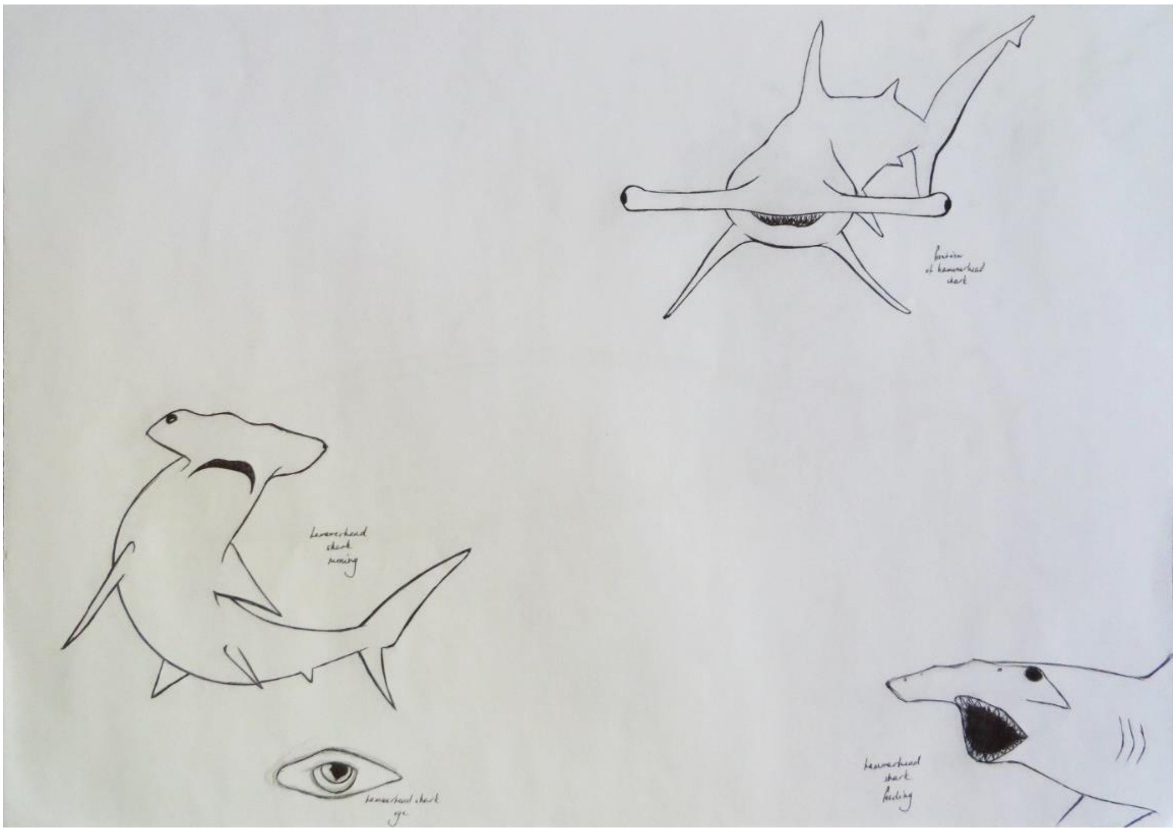

Fig. 3.6.1.2.2: Great Hammerhead Shark Motion Study (Van Zyl: 2014)

The researcher also conducted a study of the locomotion method employed by the hammerhead shark, as discussed in Chapter two. The researcher subsequently made a locomotion study drawing of the hammerhead shark. From the drawing the following prominent features are apparent (refer to 2.2.6.1 *Locomotion*):

- The vertebral column of the shark bends sideways, creating undulation movement along its spine.
- The undulating waves increase in size as they progress down the length of the body.
- The shark relies on caudal propulsion for locomotion.
- The shark’s head acts like a rudder to allow more manoeuvrability while its fins aid in steering and stabilising.

3.6.1.3 Shark Marionette Design

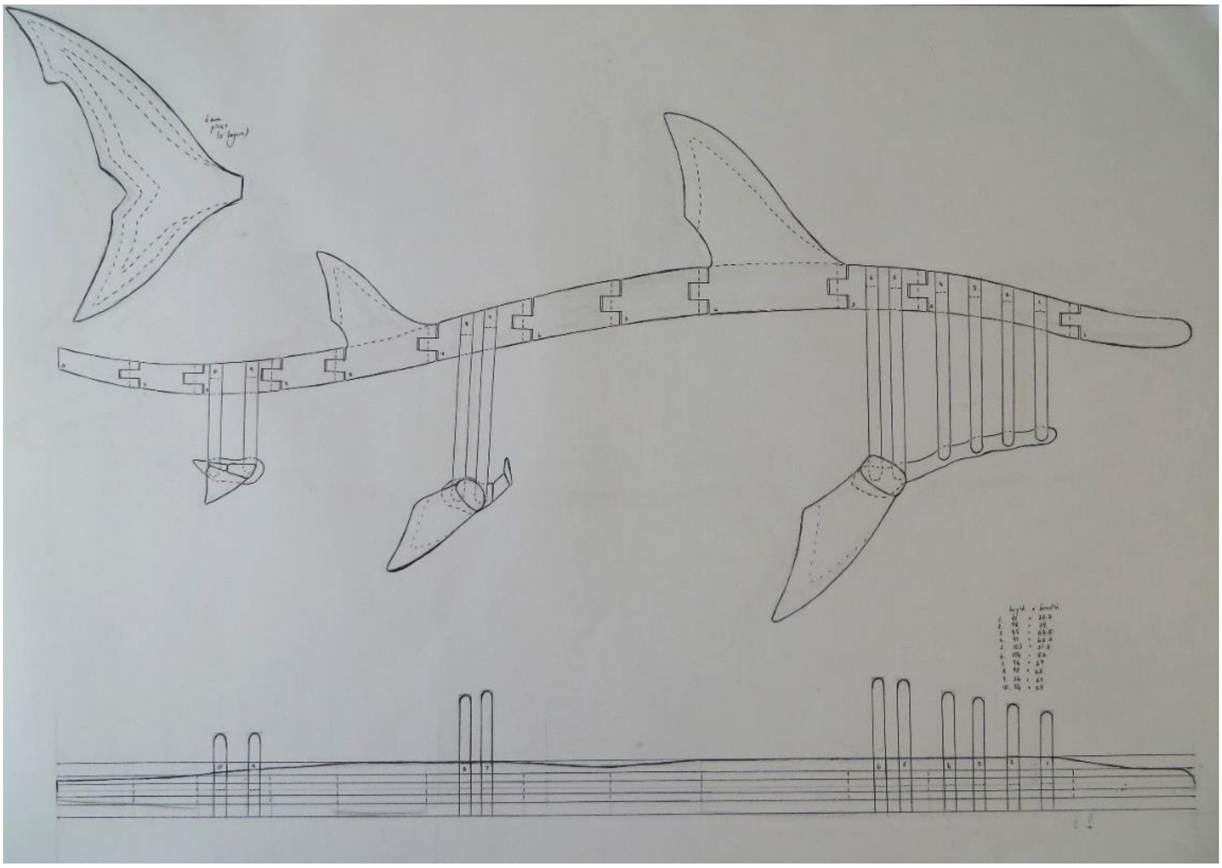

Fig. 3.6.1.3.1: Great Hammerhead Shark Construction Drawing

The construction drawing was designed to allow a lateral bending movement in the spine of the shark. These are the only joints in the marionette. The spine consists of twelve parts, linked by eleven lateral hinge joints.

The skeletal drawing of the shark indicates a rib-like structure around the shark's gills. However, since there are three sets of fins, the construction drawing of the shark marionette includes additional rib-like structures to support the last two pairs of fins. Four spine sections were designed to support the ribs and two were designed to support the dorsal fins of the shark.

3.6.2 Construction

3.6.2.1 Construction of Parts

Paper patterns were made from the construction drawing. These paper patterns were transferred to various types of plywood. Each spine segment was made from three layers of 6mm pine plywood and two layers of 4mm pine plywood. The supports between the ribs were made in the same manner. The tail, dorsal and lateral fins were made from several layers of 6mm pine plywood. The ribs were made from 6mm oak plywood to create a slight variation in the colouring of the marionette. The patterns were cut from the plywood with a jigsaw and the layers glued together. Once dry, the glued pieces were carved with a rotary tool. The following are photographs of the process:

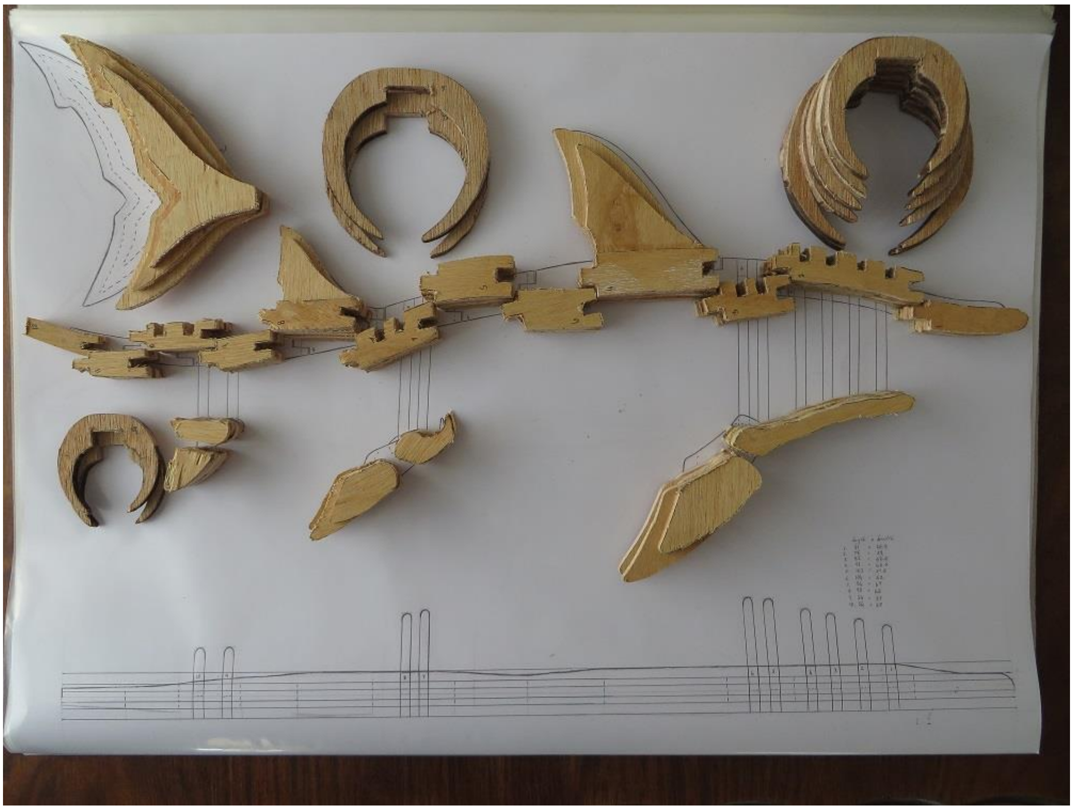

Fig. 3.6.2.1.1: Marionette Parts Glued Together

Fig. 3.6.2.1.2: Carved Parts

3.6.2.2 Assembly of Parts

Axial Skeleton

The spine of the shark consists of twelve sections linked by eleven lateral hinge joints. The joints were lubricated with a layer of glue to create smoother movement.

The ribs are attached to the spine via indents – the same method used in all the other marionettes – and strengthened with sternum-like structures.

The head of the shark was carved from jelutong wood. The head resembles the skull of a great hammerhead shark to some degree (see Fig. 3.5.2.2.2). Since the skeleton of a shark consists of cartilage, there is not a lot of the skull left once the flesh is removed. To have a more complete hammerhead shark head, the researcher decided to flesh out the skull.

Appendicular Skeleton

The fins were glued to the ribs as they do not need to move.

Fig. 3.6.2.2.1: Assembled Body of Shark Marionette

Fig. 3.6.2.2.2: Head of Shark Marionette

3.6.2.3 Movement Assessment before Stringing

The spine of the shark marionette is hinged in a manner that approximates the way a real shark's spine moves. Each joint bends slightly, ensuring that the spine of the shark marionette is not too flexible.

3.6.3 Marionette Control

3.6.3.1 Design

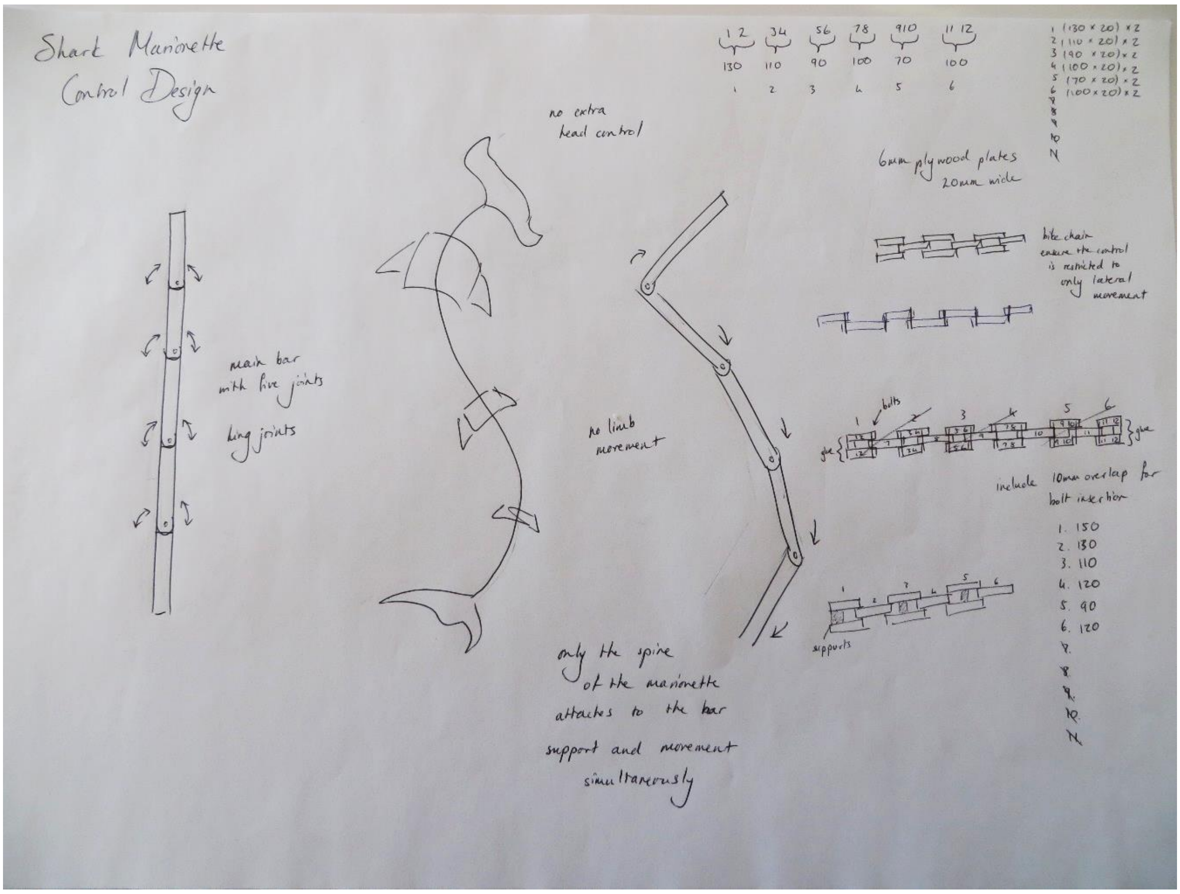

Fig. 3.6.3.1.1: Shark Marionette Control Design

The control of the shark marionette consists of a main bar with five pivot joints. The bar itself can undulate in a manner similar to the movement of a shark, therefore the undulation of the control translates into undulations of the body of the shark.

3.6.3.2 Construction

The control is made of twelve 6mm plywood strips of varying length. The length was determined by the length of the two sections of the shark's body that the strip has to support. Nine of the twelve strips were glued together to form three pieces consisting of three layers each, while the remaining three pieces are used as single layers.

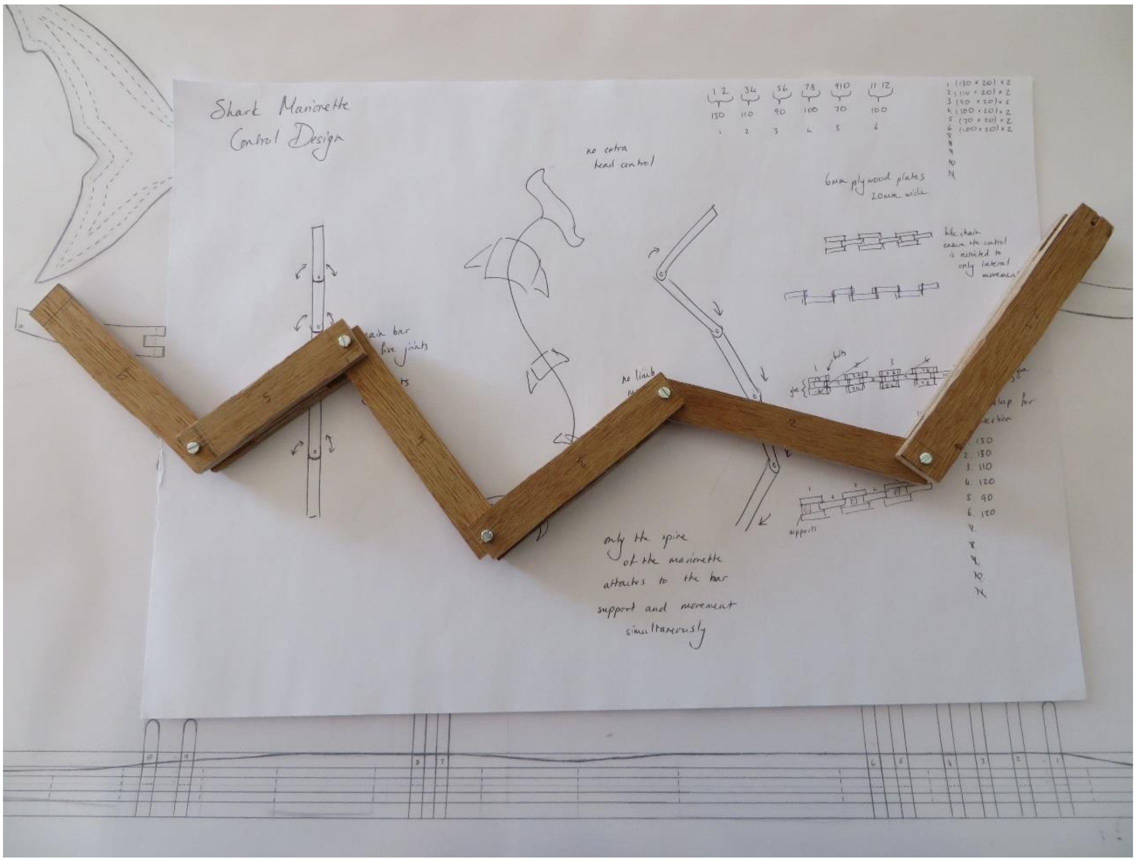

Fig. 3.6.3.2.1: Shark Marionette Control

Each strip supports two sections of the shark's body. As mentioned above, the body of the shark consists of twelve sections.

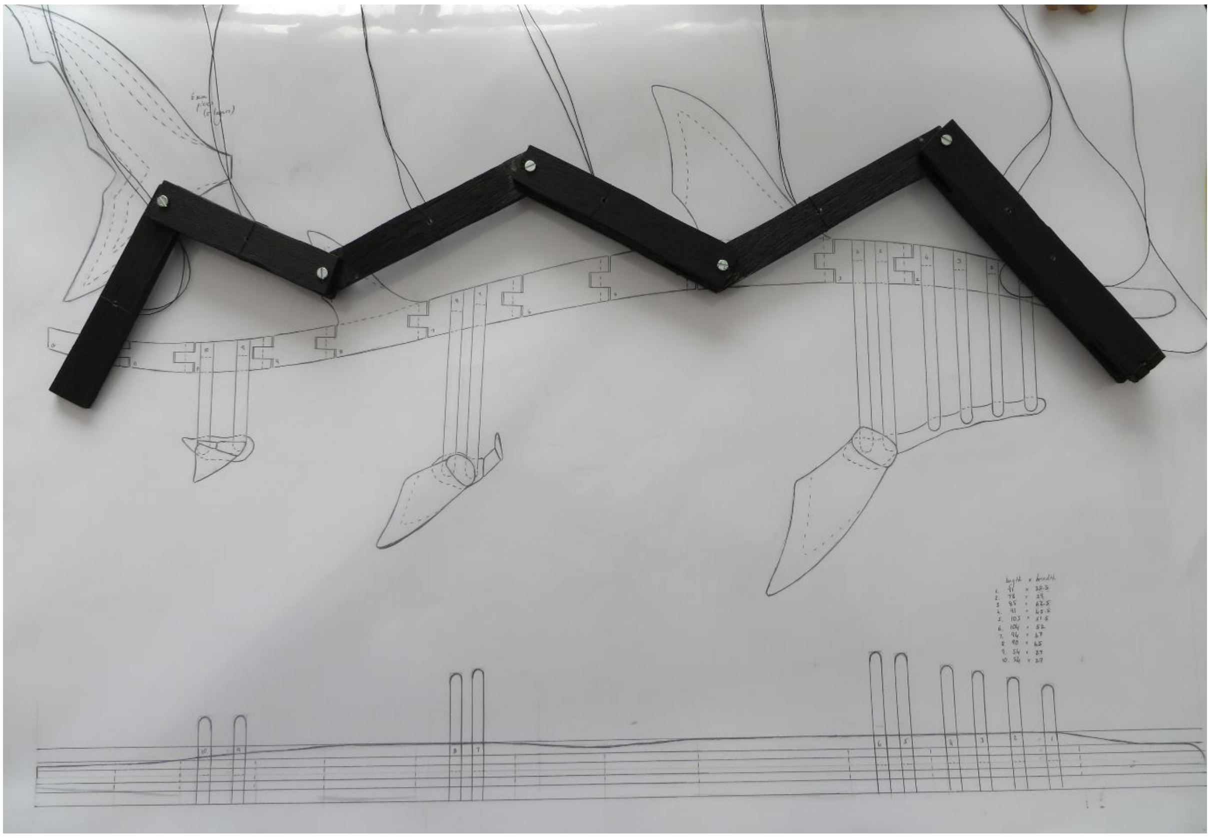

Fig. 3.6.3.2.2: Completed Shark Marionette Control

3.6.4 Analysis of Marionette

In the researcher's opinion the motion of the shark is the most impressive of the five marionettes. This is largely due thereto that the shark's mode of locomotion is relatively simple, making it easier to recreate. With no extra limbs to consider, the puppeteer need only focus on creating the smooth and fluid motion of the spine.

The shark marionette therefore exhibits natural and free anguilliform locomotion.

Fig. 3.6.4.1: Completed Great Hammerhead Shark Marionette I

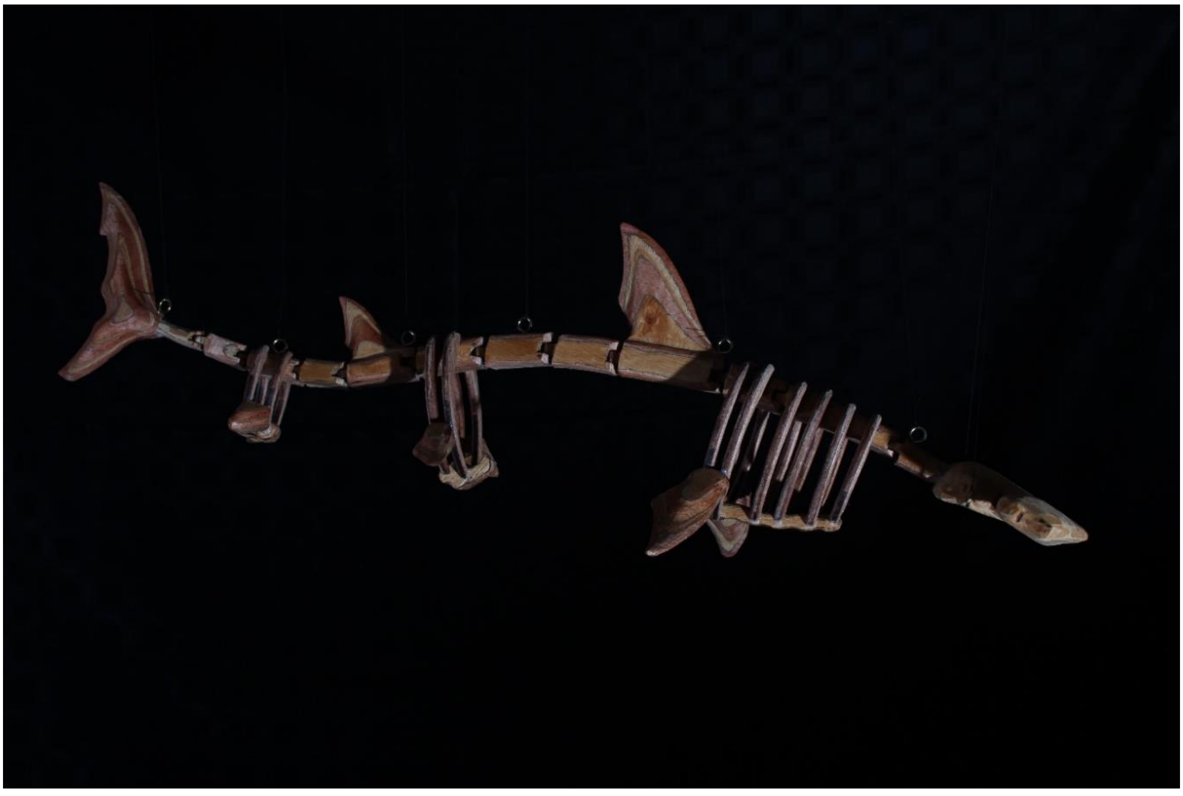

Fig. 3.6.4.2: Completed Great Hammerhead Shark Marionette II

Fig. 3.6.4.3: Completed Great Hammerhead Shark Marionette (Scale)

3.6 Conclusion

The in-depth study of animal anatomy and motion set out in Chapter two was invaluable to the design and construction of the marionettes as described and outlined in Chapter three. In the researcher's opinion the five completed marionettes can be successfully manipulated to demonstrate their specific modes of locomotion with relative ease. In addition, the marionettes also possess the means for more subtle and delicate atmospheric movements that would hopefully create a connection with the adult audience. The next chapter details the performance of the five marionettes for a target adult audience.

CHAPTER 4: Practical Marionette Performance and Data Presentation, Analysis and Discussion

4.1 Introduction

This chapter describes the actual marionette performance and analyses, interprets and discusses the data gathered during the performance. The performance focused on the movement of the five animal marionettes that had been created by the researcher. The marionettes were evaluated in terms of the effectiveness of their movement by an audience of thirty respondents. This was achieved by means of open-ended questionnaires (refer to addendum A).

The chapter is divided into two major sub-sections, namely: *Practical Marionette Performance and Data Presentation* and *Data Analysis and Discussion*. Sub-section 4.2 dealing with *Practical Marionette Performance and Data Presentation* consists of a detailed report on the two marionette performances and a presentation of the data gathered from the open-ended questionnaires. Sub-section 4.3 dealing with *Data Analysis and Discussion* analyses and discusses the data gathered from the respondents in relation to the aims of the study. As previously stated in the section on methodology (refer to section 1.4), the researcher intended to evaluate the reactions of the respondents in terms of the primary aim of the study – i.e. studying animal locomotion to construct convincing marionettes. The respondents were therefore requested to evaluate the realism of the marionettes' movement and to indicate in their responses whether this movement contributed to their ability to willingly suspend disbelief and connect with the different marionettes.

In order to keep the respondents focused on the movement of the marionettes the researcher imposed several restrictions. The first was to create skeletal animal marionettes with exposed joints that allow the respondents to view the movement without obstruction. The second was not attaching any form of persona to the marionettes. The third restriction was not using audio accompaniment and theatrical lighting during the performance to avoid distracting the respondents with the ambience of the performance. Furthermore, the marionettes moved among and between the respondents. This method allowed the respondents to discuss what they were observing among themselves and to view the marionettes up close.

To assist in sorting through the data, the researcher grouped the questionnaires according to age group and assigned a number (from 1 to 10) to each respondent. The respondents' answers to the questions were then tabulated and grouped according to how they addressed the original aims and objectives of the study. This was meant to assist with the analysis as well as to maintain the focus of the study.

The main research aim was to adapt animal marionette movement through a study of animal anatomy and motion in order to achieve convincing and more realistic marionette movement. To determine whether this primary aim had been achieved, the researcher divided the primary aim into three sections namely: *Realistic Movement* (refer to sections 4.2.2 and 4.3.1), *Emotional Connection* (refer to sections 4.2.3 and 4.3.2) and *Willing Suspension of Disbelief* (refer to sections 4.2.4 and 4.3.3).

One of the common aims of good puppetry is to connect with an audience and to create the notion of suspended disbelief, immersing the audience members in the performance to the extent that they become emotionally vested in the puppet.

Therefore the section on *Realistic Movement* relates to ‘realistic marionette movement’ as it is captured in the main aim of this research. *Emotional Connection* and *Willing Suspension of Disbelief* relate to the aspect of ‘convincing marionette movement’ as indicated in the main aim of the research.

4.2 Practical Marionette Performance and Data Presentation

This sub-section consists of a detailed report on the two marionette performances and a presentation of the data gathered from the open-ended questionnaires.

4.2.1 Report on the Performance

The performance was held at the Longstreet Art Lovers art gallery in Waterkloof, Pretoria. The reason for choosing an art gallery was to de-emphasize the theatrics of the performance. The researcher did not want the respondents to go into the illusory state of mind that is often created by realistic theatrical settings. Another reason for choosing this particular art gallery was because the gallerist allowed the researcher to use the space at no cost.

There were two performances: the first performance took place the evening of 17 June 2015 and the second the evening of 18 June 2015. Both performances were interactive with the puppeteers moving in-between and among the respondents. The purpose of the performance was to allow the respondents to observe the marionettes and evaluate the effectiveness of their movement. An interactive performance allows onlookers to observe the marionettes up close to better assess the movement. When they were not performing, the marionettes were laid out on a table in the middle of the gallery, affording the respondents an opportunity to observe the marionettes and their construction up close. Some of the respondents indicated that they greatly appreciated being able to examine the inactive puppets at close range (refer to 4.2.3 *Question 12*).

Since there were five marionettes and the researcher made use of just two amateur puppeteers, only two marionettes, with the exception of the owl marionette, were able to perform at any given time. As indicated in Chapter 3, the owl marionette requires two puppeteers in order to perform (refer to section 3.3.3.2). One puppeteer for instance would perform with the sloth marionette while the other performed with the frog marionette. The two puppeteers would then return the sloth and frog marionettes to the table and perform with the owl marionette, where after they would perform with the shark and the crocodile. This process was repeated to allow respondents to see the marionettes perform more than once.

A statistical data summary reflects the gender ratios and the ratio of respondents who had seen puppet performances in the past. The statistical data summary derives from the first four questions in the questionnaire. **Question 1** inquiries about the age of respondents; **Question 2** pertains to the respondents' gender; **Questions 3** is about the rating respondents gave the marionette performance and **Question 4** pertains to whether or not respondents had seen any puppet performances in the past.

In terms of rating, all the respondents rated the performance as *Good* or *Very Good* (none of the respondents rated the performance *Average*, *Poor* or *Very Poor*). As a result these are the only two options indicated in the table below.

Age Group	Total Respondents	Gender		Performance Rating		Past Puppetry Performances	
		Male	***Female***	***Good***	***Very Good***	***Yes***	***No***
18 – 39	10	2	8	4	6	7	3
40 – 59	10	5	5	1	9	8	2
60+	10	7	3	1	9	6	4
Total	**30**	**14**	**16**	**6**	**24**	**21**	**9**

Table 4.2.2.1.1: Statistical Analyses

Furthermore, 80% of respondents rated the performance as *Very Good* and 20% rated the performance as *Good*.

In terms of gender the table indicates that 53% of the respondents were female, while 47% were male.

A total of 70% of the respondents had seen puppet performances in the past, while only 30% had not. This statistic is very relevant as it implies that 70% of the respondents were able to give well-informed feedback because they had a frame of reference for comparing the marionette performance.

4.2.2 Realistic Movement

This section relates to the questions on the realistic movement of the marionettes.

Question 5: How did the marionettes (in this performance) compare in terms of movement with other puppets you may have seen before?

Since only twenty-one out of the thirty respondents had seen puppet performances in the past, it is only their answers that were noted. The assigned number of each respondent is indicated in column one and the each respondent's verbatim answer to question 5 appears in column two.

Age Group: 18 – 39	
Respondent No.	**Opinion**
1	The movement of the puppets are very realistic and detailed.
3	They are more complex and lifelike, their animalistic character is surreal.
4	The marionettes in this performance moved much more realistically compared to previous performances I have seen, I especially liked the frog and shark's movements.
5	Quite well. The other puppets were very large and the movement was very intricate. These with their smaller size compared very well.
6	They had organic movement.
8	Fairly well, the variety of movements were refreshing.
9	Very good, the most impressive previous performance I have seen was Warhorse. Although the scale is much different, I would definitely compare them in innovation and creativity.
Age Group: 40 – 59	
2	Extremely well, unbelievably mobile, looks like the real thing even though the puppet consists of only a suggestion of a skeleton.
3	The movement is more realistic, compared to marionettes I have seen before.
4	Very good.
5	Their movement was extremely real and smooth, very true to nature.
6	Very good, but the scales are different.

7	This was really amazing, wonderful movement and characters.
9	Swift effortless movement which belies their lifelessness, movement alone seems to bring then to life without other attributes.
10	Incredibly fine movement and poise, delicate and detailed.
Age Group: 60+	
1	Well
3	Very well
5	There are much more movement
6	Very professional
7	Very superior
10	These were very flexible and realistic (even though I have never seen a skeleton jump).

Table 4.2.2.1: Question 5

The twenty-one respondents who had seen puppet performances in the past expressed the opinion that the marionette performance compared well with other puppets they had seen previously, especially with regard to movement. Respondents mentioned that the movement of the marionettes was ‘very realistic and detailed’, ‘more complex and lifelike’, had a ‘variety of movements’ and had ‘incredibly fine movement and poise’.

Respondent No. 9 from age group 18 – 39 mentioned that he would ‘definitely compare them in innovation and creativity’ to the puppets of *Warhorse*. As previously mentioned in Chapter one, the researcher wanted to elicit a response from the audience with her marionettes that was similar to the audience reaction achieved by the *Warhorse* horse puppets. Although the design of the horses in *Warhorse* left the viewer in no doubt that they are not real, their movement was so effective that members of the audience became emotionally involved. The horses in *Warhorse* are important to this study because they are proof of the value of realistic movement in puppetry, something which speaks to the main aim of the study.

Respondent No. 2 from age group 40 – 59 made a remarkable point when he mentioned that the marionettes were ‘unbelievably mobile, looks like the real thing even though the puppet consists of only a suggestion of a skeleton’. This is another important point as it seems to confirm the argument that the skeleton alone is sufficient to create realistic movement. Puppet makers sometimes cover animal puppets in fur to make them appear more real, but the researcher believes that such additions are unnecessary and, in the researcher’s opinion, detract from the overall aesthetic value of the puppet.

Respondent No. 9 from age group 40 – 59 echoed the same sentiment, remarking that ‘swift effortless movement which belies their lifelessness, movement alone seems to bring them to life without other attributes’.

Question 6: Did this difference add or detract value from your appreciation for this performance?

Question 6 relates to questions 4 (has the respondent seen puppetry performances in the past) and 5 (how did the marionettes compare in terms of movement with other puppets), and therefore is only applicable to the 21 respondents that had seen puppet performances in the past. Respondents No. 6 and 10 from age group 40 – 50 and Respondent No. 6 from age group 60+ did not give an answer to question 6, even though they had answered question 5. Therefore only the answers from the remaining eighteen respondents were considered for this question.

Age Group: 18 – 39	
Respondent No.	**Opinion**
1	It added value and made it a lot more enjoyable.
3	Add, especially with the subject matter.
4	This added to my appreciation for this performance.
5	It added to the value of this performance, made me realise what an incredible talent this is.
6	Yes, it's not that I only enjoy organic movement but something about what it meant to these puppets and the fact that they moved through the air was beautiful and surreal.
8	It most certainly added value.
9	Add. Showing the bones and the core mechanics of the puppet was incredibly enjoyable to me.
Age Group: 40 – 59	
2	No, it so contributed, added.
3	The difference added value to the performance.
4	Add
5	Add, created original awareness for the truth.
7	Definitely add value.
9	Very much appreciated, ability of movement alone to represent essence of an animal.
Age Group: 60+	
1	Add
3	Add
5	It added to the appreciation
7	Added value
10	Added to it

Table 4.2.2.2: Question 6

The eighteen respondents that answered question 6 all concluded that this difference added to their appreciation of the marionette performance.

In addition, Respondent No. 9 from age group 18 – 39 mentioned that he enjoyed seeing ‘the bones and the core mechanics’ of the marionettes. Respondent No. 5 from age group 40 – 59 mentioned that the researcher’s work ‘created original awareness for the truth’. However, it is not quite clear what this statement is trying to convey. Respondent No. 9 from age group 40 – 59 mentioned that he appreciated the ‘ability of movement alone to represent essence of an animal’, which is another opinion that supports the researcher’s argument in favour of the primacy of skeletal construction in the creation of convincing and more realistic movement.

Question 10: Compared to your own knowledge of animal movement, how realistically did the animal marionettes move on a scale of 1 to 10 (1 being *Completely Unrealistic* and 10 being *Extremely Realistic*).

The table below demonstrates the answers to this question statistically for purposes of a summative assessment of the overall view of the realistic movement of the five animal marionettes.

Age Group 18 – 39		Age Group 40 – 59		Age Group 60+	
No.	**Rating**	**No.**	**Rating**	**No.**	**Rating**
1	10	1	8	1	8
2	9	2	10	2	8
3	9	3	7	3	8
4	8	4	9	4	8
5	6	5	9	5	8
6	9	6	8.5	6	8
7	9	7	9	7	10
8	7	8	9	8	8
9	10	9	8	9	8
10	8	10	8	10	8
Total	**85/100**	**Total**	**85.5/100**	**Total**	**82/100**

Table 4.2.2.3: Question 10

The table above indicates a total of 252.5 out of 300, which converts to a score of 84% for realistic movement.

The researcher believes that the purpose of realistic movement is to entice the respondents to willingly suspend disbelief and to become emotionally invested in the marionettes. Realistic movement makes the willing suspension of disbelief easier to achieve and also connects the respondents and the marionettes on a deeper level.

4.2.3 Emotional Connection

The aim of a puppet performance is usually to connect with an audience at an emotional level. This is accomplished through various means, such as the design of the puppets, direct interaction with the audience, immersive dialogue and an immersive storyline. The researcher however believes that realistic movement is the most important element required in order to connect with an audience. Humans rely on visual input to a great extent and therefore one could argue that watching realistic movement will definitely have an effect on achieving an emotional connection.

Some respondents made reference to 'atmospheric movements'. Although the term is not widely used and recognised, the researcher uses it to describe a specific type of movement. For the researcher, atmospheric movement describes small, subtle movements that contribute to the realistic aesthetics of a puppet. An example is when an animal puppet scratches itself or turns its head sideways in contemplation. These motions make puppets appear natural and lifelike.

Some respondents made reference to the ambience created by the marionettes. This is understood as 'atmosphere' or 'mood", and as mentioned in the introduction (refer to section 1.4) the researcher purposefully avoided a theatrical ambience (or ambience of any kind for that matter) so as to not distract the respondents from the movement of the marionettes.

Some respondents also made reference to the persona of the marionettes. As stated above, the researcher avoided creating intentional persona for the marionettes (refer to section 4.1) to allow the respondents to focus on the movement of the puppets.

The following questions relate to the emotional connection between the respondents and the marionettes. Questions 7 and 8 directly relate to the topic of emotional connection while Question 11 refers to it indirectly.

Question 7: Did you feel a connection with any particular marionette(s), if so which one(s)?

Question 8: What created the emotional connection, or why do you think there was no connection?

Since Questions 7 and 8 are linked, the answers to both are outlined in the table below. The first column shows each respondent's attributed number, while the second column indicates whether or not the respondent felt an emotional connection to one or more of the marionettes. The third column indicates which marionettes they felt a connection with, and the last column indicates the reason why the respondents did or did not feel that connection.

Age Group: 18 – 39			
No.	**Connection**	**Marionettes**	**Reason**
1	Y	Frog Sloth Shark	I though the movement of the bullfrog was very realistic as well as that of the sloth and hammerhead shark. I really like nature and art, my zoology background helps to add personal value for me to each of these marionettes.
2	Y	Shark	The graceful movement reminded me of what I want most in life – peace and elegance.
3	Y	Shark	Its movement is so real that it feels as if a real shark is swimming among us.
4	Y	Shark	I felt a connection with the shark, as it transformed me as though watching an actual shark.

			I have a fascination with sharks and the lifelike movements of the shark felt really realistic and fascinated me further is even the skeletal structure of the sharks.
5	Y	Shark Crocodile	The hammerhead shark – loved the fluid movement, and the crocodile. I think these two animals had the most fluid movement.
6	Y	Frog Owl Shark	Yes, the frog because I love frogs and the frog's jump worked well in a crowd. Also the owl. I like its neck movement together with the rest of the body. Oh and the shark! Swimming through the air/water, amazing, smooth and beautiful. The dreamlike state it evokes inspires me creatively.
7	Y	Shark Frog Crocodile Owl	Yes, the shark and the African bullfrog. I really enjoyed the crocodile's attitude, as well as the owl's beauty. I was very excited by how animated these puppets were – very life like and full of character
8	N	n/a	I found it hard to place an emotion to the mere movement of an animal. I would perhaps require another aspect to spark emotion
9	Y	Shark Owl	The slow methodical movements of the shark built tension, it contains an ominous demeanour. The owl clearly showed flight which gave incredible joy to see this jumble of bones take to the air.
10	Y	Shark	Its realistic movement.
Age Group: 40 – 59			
1	Y	Shark	The way it moved.
2	Y	Shark Crocodile	Yes, because of the lifelike movement.
3	Y	Shark	Liked the motion and movement of the shark.
4	Y	Owl	The movement and way the puppeteer manipulated it.

		Frog	
5	Y	Owl	My deep love for birds, now I even love them more.
6	Y	Sloth	The lifelike quality of the sculpted parts emphasised the movement.
7	Y	Frog Shark	You start to believe in the animal as if it is real.
8	Y	All	Loved the shark and the sinuous movement, but all were great. The convincing movement that created character.
9	Y	Shark	Hammerhead shark, the zig-zag movement like a fish in water. The effortless zig-zag movement, from head to tail-fin.
10	Y	Shark Crocodile	The puppets are full of character which is amplified by their movement and even stillness.
Age Group: 60+			
1	Y	Shark	Freedom of movement.
2	Y	Shark Crocodile	Lifelike movement.
3	Y	Shark	Movement
4	Y	Shark Owl	The typical movements and grace they were making.
5	Y	Owl	Movement of the head.
6	Y	All	The dynamics of the animal.
7	Y	All	The visual impact.
8	N	n/a	I do appreciate the thought and amount of work that went into this, but it does not affect me otherwise.
9	Y	Shark	Movement

10	Y	Frog	This is probably the closest I've ever come to having an emotional connection to a frog. Well – no – it was interesting (in a David Attenborough way). The frog, particularly when it moved. I also liked the drawing of the frog.

Table 4.2.3.1: Question 7 and 8

The majority of respondents mentioned that it was the realistic movement that caused them to feel an emotional connection with one or more of the marionettes. The respondents' responses are discussed in-depth in this section. To organise the data, responses from the different age groups are grouped together.

Age Group 18 – 39 (refer to table 4.2.3.1)

In this age group respondent No. 8 was the only respondent who did not feel a connection to any of the marionettes. The other 9 respondents all answered 'Yes'.

Respondent No. 1 mentioned that she thought the movement of the frog, the sloth and the shark marionettes was very realistic. She also mentioned that she had a background in zoology, something which, in the researcher's opinion, adds weight to her view.

Respondent No. 2 felt that a connection was created with the shark marionette because of its 'graceful movement', which instilled a sense of 'peace and elegance'. This relates to the ambience that was created by the shark's movement. Although no ambience was intended, it would seem that the movement was capable of creating it (refer to section 4.3.2.2).

Respondent No. 3's comment on the movement being 'so real it feels as if a real shark is swimming among us' is a clear indication that the movement of the shark marionette was extremely convincing. Respondent No. 4 made a similar remark, saying that ‘it transformed [her] as though watching an actual shark’. She also mentioned that the ‘lifelike movements of the shark felt really realistic’. Respondent No. 3 expressed an appreciation for the design of the marionette, stating that what ‘fascinated [her] further is even the skeletal structure of the shark [sic]’.

Respondent No. 5 felt the shark and crocodile marionettes had the most ‘fluid movement’.

Respondent No. 6 mentioned the specific movements that interested her. She thought the ‘frog's jump worked well in a crowd’. She also liked the movement of the owl with particular reference to its ‘neck movement’. This refers to the owl marionette’s atmospheric movement. She mentions the ‘amazing, smooth and beautiful movement of the shark’, adding that the ‘dreamlike state it evokes inspires [her] creatively’. This appears to echo Respondent No. 2’s answer, which refers to the ambience created by the movement of the marionette (refer to section 4.3.2.2).

Respondent No. 7 mentions that she liked the shark, the frog, the crocodile and the owl marionettes because they were ‘very lifelike and full of character’. She also mentioned that she ‘really enjoyed the crocodile’s attitude’ and the ‘owl’s beauty’. Commenting on the ‘character’ of the crocodile is an interesting observation as the marionettes were not intended to have a persona. It is possible that the reference to ‘character’ is in relation to the marionettes’ natural movement, which created a form of persona.

Respondent No. 8 was the only respondent in this age group who did not feel an emotional connection with any of the marionettes. Her reason was that she ‘found it hard to place an emotion based on the mere movement of an animal’. She mentions that perhaps she requires ‘another aspect to spark emotion’. This is an interesting observation which may link to her imagination. This implies that for this respondent movement alone is not enough to create a connection.

Respondent No. 9 mentioned that he felt a connection with the shark because of its 'slow methodical movement' that 'built tension'. The reference to ambience is again repeated in this respondent's comment with regard to the movement of the shark in terms of its ability to create tension. It could be that this respondent has a very active imagination and is able to imagine the shark preparing to attack prey. He also appreciated the owl because it gave him 'incredible joy to see [that] jumble of bones take to the air'.

Respondent No. 10 mentioned that he felt a connection with the shark marionette on account of its 'realistic movement'.

Age Group 40 – 59 (refer to table 4.2.3.1)

All the respondents in this age group felt a connection with one or more of the marionettes.

Respondent No. 1 said the emotional connection was due to the way the shark moved. Respondent No. 2 echoed the same thought about the shark and the crocodile, referring to their 'lifelike movement'. Respondent No. 3 also mentioned the shark and felt the connection was on account of its 'motion and movement'. Although these respondents did not specify what type of movement influenced them, they nonetheless mentioned 'movement'.

Respondent No. 4 mentioned the movement of the owl and frog. The 'way the puppeteer manipulated it' made her feel a connection. This comment implies that this respondent was quite aware of the presence of the puppeteers during the performance and observed them as well as the puppets (refer to section 4.3.4.2).

Respondent No. 5 simply remarked that she was fond of birds and that this was the reason why she felt a connection with the owl. This could suggest a degree of subjectivity on her side. By implication, had the bird marionette not moved realistically, she probably would still have felt a connection thereto.

Respondent No. 6 referred to the ‘lifelike quality of the [sloth marionette’s] sculpted parts [that] emphasised the movement’. This implies that the respondent was aware of the aesthetic quality of the marionette during the performance. That the realism of the ‘sculpted parts’ contributed to movement could also relate to this respondent’s imagination. It can be said that the realistic movement aided in the willing suspension of disbelief.

Respondent No. 7 mentioned that he felt a connection to the frog and the shark marionettes and that he started to ‘believe in the animal as if it is real’. This is yet another comment in support of the researcher’s aim, though this respondent does not state whether it was the movement that created this belief.

Respondent No. 8 felt a connection with all the marionettes and said that it was because of their ‘convincing movement that created character’. He particularly liked the ‘sinuous movement’ of the shark marionette. The notion of ‘convincing movement that created character’ might explain why some respondents saw ‘character’ in the marionettes, which were intended not to have any semblance of persona (refer to 4.3.2.1).

Respondent No. 9 also felt a connection with the shark marionette due to its 'movement like a fish in water' and the 'effortless zig-zag movement, from head to tail-fin'. 'Zig-zag movement' is often the description used to explain undulating movement. This respondent thus accurately recognised the type of movement employed by the shark.

Respondent No. 10 made the noteworthy observation that the shark and the crocodile marionettes were 'full of character' that was 'amplified by their movement and even stillness'. It appears to be another reference to the natural movement of the marionette and the notion that movement might assist in creating a persona.

Age Group 60+ (refer to table 4.2.3.1)

In this age group only one respondent did not feel a connection with any of the marionettes.

Respondent No. 1 felt a connection with the shark's 'freedom of movement'. Respondent No. 2 mentioned the 'lifelike movement' of the shark and the crocodile marionettes. Respondent No. 3 simply confirmed 'movement' as the reason for his connection with the shark marionette. Respondent No. 4 enjoyed 'the typical movements and grace' of the shark and the owl marionettes. All the respondents confirmed that it was the movement of the marionettes that created an emotional connection. However, none mentioned that it was the realism of the movement. The supposition can be made that since all other elements (ambience, persona etc.) were omitted, it must be the realistic movement that created the emotional connection.

Respondent No. 5 mentioned that the ‘movement of the head’ of the owl affected her. This is another reference to atmospheric movement.

Respondents No. 6 and No. 7 had a connection with all the marionettes. Respondent No. 6 mentioned that it was the ‘dynamics of the animal’ that affected him, while Respondent No. 7 was affected by the ‘visual impact.’

Respondent No. 8 was the only other respondent not to feel an emotional connection with the marionettes. She mentioned that she appreciated the thought and the work that went into the construction of the marionettes, ‘but it does not affect [her] otherwise’. Unfortunately her answer cannot be interpreted further as she does not give any reasons for her response.

Respondent No. 9 also mentioned the shark and that is was simply ‘movement’ that created the connection.

Respondent No. 10 felt a connection with the frog marionette and also mentioned that it is ‘probably the closest [he has] ever come to having an emotional connection to a frog’. He attributed it to the fact that it was interesting ‘in a David Attenborough way’. This is an interesting remark in view thereof that a lot of the data gathered on the anatomy and motion of the animals used in the study was based on documentaries by David Attenborough.

Summative Assessment

The table below (table 4.2.3.2) contains a statistical summary of the popularity of the different animal marionettes. Each column (example, *Sloth, Owl* etc.) shows how many times each marionette was mentioned, as being the marionette that elicited an emotional connection with a respondent, within each age group. Some respondents mentioned more than one marionette.

Age Group	Sloth	Owl	Crocodile	Frog	Shark	None
18-39	1	3	2	3	9	1
40-59	1	2	2	2	7	0
60+	2	4	3	3	7	1
Total	4	9	7	8	23	2

Table 4.2.3.2: Marionette Connection Statistics

The shark was by far the most appreciated marionette and the sloth the least appreciated. Only two out of the thirty respondents mentioned that they did not feel a connection with any of the marionettes, namely Respondent No. 8 from age group 18 – 39 and Respondent No. 8 from age group 60+.

It is clear from the answers to questions 7 and 8 that it was largely the movement of the marionettes that created an emotional connection between the marionettes and the respondents. Some respondents confirmed that it was the realistic or lifelike movement that created that emotional connection.

In total sixteen out of the thirty respondents stated that it was movement that affected them, while nine out of thirty confirmed that it was realistic / lifelike movement that affected them. Out of the thirty respondents only two were not affected at all. One respondent was affected due to subjectivity towards birds, as was the case with Respondent No. 5 from age group 40 – 59. The remaining two respondents were affected by the design of the marionettes.

Three respondents referred to the ambience created by the marionettes and four referred to the persona of the marionettes. As already stated, there was never an intention to create ambience, since the marionette performance focused solely on the evaluation of realistic movement. It is the researcher's opinion that the realistic movement of the marionettes created ambience. Concerning the persona of the marionettes, they were not designed or constructed with specific 'characters' in mind. The puppeteers were under clear instruction not to perform with the aim of creating a persona for any of the marionettes.

Despite this the respondents still experienced a sense of ambience as well as a persona in the marionettes. Since the marionettes did not do anything other than moving, it can be argued that 'ambience' and 'persona' were a result of the realistic movement. This will be discussed further under sections 4.3.2.1 and 4.3.2.2.

Question 11: What would you generally like to see in future marionette performances in order for it to make an impression on you?

Age Group: 18 – 39	
No.	**Opinion**
1	I would love to see this type of marionette in a story or part of a performance. They could even be used for teaching in university for skeletal structure and locomotion.
2	Even more interaction.
3	If the marionette manages to make you forget about the puppeteer then I feel it has succeeded.
4	I would like future marionette performances to also show a greater focus on the movement of the marionettes so that you can lose yourself in the performance rather than constantly being aware of watching inanimate objects.
5	Realistic movement like seen tonight makes such a big difference to make them look believable.

6	Interesting lighting and shadows.
7	Not much, this experience was very new and unmatched. The movement between crowds was also quite clever, perhaps even more interactivity.
8	I personally valued the variety of movements created when two puppeteers handled the marionettes and would advise one to increase both the variety of movements (and twitches) as well as puppeteers.
9	I already enjoy marionette performances.
10	I enjoy the 'fantasy' type sculptures / puppets,
Age Group: 40 - 59	
1	The puppets moving without the puppeteers.
2	To be more like this one.
3	I would appreciate background information regarding the character of the marionettes.
4	n/a
5	True passion in understanding your subject.
6	I like a soundtrack.
7	Realistic movement like this.
8	More of this, also large scale, love the skill involved in the making.
9	Effortless movement which can animate lifeless objects to 'life' in the absence of other attributes.
10	I would like to see more.
Age Group: 60+	
1	Marionettes interacting (like in an ecosystem of marionettes).
2	Not easy to top this performance.
3	To be entertained.
4	This performance was done in such a way. Loved it.
5	The marionette to be realistic and authentic.

6	Application to theatre performance with human actors.
7	The humanity of the puppet.
8	This performance was absolutely great and needs no extra boost.
9	The same.
10	Of course, scale, a life-sized T-rex would be awesome.

Table 4.2.3.2: Question 11

It is apparent that a number of respondents answered this question incorrectly to a degree. This question focused on general marionette performances that the respondent might see in the future and not necessarily the performance that was under review. However, it seems some respondents answered this question in terms of this researcher's possible future performances. Therefore the answers will be divided as follows: first by discussing the researcher's 'future performances' and secondly general future marionette performances.

With regard to the researcher's 'future performances', respondents expressed several views that clearly indicate that they would like to see the performance in a more 'theatrical setting'. There was a desire to see a storyline, lighting, fantasy elements and music. Some respondents expressed a desire to see the marionettes on a larger scale and some said they would like to see the marionettes manipulated by more professional puppeteers.

In terms of general future marionette performances, respondents indicated that they would like to see more interaction between the puppets themselves and would also like to be more entertained and in general would like to see puppets with more realistic movement.

Respondent No. 1 from age group 40 – 59 expressed a desire to see the ‘puppets moving without the puppeteers’. Perhaps this was the expression of a desire to have a performance in which the puppeteers are less visible, implying that this respondent connects better to puppets when the puppeteers are not visible. Respondent No. 3 from age group 18 – 39 shared a similar view. She mentioned that she believes if one is able to forget that the puppeteer is present then the performance has succeeded. This observation implies that this respondent believes that if the puppeteer performs convincingly she will forget about the presence of the puppeteer and connect with the puppet. These observations will be discussed in-depth under sections 4.3.4.1 and 4.3.4.2.

Respondent No. 7 from age group 60+ indicated that he would like to see ‘the humanity of the puppet’. It is unclear what exactly he meant by this.

Respondent 9 from age group 40 – 59 stated ‘effortless movement which can animate lifeless objects to ‘life’ in the absence of other attributes’. This statement supports the researcher’s aim of proving the importance of movement in bringing puppets to life, or in other words, connecting with them on an emotional level.

Respondent 1 from age group 18 – 39 (who has a background in zoology, refer to question 8), mentions that the marionettes ‘could even be used for teaching in university for skeletal structure and locomotion’. This endorsement is another clear indication that the researcher’s aim of creating realistic movement through the study of animal physiology was realised. However, this remark relates to the accuracy of the skeletal structure and realism of the marionettes’ movement and not necessarily to the emotional connection created between the respondent and the marionettes.

4.2.4 Suspended Disbelief

Willing suspension of disbelief relates to the audience putting aside their notions about everyday reality and accepting the quasi reality of the performance (Downs, Wright and Ramsey, 2007: 81). In other words, for the duration of the performance the audience choose to believe that the actors are real people experiencing real life (Barton and McGregor, 2008: 22). The fact that a ‘person chooses to believe’ indicates that it is up to the performer to convince the audience to suspend disbelief.

Therefore, in relation to puppetry it makes sense that the realistic movement of a puppet could cause respondents to willingly suspend disbelief, because realistic movement is consistent with everyday reality. The respondents were aware of the fact that the puppets are not living beings, but once the puppets started to move, the respondents were lulled into setting aside their scepticism, if only for the duration of the performance. The puppet’s movement should convince them that the movement is real and so consistent with the movement of the actual living creature, that it takes on a life of its own and becomes a separate entity with an authentic personality.

The following question posed to respondents relates to the notion of the willing suspension of disbelief.

Question 9: Did you at any point forget that you were watching a lifeless object being manipulated by a person? What is the reason for your answer?

Although phrased differently when asked to the respondents, the focus of question 9 is suspended disbelief. This relates to whether respondents were able to willingly suspend their disbelief with regard to the marionettes. In other words: were they able to see the puppets as more than just objects, perceiving them as living creatures instead?

The terms “suspended disbelief”, “willing suspension of disbelief” and “immersion” are used interchangeably in this section.

Age Group: 18 – 39		
No.	**Forgot it was a puppet**	**Reason**
1	Y	Very realistic, detailed movement.
2	Y	The movements imitated real-life but the physical design of the object remained. It felt like it was a lifeless object that became alive through magic.
3	Y	The manner in which they move/are manipulated makes them appear real.
4	Y	The shark especially moved very realistically as though swimming though water, which reminded me more of watching a shark on film.
5	Y	At one stage where the crocodile 'scurried' between the people.
6	Y	Brief moments, my imagination took over for those moments.
7	Y	The movement was incredibly realistic and the skeletal nature of the marionettes made them seem quite eerie which added atmosphere.
8	Y	The movements were so lifelike and interesting (from the variety of small twitches to big limbs moving) it captures all my attention as a subject on its own.
9	N	I don’t see it as a bad thing, for instance the frog is seriously impressive due to the simplistic movements that were required from the puppeteer to make it hop. Also I believe attaching a simple narrative to the performance would have me answer yes.
10	Y	Although, lying still I can still imagine the creature moving. I find myself thinking of the creature in its natural habitat.
Age Group: 40 – 59		
1	Y	Looks very lifelike.
2	Y	Lifelike movement and able manipulation.
3	Neutral	I think I focused too much on the marionette as an object.

4	Y	Movement.
5	Y	They made me think they were real.
6	N	Rationalist.
7	Y	The movement was so real and this took over the being of the puppeteer.
8	Y	The puppet took on a life of its own.
9	Y	The reality of the effortless movement bringing the puppets to 'life'.
10	Y	The puppet characters are emphasised by their movements.
Age Group: 60+		
1	Y	Fascination.
2	N	I could imagine the real animal's movement.
3	N	They're puppets.
4	N	It still remained an object for me but I could appreciate the art and technique.
5	Neutral	n/a
6	Y	The marionette became an object with a life of its own.
7	Y	The movement seemed convincing.
8	N	At my age I am not sentimental like I was when I was younger.
9	Y	I know wood.
10	N	Because I actually was watching a lifeless object being manipulated by a person.

Table 4.2.4.1: Question 9

Age Group 18 – 39 (refer to table 4.2.2.2.5)

Of the ten respondents, an impressive nine were able to suspend their disbelief and see the marionettes as more than mere wooden puppets, but as inanimate objects that were nevertheless able to acquire ‘a life of their own’.

Respondent No. 1 believed it was the ‘very realistic, detailed movement’ that persuaded him to suspend disbelief. Respondent No. 3 stated that it was the ‘manner in which they move / are manipulated makes them appear real’. Respondent No. 4 mentioned that it was the realistic movement of the shark, ‘as though swimming through water’. These comments support the researcher’s argument that a proper anatomical study of animal locomotion applied to marionette construction will result in more realistic movement.

Respondent No. 2 made a particularly relevant point in terms of puppetry. She mentioned that the ‘movements imitated real-life but the physical design of the object remained’ and that ‘it felt like it was a lifeless object that became alive through magic’. In broad terms this statement could be described as the basic aim of puppetry. This respondent saw the marionette as a puppet, but was still able to imagine it as having a life of its own.

Respondent No. 5 indicated that she became immersed the moment when ‘the crocodile “scurried” between the people’. This is a reference to persona as well as atmospheric movement as the cause of the immersion.

Respondent No. 6 stated that it was in the ‘brief moments, [her] imagination took over’ that she started to see the marionettes as real creatures. This comment will be discussed further in section 4.3.4.1.

Respondent No. 7 was influenced by the ‘incredibly realistic’ movement of the marionettes and also mentioned that the ‘skeletal nature of the marionettes made them seem quite eerie’. In her opinion this contributed to the ‘atmosphere’ of the performance. It is important to note the discussion on specifically refraining from creating ambience (refer to section 4.3.2.2).

Respondent No. 8 was fully captivated by the ‘lifelike and interesting’ movement as she mentioned that all the movements ‘from the variety of small twitches to big limbs moving’ captured her attention ‘as a subject on its own’. This comment demonstrates that this respondent noticed the significance of both locomotion and atmospheric movement.

Respondent No. 9 was the only respondent in this age group that did not become immersed in the movement of the marionettes. He mentioned that he does not see this inability as a complication to the process. He remarked that ‘for instance the frog is seriously impressive due to the simplistic movements that were required from the puppeteer to make it hop’. He also indicated that if the performance had a form of narrative perhaps he would have been more immersed.

Respondent No. 10 experienced suspended disbelief even without the movement of the marionettes: ‘lying still I can still imagine the creature moving’. It seems that for this respondent the willing suspension of disbelief comes easily and that he does not necessarily require external stimuli (like movement) to immerse him.

Age Group 40 – 59 (refer to table 4.2.2.2.5)

Of the ten respondents in this age group eight experienced suspended disbelief, one was neutral and one answered ‘No’.

Respondent No.1 mentioned that the marionettes looked ‘very lifelike’. Respondent No. 5 mentioned that the marionettes ‘made [her] think they were real’. Respondent No. 8 mentioned that the ‘puppet took on a life of its own’. All these comments reflect the notion that the respondents were immersed in the actions of the marionettes and therefore perceived the marionettes as ‘lifelike’ and ‘real’.

Respondent No. 2 articulated that is was the ‘life-like movement and able manipulation’ that induced his willing suspension of disbelief. Respondent No. 9 stated that it was the ‘reality of the effortless movement bringing the puppets to “life”’ that influenced him. Respondent No. 4 simply gave ‘movement’ as a reason. All these comments attribute the ‘lifelike’ quality of the marionettes to movement.

Respondent No. 3 answered ‘neutral’ and indicated that she ‘focused too much on the marionette as an object’ and that this was a hindrance to her ability to see the marionette as more than a puppet. The mention of the puppet remaining an object seems to be an emerging concern from some respondents (refer to 4.3.4.1).

Respondent No. 6 did not see the marionettes become more than inanimate objects and his reason is that he is a ‘rationalist’.

Respondent No. 7 made an observation that is viewed by some as one of the basic aims of puppetry. He was able to perceive the puppets as more than mere objects and the reason he gave was that the marionettes’ ‘movement was so real and this took over the being of the puppeteer’ (refer to section 4.3.4.1).

Respondent No. 10 was affected by the persona of the marionettes, which he says was ‘emphasised by their movements’. This respondent also mentioned the ‘character’ of the puppets (refer to 4.3.2.1).

Age Group 60+ (refer to table 4.2.2.2.5)

Of the ten respondents four answered yes, one was neutral and five respondents were not influenced by the marionettes at all.

Respondent No. 1 experienced suspended disbelief and attributed this to ‘fascination’, which is unfortunately rather vague, although one can assume that he was fascinated by the actions of the marionettes.

Respondent No. 2 did not experience suspended disbelief but mentioned that the reason was that she ‘could imagine the real animal's movement’. This comment is also vague because her answers to questions 7 and 8 indicated that she felt a connection with two marionettes on account of their ‘life-like movement’.

Respondent No. 3 was also not influenced by the marionettes and cited the reason that ‘they're puppets’. Respondent No. 4 answered that she was not affected by the marionettes because they ‘still remained an object for [her] but [she] could appreciate the art and technique’. Both these respondents thus focused on the inanimate nature of the marionettes. Respondent No. 10 also answered ‘no’. He did not experience the willing suspension of disbelief because ‘[he] actually was watching a lifeless object being manipulated by a person’.

Respondent No. 5 answered ‘neutral’ and did not give a reason for his answer.

Respondent No. 6 was affected and mentioned that the reason was because the marionette ‘became an object with a life of its own’. The respondent however did not specify the reason why the ‘object’ took on a ‘life of its own’.

Respondent No. 7 was also affected and indicated movement that ‘seemed convincing’ as the reason for the suspended disbelief.

Respondent No. 8 was not influenced by the marionettes and attributed it to her age, stating that she is ‘not sentimental like [she] was when [she] was younger’.

Respondent No. 9 experienced suspended disbelief but his answer was simply that he ‘know[s] wood’. It is not clear what the respondent meant by this comment.

4.2.5 General Comments

Questions 12, 13 and 14 fall under the heading *General Comments*, since these questions solicited the overall opinion of the respondents on the marionette performance.

Question 12: Has this show changed your outlook or appreciation of marionette performances in any way?

The focus of this question was to identify individuals who had preconceived notions about puppetry and to find out whether the researcher’s work changed their perceptions. The table displays all the answers of respondents who had preconceived notions about puppetry. The answers that are omitted expressed an appreciation for the aesthetic quality of the researcher’s work and were therefore not deemed relevant for the purpose of this question.

Age Group: 18 – 39	
No.	**Opinion**
1	Yes, I wasn't aware that it is possible for marionettes to move in such a realistic manner.
2	Yes, it has made me realise how extraordinary marionettes actually are and that it an art made alive again.
3	Yes, most marionettes cannot be appreciated up close, by first having the chance to view the joints etc. You appreciate it even more when animated.

4	Yes, I definitely have a greater appreciation of marionette performances as they can transform you into the wilderness moving naturally.
5	Yes, it is a true art form. I did not realise the amount of planning that goes into this and all the 'planning drawings' made me realise the amount of work.
6	Yes, it reminded me how they work and the actual function / value of the skeleton.
7	Yes, a lot more entertaining and engaging than I thought it would be.
8	Yes, having only intricate skeletons present oddly made not only the puppet seem more intricate but the bare movements as well.
9	I definitely gained more appreciation on how much planning is involved in creating the movement of the puppets.
10	Definitely, before I had no experiences with modern puppetry. Really opened myself to another dimension in art.
Age Group: 40 – 59	
2	Yes, this one consists of really beautiful artworks instead of dolls, meant for adults not children.
3	Yes, I appreciate it as an art form. It gave me a newfound appreciation for marionette performances.
4	Better insight of what it’s about, the immense amount of work to get to the point of actually making a working puppet.
5	Yes it has, people who engage with marionettes must do a complete study of the subject.
6	Yes, it is a too unexpected medium.
7	Yes, normally it is done in a box or small theatre and with this the puppets moved realistically amongst the respondents.
9	Yes, the importance of movement in 'bringing to life'
Age Group: 60+	
1	These marionettes are pushing boundaries.
4	Yes, it is an art form and the researcher has done just that.
5	Yes, I would like to see more marionette shows.
6	Impressed by the possibility of performance in marionette manipulation.

10	Not really, because each marionette maker and operator is different and that's the art of the process. The researcher has brought her own style to the genre.

Table 4.2.5.1: Question 12

Age Group 18 – 39 (refer to table 4.2.5.1)

Respondent No. 1 mentioned that she was not aware that ‘it is possible for marionettes to move in such a realistic manner’. Respondent No. 2 realised ‘how extraordinary marionettes actually are and that it is an art made alive again’. Respondent No. 3 appreciated being able to see the marionettes up-close before the performance, remarking: ‘having the chance to view the joints, [one] appreciate[s] it even more when animated’. Respondent No. 5 confirmed that it is a ‘true art form’ and both she and Respondent No. 9 indicated that they did not realise how much work is required to make marionettes. Respondent No. 7 found the performance to be ‘a lot more entertaining and engaging than [she] thought it would be’. These comments demonstrate that greater understanding of puppetry breeds greater appreciation therefore.

Respondent No. 4 stated that marionettes can ‘transform [one] into the wilderness moving naturally’. Respondent No. 6 was reminded of the ‘actual function / value of the skeleton’. Respondent No. 8 observed that ‘having only intricate skeletons present oddly made not only the puppet seem more intricate but the bare movements as well’. These comments relate to the realism of movement and skeletal design of the marionettes.

Respondent No. 10 remarked that he previously had ‘no experience with modern puppetry’ and that it ‘really opened [him] to another dimension in art’. This comment demonstrates a paradigm shift with regard to the understanding of puppetry (refer to section 5.4).

Age Group 40 – 59 (refer to table 4.2.5.1)

Respondent No. 2 stated that the marionette performance 'consists of really beautiful artworks instead of dolls, meant for adults not children'. Respondent No. 3 mentions that she 'appreciate[s] it as an art form' and that it 'gave [her] a newfound appreciation for marionette performances'. These thoughts relate to the preconceived notion that puppetry is intended as children's theatre and that it is not a mature art form in its own right.

Respondent No. 4 also expressed admiration for the amount of work that goes into 'making a working puppet' and also links with the fact that the performance was part of an academic study. Respondent No. 5 echoed this thought by mentioning the 'complete study of the subject'. These thoughts relate to the aforementioned notion that better understanding of a subject inevitably creates greater appreciation therefore.

Respondent No. 6 thought that it is a 'too unexpected medium [sic]' and respondent No. 7 expressed the thought that 'normally [a puppet performance] is done in a box or small theatre and with [the researcher's performance] the puppets moved realistically amongst the respondents'.

Respondent No. 9 makes a relevant observation: 'importance of movement in "bringing to life"'. The researcher agrees with this statement in that it is the energy supplied by the puppeteer to create both atmospheric movement and locomotion in the puppet that brings it to life. This relates to Tillis' belief (refer to section 1.1) that a puppet requires at least one of three components to be brought to life: design, movement or sound. In the researcher's opinion movement is vastly superior to either sound or design.

Age Group 60+ (refer to table 4.2.5.1)

Respondent No. 1 remarked that the 'marionettes are pushing boundaries'. This is a profound compliment.

Respondent No. 4 affirmed that puppetry 'is an art form and the researcher has' changed this respondent's outlook or appreciation of marionette performances. This is a reiteration of an opinion previously expressed by most of the respondents.

Respondent No. 6 mentioned that he was 'impressed by the possibility of performance in marionette manipulation'.

Respondent No. 10 was the only respondent who did not feel that his outlook or appreciation had been changed because 'each marionette maker and operator is different and that the art of the process, the researcher has brought her own style to the genre'.

Question 13: What is your overall impression of this performance?

Age Group: 18 – 39	
No.	**Opinion**
1	I was extremely impressed with the performance and would love to see more of this artist's work.
2	It was very creative and beautiful to watch.
3	Very good.
4	I loved the performance in general and would want future marionette

	performances to also focus on realistic movement.
5	Was very good and really enjoyed it, well done on the excellent planning and work.
6	Has a lot of potential, inspiring.
7	I want more.
8	It went fairly well.
9	Very positive – loved it.
10	Creative and beautiful.
Age Group: 40 – 59	
1	Love the puppets.
2	Well done, it's beautiful.
3	Marionette performances is an absolute art, which is not appreciated enough.
4	Wonderful.
5	It was magnificent because of the true experience it had as a result.
6	Super.
7	This can be developed into something bigger.
8	Good as a demonstration but would love to see an actual performance.
9	Very good.
10	Too short.
Age Group: 60+	
1	Excellent.
2	Well done and imaginenative, well controlled.
3	Very good.
4	We appreciated and observed the dedication, passion and very detailed way of looking at movement etc., in her objects of art.

5	I liked the variety of animals.
6	Outstanding.
7	Excellent.
8	Needs no improvement.
9	Magnificent.
10	Really good.

Table 4.2.5.2: Question 13

The overall impression the performance made on respondents was positive. The majority of respondents enjoyed the experience either as a form of entertainment or as works of art.

For some individuals the experience was very moving. Respondent No. 3 (age group 40 – 59) observed that 'marionette performances are an absolute art, which is not appreciated enough'.

Question 14: Additional Comments

Not all the respondents made an 'additional comment'. The table below was compiled from the answers of the respondents who provided additional comments.

Age Group: 18 – 39	
No.	**Opinion**
1	Great exhibition with lovely realistic marionettes. Job well done.
6	Well done.
7	Fantastic work, aesthetically pleasing and functionally enticing. I want to see more and a larger scale and well as a minute scale. Perhaps true to the actual size of the animals?

9	Very good – loved the designs.
Age Group: 40 – 59	
2	Inspiring
4	Loved it.
5	The researcher's creative mind and very hard work have made all the difference.
6	Well done.
7	One can clearly see the researcher's passion for the topic.
8	Looking forward to more.
9	It would be interesting to see how these puppets move if constructed to life size.
Age Group: 60+	
1	Very creative and stimulating.
4	The researcher did a great job. It was excellently done by someone with an eye for detail, movement and not afraid of hard work.
6	Would like to see more performances in future.
7	Marvellous craftsmanship.
8	Thank you for a most enjoyable evening.
9	Like the people, their appreciation tremendous.
10	I love the fantasy marionettes. I've always been a fan of Marcel Duchamp (Nude descending a staircase) and Edward Muybridge's studies of people and animals in motion. This work fits right in there.

Table 4.2.5.3: Question 14

All these comments are a general expression of appreciation. The additional comments however are not necessarily relevant to the purpose of this study. However, the sentiment generally expressed that the respondents enjoyed and appreciated the researcher’s work is an indication that the performance captured the attention and the interest of the respondents.

4.3 Data Analysis and Discussion

This section expands on some of the observations made by the respondents as outlined above. It summarises the main trend in each age-group in so far as these relate to the main aim and purpose of the study. The responses relate to either the realistic movement of the marionettes, the emotional connection between the respondents and the marionettes, or the willing suspension of disbelief induced within the respondents.

In some cases the researcher used ‘word clouds’ to visually track the preponderant idea in the respondent’s answers. A word clouds is a simulator that is used in data analysis to demonstrate the recurrence of words in a piece of text. The respondent’s answers to a specific question are fed to the word cloud generator and the program identifies recurring words. The more often a word is repeated the larger it features in the generated word cloud (McKee, 2014).

The researcher is not using the word clouds for data analysis as this has already been done in section 4.2.2. A major concern with word clouds is that they take the meaning of the answer out of context because it focuses on a single word. However in the way the researcher is using the word cloud the meaning cannot be taken out of context because the researcher generated word clouds for direct questions.

The researcher made use of the word cloud generator created by J. Davies on jasondavies.com/wordcloud to generate all the word clouds found in this study (Davies, S.a.).

4.3.1 Realistic Movement

It is clear from the analysis of the answers from the respondents pertaining to the performance that the realistic movement of the marionettes was generally convincing. This section discusses the general consensus on questions that relate to movement in some way, indicating that the performance was convincing in terms of the realistic movement of the marionettes.

In terms of the answers to question 5 (refer to section 4.2.2), the overall opinion was that the researcher’s work compared well to other puppets, especially with regard to their movement. Respondents mentioned that the movements were ‘very realistic and detailed’, ‘more complex and lifelike’, exhibited a ‘variety of movements’ and ‘incredibly fine movement and poise’.

With regard to question 6 (refer to section 4.2.2), the researcher generated a word cloud to demonstrate that the respondents felt that the marionettes compared well with puppets seen from previous performances, and that this difference added to the respondents’ appreciation of the performance.

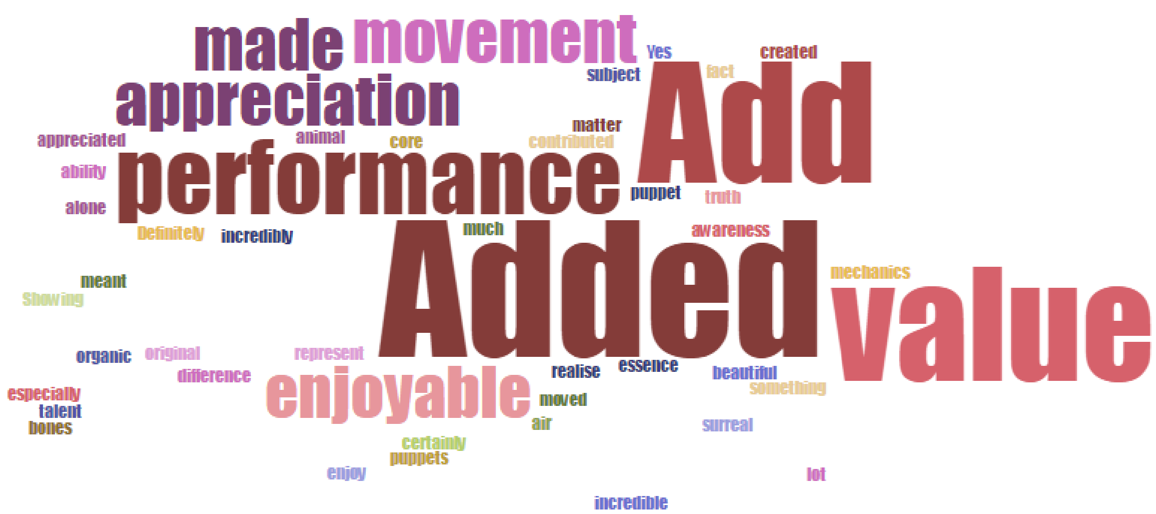

Fig. 4.3.1.1: Question 6 Word Cloud

Question 10 (refer to section 4.2.2) asked the respondents to score the degree of realism of the marionette movement. The summative result is a total of 252.5 out of 300, which is an 84% score for realistic movement.

Some respondents also made reference to atmospheric movements. Although this is not a term that is widely recognised, the researcher uses it to describe a specific type of movement. As mentioned before, for the researcher the term ‘atmospheric movements’ describes small, subtle movements that contribute to the realistic aesthetic of a puppet. These are subtle motions that make a puppet seem lifelike and natural. This concept ties in with the achievement of effective movement as per the researcher’s main aim.

Respondent No. 6 (age group 18 – 39) liked the movement of the owl, particularly its ‘neck movement’. Respondent No. 5 (age group 60+) mentioned that the ‘movement of the head’ of the owl affected her. Respondent No. 8 (age group 18 – 39) was entirely captivated by the ‘lifelike and interesting’ movements, as she mentioned that all the movements ‘from the variety of small twitches to big limbs moving’ captured her attention ‘as a subject on its own’.

These comments indicate that the respondents were more focused on the atmospheric movements of the marionettes than their locomotion. This therefore demonstrates the importance of atmospheric movement in the willing suspension of disbelief to create a connection between the puppet and respondents.

4.3.2 Emotional Connection

Question 7 (refer to section 4.2.3) inquired whether respondents felt a connection to any particular marionettes. The result was that all but two respondents felt a connection to one or more of the marionettes.

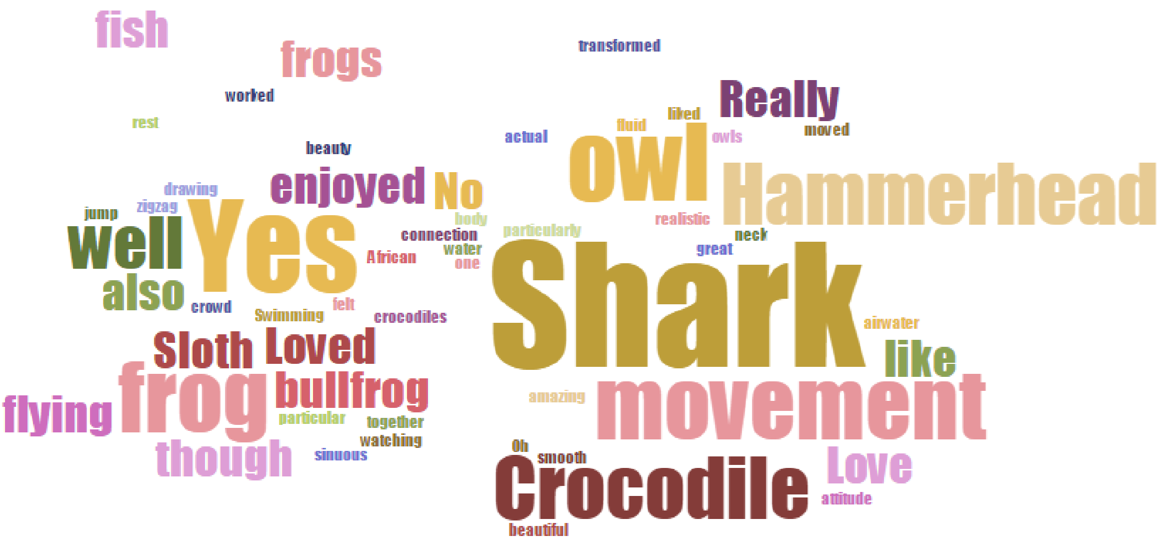

Fig. 4.3.2.1: Question 7 Word Cloud

The shark marionette was by far the most popular of all the marionettes in terms of its movement. Most respondents who mentioned that they felt a connection to the shark said it was because of the shark's movement (refer to 4.2.3 *Question 8*).

The owl marionette was the second most convincing marionette in terms of movement. The marionette also required two puppeteers to manipulate, but despite this the control used to manipulate the wings was based on a real bird's wing. Therefore the motion of flight was naturally translated into the marionette. Some respondents specifically mentioned that they liked the head movement, which was created by the puppeteer manipulating the head with sharp movements. This also relates to the atmospheric movement of the owl marionette.

The frog was the third most convincing marionette. Respondents consistently referred to its simplistic and natural movement. The respondents also mentioned that they liked the frog 'hopping' around them. The interactive aspect of the performance worked to great advantage for the frog marionette.

The crocodile was the second least mentioned marionette; although it was a favourite among some respondents who liked its movement, attitude and character (refer to 4.2.3 *Question 7*).

The sloth was the least mentioned of all the marionettes (refer to 4.2.3 *Question* 7). Its slow and deliberate mode of locomotion could likely be a reason for this. There is not much fluidity or strength in the movement of a sloth. Respondents reacted better to the livelier movements of the other marionettes. However, this is not a concern as the purpose of the study was to recreate realistic movement.

Question 8 (refer to section 4.2.3) inquired as to the reason why the respondents did or did not feel a connection. The most common reason given for experiencing a connection was the 'movement' or 'movements' that were 'realistic' and 'lifelike' (refer to table 4.2.3.1). In total sixteen out of the thirty respondents stated that it was movement that affected them emotionally, while nine out of thirty confirmed that it was realistic / lifelike movement that affected them emotionally.

The word cloud (see Fig. 4.3.3.4) was generated from the answers of respondents who mentioned that they felt a connection with one or more of the marionettes. This was done to ensure that the words included in the word cloud are not taken out of context. If the researcher included the reasons provided by respondents who did not feel a connection the word cloud would not reflect the answers accurately.

Fig. 4.3.2.2: Question 8 Word Cloud

Of the two respondents who did not feel a connection the one said it was because she ‘found it hard to place an emotion to the mere movement of an animal’ and the other simply said it did not affect her.

With regard to question 11 (refer to section 4.2.3.2), respondents would like to see more interaction between puppets, would like to be more entertained and in general would like to see puppets with more realistic movement in general in future marionette performances.

Six of the thirty respondents remarked on the persona of the marionettes (refer to the answers to questions 7, 8, 9 and 11). As stated earlier, the marionettes for this study were not designed to have any form of obvious persona so as not to distract the respondents from focusing on the movement.

4.3.2.1 Reference to persona

According to Sanchez (1997: 35, 36) ‘Persona’ has several meanings. It can be understood as how ‘one appears to others (but not really as one is)’ or as the ‘part someone plays in life’ or finally as ‘as assemblage of personal qualities that fit a man for his work’.

Therefore, in terms of this study: when the respondents refer to the ‘character’ of the marionettes they are referring to the role portrayed by the marionettes or how they appear to the respondents (but not really who they are). In relation to puppetry this could refer to ability of puppets (which are lifeless objects, a fact the observers are aware of) to come to life.

Respondent No. 5 from the youngest age group felt a connection with the crocodile when the crocodile ‘scurried’ between the respondents. Respondent No. 7 stated that several of the marionettes were ‘very lifelike and full of character’. She particularly ‘enjoyed the crocodile’s attitude’.

Four respondents from age group 40 – 59 mentioned something similar. Respondent No. 3’s answer on what she would like to see in future marionette performances was: ‘I would appreciate background information regarding the character of the marionettes’. Respondent No. 3 was one among several who answered this question with reference to future marionette performances or marionettes still to be made by the researcher.

Respondent No. 7 believed that the marionettes had ‘wonderful movement and characters’. Respondent No. 8 felt a connection with all the marionettes and said that it was their ‘convincing movement that created character’. Respondent No. 10

observed that the shark and the crocodile marionettes were ‘full of character’, which was ‘emphasized’ and ‘amplified by their movement and even stillness’.

These comments refer to the intended roles or ‘characters’ the marionettes portrayed in the performance. As mentioned previously the researcher designed the marionettes without a persona, however the notion of ‘convincing movement that created character’ might explain the recurring references to persona. The reason for not creating persona for the marionettes was to ensure that the respondents would not be distracted from observing the marionettes’ movement.

The researcher believes that the movement was so real that the respondents were caught up in the lifelike quality of the marionettes. Experiencing the marionettes as real creatures persuaded the respondents to imagine them to have personality. Incidentally, the six respondents who made reference to persona all felt a connection to one or more of the marionettes. All of them except Respondent No. 3 (age group 40 – 59) were able to willingly suspend disbelief.

Apart from attributing persona to the marionettes, some respondents also made reference to the ambience of the performance.

4.3.2.2 Reference to ambience

Malpas (2015) asserts that ‘the art form of theatre relies heavily on atmospheres, which support the integrity, continuity and reality sense of the story regardless of the often abstracted and vaguely hinted scenographic features of places or spaces… and immaterial ambience creates the experience of a material place through emotive suggestion. It can be understood as the mood or tone created by a scene. This is often done through the use of sound and lighting, for example the sound of a waterfall and amber lighting could be used to create the ambience of a romantic scene. Ambience is important in immersing the audience in a performance. Audience members are better entertained when they get immersed and are better able to reflect on the story or actions being performed. In this manner they get more emotionally invested in the story.

However, for the purposes of allowing the respondents to concentrate on the movement of the animal marionettes the researcher wanted to avoid creating ambience. This was accomplished in three ways. In the first place the marionettes performed without any audio accompaniment as no music, sound effects or dialogue were used. Secondly, the marionettes performed under the house lights of the art gallery, i.e. the same white light used by the gallery to showcase its art works. The third and last measure was to have the marionettes perform among the respondents, mixing and mingling, while the respondents were encouraged to move around the room and converse among themselves. When the performers were not performing with the marionettes, they were laid out on a table in the middle of the gallery, affording the respondents the opportunity to observe the marionettes up close.

Despite the measures put in place by the researcher to avoid creating ambience, four respondents (all from the youngest age group) still mentioned the presence of ambience.

In the age group 18 – 39 Respondent No. 2 felt a connection was created with the shark marionette because of its 'graceful movement', which instilled a sense of 'peace and elegance'. Respondent No. 7 said that 'the movement was incredibly realistic and the skeletal nature of the marionettes made them seem quite eerie which added atmosphere'. Respondent No. 9 also made reference to ambience when he mentioned that he felt a connection with the shark because of its ‘slow methodical movement’ which ‘built tension’.

It is therefore reasonable to deduce that the realistic movement of the marionettes created ambience. As background to this study, this researcher watched many wildlife documentaries focusing on animal movement and she remembers instances where the motion and locomotion of the animals affected her emotionally. These ranged from the serenity of fish swimming to the juxtaposition of grace and power in predators. These movements do not define the personality of the animals but nonetheless causes one to attach traits to them. For example, one might imagine fish to be serene by nature and lions to be noble. This however is not true. Fish are not serene by nature any more than lions are noble. It is a question of human perception and the tendency to anthropomorphise animals.

It can be deduced that the realistic and natural representation of animal locomotion in the marionettes inspired a similar experience as watching the graceful movement of real animals in their natural habitats.

This also underlines the value of using accurate realistic movement in animal marionettes so as to affect the respondents emotionally and to immerse them in the performance.

4.3.4 Suspended Disbelief

As mentioned above (refer to section 4.2.4), the notion of willing suspension of disbelief relates to the respondents’ ability to set aside their notions about everyday reality and accept the reality of the performance. Relating this to puppetry implies that, though aware of the puppet as an object, audience members are willing to disregard this notion and regard the puppet as a living creature.

In terms of question 9 (refer to section 4.2.4), the majority of respondents made the point that it was the movement of the marionettes that led to their willing suspension of disbelief (refer to table 4.2.4.1). Some respondents mentioned that it was the ‘realistic movement’ or ‘lifelike’ quality of the marionettes. For the same reason as mentioned for question 8, the word cloud is generated solely from the answers of the respondents who were able to willingly suspend disbelief.

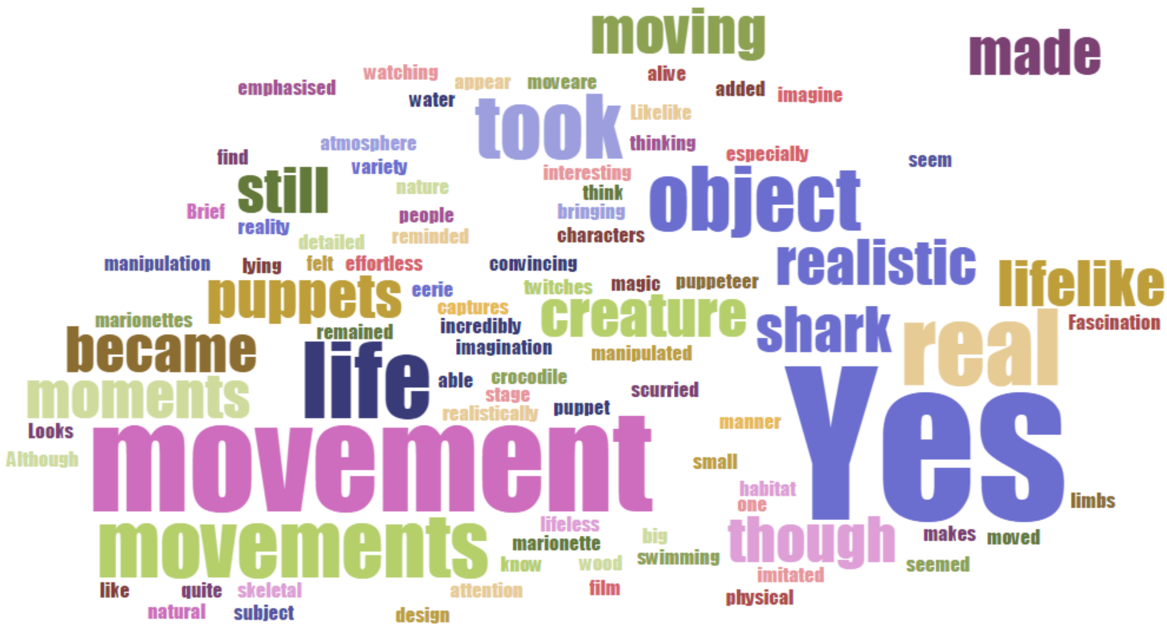

Fig. 4.3.4.1: Question 9 Word Cloud: Respondents who answered ‘Yes’

The respondents who answered ‘No’ mostly indicated that the reason for their answer was that the marionette remained a mere object for them. Of the two respondents who answered ‘Neutral’ only one gave a reason, which was that she had ‘focused too much on the marionette as an object’.

4.3.4.1 The Presence of the Object

A puppet is a lifeless object that is brought to life through the actions of the puppeteer. When watching a puppet show one is sometimes able to forget that the puppet is a lifeless object that is being manipulated. This is of course the notion of suspended disbelief. Several respondents made reference the marionettes as mere objects (refer to questions 8 and 9). Some respondents were unable to willingly suspend disbelief because the marionettes remained mere objects to them.

Respondent No. 2 (age group 18 – 39) mentioned that the ‘movements imitated real-life, but that the physical design of the object remained’ and that ‘it felt like it was a lifeless object that became alive through magic’. Respondent No. 3 (age group 40 – 59) said she ‘focused too much on the marionette as an object’. Respondent No. 3 (age group 60+) was also not influenced by the marionettes and made the point that ‘they're puppets’. Respondent No. 4 (age group 60+) answered that she was not affected by the marionettes because they ‘still remained an object for [her]’. Respondent No. 7 (age group 60+) felt he would like to see ‘the humanity of the puppet’. Respondent No. 8 (age group 60+) was not influenced by the marionettes and attributed this to her age, stating that she is ‘not sentimental like [she] was when [she] was younger’. Respondent No. 10 (age group 60+) did not experience a willing suspension of disbelief because ‘[he] actually was watching a lifeless object being manipulated by a person’.

The observations made by these respondents make it clear that the majority would have experienced suspended disbelief if they were able to see beyond the marionette as being a mere object. However, the researcher does not believe that the inability to see beyond the marionette as an object should be a concern, but is of the opinion that it is a notion in puppetry that ought to be further explored.

It seems unnecessary to try and hide the fact that a puppet is just a lifeless object. This relates to Tillis’s discussion on the double vision theory in puppetry (Tillis, 1992:

129). The double vision theory argues that the audience can perceive the puppet as an 'inanimate doll' or as a 'living being'. The performance should immerse the respondents to such an extent that they know it is a lifeless object but they cannot help but feel an emotional connection to it.

This is where the relationship between the puppet and puppeteer comes into play. In a sense the puppeteer is believed to transfer his energy into the puppet in order to bring it to life. To sever this connection would mean the death of the puppet – not just an absence of life, but the death of the very essence of the puppet. For instance, humans are believed to have souls that are the very essence of their being. Some believe the soul governs one's emotions, personality and morality. To lose one's soul would be to lose one's humanity. The same is true of a puppet. Without the energy from the puppeteer, the puppet is not only dead but has no meaningful purpose. This interconnectedness should form part of the performance, because it is a very delicate and precious relationship.

4.3.4.2 Visibility of Puppeteers

Several respondents mentioned the puppeteers in their questionnaires (refer to questions 8 and 9).

Respondent No. 1 (age group 40 – 59) expressed a desire to see 'puppets moving without the puppeteers'. Respondent No. 3 (age group 18 – 39) shared a similar view. She mentioned that she believes if one is able to forget that the puppeteer is present, then the performance has succeeded.

On the other hand, Respondent No. 4 in the age group 40 – 59 felt a connection with the owl and frog because of the 'way the puppeteer manipulated' the marionettes. Respondent No. 7 was similarly able to perceive the puppets as more than mere objects and his reason was that the marionettes' movements were so real and this 'took over the being of the puppeteer'.

It seems that the visibility or non-visibility of the puppeteer during a performance is a personal preference for each observer. Some respondents like to see the puppeteers alongside the puppets and some prefer to not see the puppeteers at all. Modern forms of puppetry experiment a great deal with the relationship between the puppet and puppeteer by playing around with the visibility of the puppeteer.

The researcher is of the opinion that the relationship between the puppet and the puppeteer is very powerful and therefore it is important for the puppeteer to be visible. There is a tension between the puppet and puppeteer since the one is entirely dependent on the support of the other. Humans understand and interpret emotion and meaning by looking for signs in each other's faces. A puppet however does not have moveable facial features, unless it is a complicated puppet with facial mechanics. Therefore, to understand a puppet's emotions and intentions one would not only look at the puppet's movements and gestures for guidance, but also to the puppeteer.

A very successful puppeteer becomes immersed in the puppet, interpreting and expressing all the emotions and experiences of the puppet. It can be argued that the ability of the puppeteer to become immersed in the puppet creates ambience, because if the puppeteer is investing all his energy into the realism of the puppet, then the respondents will become immersed in the puppet as well.

The relationship between the puppeteer and the puppet is of a curious and delicate nature, therefore it seems reasonable to experiment with this relationship between a human and an inanimate object.

4.4 Conclusion

It would seem that the movement of the marionettes was convincing enough to cause a number of respondents to connect emotionally with the marionettes and to cause the respondents to willingly suspend disbelief.

The movement caused some respondents to anthropomorphise the marionettes, even though the researcher wished to avoid persona in the marionettes. The movement also caused the creation of ambience: another feature that the researcher deliberately tried to avoid for this performance. It would seem that the movement was so convincing that it imbued the marionettes with personality and created a sense of ambience. This relates to the aim of the study to adapt animal marionette movement through a study of animal anatomy and motion in order to achieve convincing and more realistic marionette movement. It also relates to the objectives of the study to design and construct five animal marionettes based on the research done on animal anatomy and motion; and to stage a puppet show involving the five animal marionettes for an adult audience of thirty respondents to test the effectiveness of the animal marionettes in terms of realistic movement.

Despite the fact that all theatrical elements (lighting, sound, persona and ambience) were stripped from the puppetry performance, some respondents still mentioned the presence of persona and ambience. Since everything else had been removed, it is reasonable to assume then that the realistic movement was the reason for the perception of persona and ambience. If respondents who only saw joints and nothing else were convinced they were seeing something ‘real’, then the movement of those joints (locomotion) is what convinced them. This also takes us back to the whole notion of the primacy of skeletal structure in animal puppetry design.

The next chapter concludes the study and will discuss the conclusions and recommendations drawn from the study in greater depth.

CHAPTER 5: Conclusion

5.1 Introduction

This is the final chapter and conclusion of the study. It summarises all the research processes, the practical aspects and the overall findings of the project.

5.2 Literature Review and Animal Marionette Construction

The first objective of the study was to design and construct five animal marionettes based on research done on animal anatomy and motion (refer to section 1.3). The design and construction of the marionettes formed the foundation for the rest of the study.

The data gathered during this process demonstrated how complex the animal kingdom is. The researcher had to constantly simplify complex physiological terms in order to adapt the terms for a study in the construction of theatre props. It was however worthwhile to investigate and attempt to understand these terms as they contributed greatly to the researcher's ability to extrapolate meaning from the data.

The data that the researcher considered most relevant related to either the anatomy or the movement of the animals chosen for the study. The knowledge the researcher had gained as a result of the anatomical study of animals aided with the creation of the construction designs for the animal marionettes. Studying movement was invaluable to the design and construction of the animals' joints to achieve the movement envisaged. For this reason the researcher was only interested in information that relates to the structure and function of the skeleton.

Nyakutara's photos on sloth locomotion (refer to section 2.2.1) clearly demonstrate that merely observing the animal may not be not as effective as understanding its skeleton. Although Nyakutara's images depict the sloth in motion, the muscles and fur obscure the angle of the limbs during locomotion. Comparing skeletal images of the sloth in motion clearly indicates how sharply and at what angles the joints bend during locomotion.

The researcher studied the lectures of P.D. Polly (professor of geological sciences at the Indiana University) (refer to section 2.2.1), who identifies eight types of locomotion. Due to time constraints the researcher was only able to make five marionettes and therefore could only recreate five types of locomotion (see Fig. 5.2.1). After considering the different types of locomotion, the researcher chose to make a scansorial (tree-climbing) two-toed sloth, an aerial (flying) common barn owl, a cursorial (land-striding) slender-snouted crocodile, a saltatorial (hopping) African bullfrog and a natatorial (swimming) great hammerhead shark.

Fig. 5.2.1: Scansorial, Aerial, Cursorial, Saltatorial and Natatorial Locomotion

In addition, the researcher noted the behavioural characteristics of the five animals. This information was not discussed in detail in the study, but the researcher discussed it with the puppeteers. This information was used by the puppeteers to manipulate the marionettes in a more adept manner. Understanding the behavioural traits of the animals was then translated into the atmospheric movements of the marionettes (refer to 4.2.3). Many of the respondents referenced atmospheric movement in their questionnaires, some respondents doing so without realising it.

5.3 Practical Marionette Performance and Data Presentation, Discussion and Analysis

The respondents' observations on the marionette performance led to several interesting notions in relation to realistic movement, emotional connection and the willing suspension of disbelief.

With regard to realistic movement, many respondents described the movement as 'very realistic and detailed', 'more complex and lifelike' and observed that the marionettes exhibited a 'variety of movements' and 'incredibly fine movement and poise' (refer to section 4.2.2). The respondents scored the movement based on the degree of realism. The summative total for realistic movement was 252.5 out of 300, which amounts to a score of 84%.

Some respondents also mentioned atmospheric movements, a term used by the researcher to describe small, subtle movements that contribute to the realistic aesthetic of a puppet. Atmospheric movement refers to motions that make a puppet seem lifelike and natural. In the opinion of the researcher atmospheric movement is very important as it can aid in convincing respondents to suspend disbelief and connect emotionally with a puppet. This concept ties in with the whole notion of effective movement as per the researcher's main aim.

As far as an emotional connection with the puppets is concerned, 93% of the respondents connected with one or more of the marionettes (refer to section 4.2.3). The shark marionette was by far the most successful marionette per the main aim of the study as the majority of respondents who felt a connection with the shark mentioned that it was on account of its movement. The sloth was the least mentioned of all the marionettes (refer to section 4.2.3). Its slow and deliberate mode of locomotion could likely be a reason for this. Respondents reacted more positively to the livelier movements of the other four marionettes. However, this is not a concern as the sole purpose of the study was to replicate realistic movement. The majority of respondents attributed their emotional connection to the 'realistic' and 'life-like' movements of the marionettes (refer to table 4.2.3.1).

With regard to the willing suspension of disbelief, 70% of respondents were able to willingly suspend disbelief (refer to section 4.2.4). The majority of respondents indicated that the movement of the marionettes was the basis for their willing suspension of disbelief (refer to section 4.2.4). Some respondents mentioned that it was the 'realistic movement' or 'lifelike' quality of the marionettes. The respondents who did not experience willing suspension of disbelief expressed the opinion that the marionettes remained mere objects for them.

Four noteworthy concepts emerged from the respondents' answers, namely: reference to the marionettes' persona, the ambience created by the marionettes, the presence of the puppeteers and finally concerns about the marionettes as lifeless objects.

Several respondents remarked on the persona or 'character' of the marionettes. The marionettes were designed without a persona, yet some of the respondents still perceived 'character'. Furthermore, the respondents made comments about the 'ambience' created by the marionette; although the researcher avoided using theatrical lighting and audio to ensure that there would not be any ambience. The reason for avoiding persona and ambience was to avoid distracting the respondents from evaluating the movement of the marionettes. It would appear then that the realistic movement of the marionettes was the cause for both the establishment of persona and the creation of ambience (refer to section 5.6).

Respondents also mentioned the presence of the puppeteers and the fact that the marionettes remained objects for them. Some respondents expressed concern about being able to see the puppeteers, while others were interested in observing the relationship between the puppet and the puppeteer. Some respondents mentioned that they were unable to willingly suspend disbelief because they were too focused on the marionettes as objects. The researcher however believes that neither the presence of the puppeteers nor the fact that the marionette is an object should be ignored. This should rather be further explored and experimented with in order to play with the respondents' ability to connect emotionally with lifeless objects and to willingly suspend disbelief.

5.5 Recommendations

Puppetry has advanced over the years to become a more conceptual form of theatre. This means that puppets are often used as a symbol for social commentary and to represent abstract ideas. Like conceptual art, the idea behind the performance is more important than the aesthetic quality of the performance.

Puppetry has become conceptual to the point where some people often fail to recognise it as puppetry. Many people are also still under the impression that puppetry is limited to dolls animated by puppeteers. The researcher believes that Tillis' definition of puppetry is an accurate and all-encompassing description:

> ‘The puppet is a theatrical figure, perceived by an audience to be an object, that is given design, movement and frequently speech, so that it fulfils the audience’s desire to imagine it as having life; by creating a double-vision of perception and imagination, the puppet pleasurably challenges the audience’s understanding of the relationship between objects and life’ (Tillis, 1992, p. 65).

Therefore, if one were to take Tillis’ definition as the norm for what a puppet is, then puppets are more prevalent in everyday life than people are actually aware.

Puppets are commonly found in the world of entertainment, performing specific characters in a play, but they can also perform in other forms. The *Cirque du Soleil’s O* theatre in America is staged in and around a large water tank, but the performers sometimes twirl large, colourful cloths underwater to create the semblance of ethereal underwater creatures. Puppets are prevalent in the digital world as many scholars consider stop motion animation, animated film characters and motion tracking animation to be forms of puppetry. Animatronics also falls under the umbrella of puppetry. The mechanical dinosaurs used in the *Jurassic Park* and *Jurassic World* movies (1993, 1997, 2001) are good examples.

Apart from the entertainment world, puppets can also be used as tools in education and in methods to communicate with patients, especially children. Puppets are present in everyday life, for example when a parent tries to feed a child by pretending the food-laden spoon is a train. Many South Africans anthropomorphise their automated swimming pool cleaners (also known as *kreepy kraulies*), assigning a gender to them and referring to their ‘mouths’ and ‘throats’ that get clogged with debris. Then there are those plastic figures dancing in front of car dealerships, inflated with hot hair and waving their arms about. Puppets exist in many forms and people are more in contact with them than they realise.

Following on this study, it is the researcher's recommendation that puppetry should be explored further and experimented with within the general framework of performing arts studies and their attendant technologies.

A puppet is a powerful medium with which to convey a message, and the researcher believes that more people should be exposed to puppetry and its manifold applications. There is great room for experimentation with puppetry, especially with regard to emotional connection, the willing suspension of disbelief, the presence of the puppeteers and the perception of marionettes as lifeless objects.

5.6 Conclusion

Realistic puppetry movement is like effective communication. In basic models for effective communication the process of communication is described as 'the steps between a source and a receiver that result in the transference of meaning' (Coetzee, Steinmann and Christodoulou, 2006: 38). The process begins with the 'source' sending a 'message' through a 'channel' which is received and interpreted by the 'receiver'. This can be applied to puppetry (see Fig. 5.6.1).

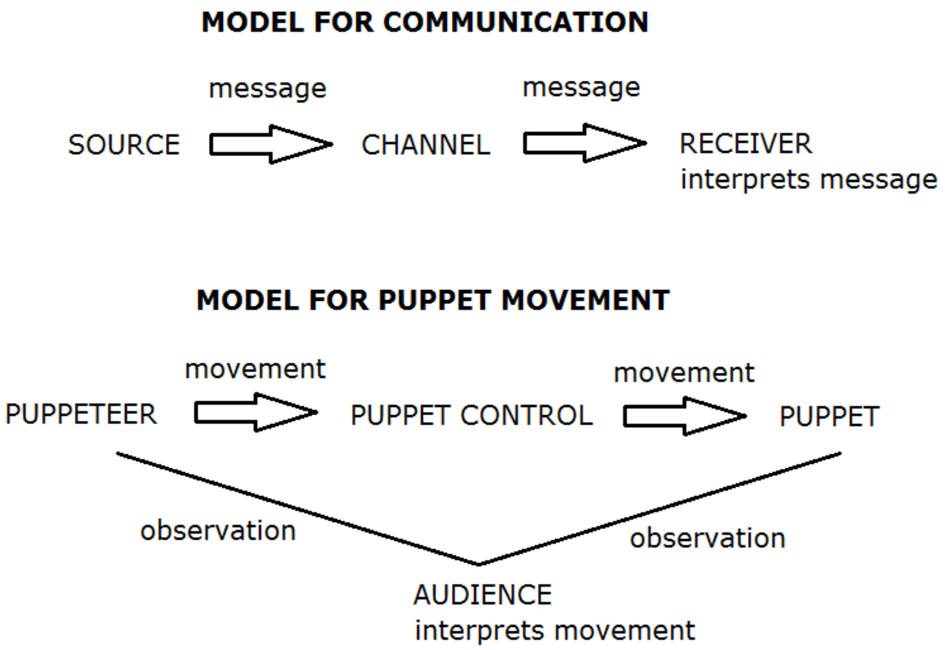

Fig 5.6.1: Basic Model for Communication (top) and Model for Puppetry Movement (bottom)

The puppeteer (source) sends movement (message) through the puppet's control mechanism (channel) to the puppet (receiver). The audience observes this process and interprets the movement. If the movement is convincing the audience will become emotionally involved and will willingly suspend disbelief for the duration of the performance.

A puppet is a lifeless object that is brought to life through the actions of the puppeteer. When watching a puppet show one is sometimes able to forget that the puppet is a lifeless object that is being manipulated. Several respondents mentioned that they were unable to willingly suspend disbelief because they concentrated too much on the marionettes as mere objects. However, these were in the minority, as twenty one respondents out of thirty were able to willingly suspend disbelief.

The above notwithstanding, this researcher believes that it is unnecessary to try and hide the fact that a puppet is just a lifeless object. The performance should immerse the respondents to such an extent that, although they know that the puppet is a lifeless object, they cannot help but feel an emotional connection to it. In the researcher's opinion this is where realistic movement plays a vital role.

In a sense a puppeteer is believed to transfer his energy into a puppet in order to bring it to life. Humans understand and interpret emotion and meaning by looking for signs in each other's faces. A puppet however does not have moveable facial features, unless it is a complicated puppet with facial mechanics. Therefore, to understand a puppet's emotions and intention one has to look to its movements and gestures, as well as the puppeteer, for guidance. It can be argued that the ability of a puppeteer to become immersed in the puppet affects the audience. If a puppeteer is investing all his energy into the realism of a puppet, then the audience will become immersed in the puppet.

One of the respondents mentioned that he was emotionally affected by the 'convincing movement that created character'. Another respondent mentioned that the marionettes were 'unbelievably mobile, looks like the real thing even though the puppet consists of only a suggestion of a skeleton'. Two other respondents continued this thought saying: 'swift effortless movement which belies their lifelessness, movement alone seems to bring them to life without other attributes' and 'ability of movement alone to represent essence of an animal' (refer to 4.3.3).

The researcher deduces that the movement was so real that the majority of respondents were caught up in the lifelike quality of the marionettes, perceiving the marionettes as real creatures and being persuaded to imagine them as being more than inanimate wooden objects.

It would seem that the effect of natural movement was more powerful than the researcher had anticipated. This thought stems from the fact that, although the marionettes were stripped of significant theatrical attributes such as specific character roles, ambience, use of sound and lighting, fur and costume, the majority of the respondents still experienced persona, ambience, emotional connection and the willing suspension of disbelief.

The researcher believes that this study demonstrates the value of a symbiosis between different fields of study that do not often come into contact. In this case the physiological study of animal anatomy and locomotion, which relates to zoology, combined with puppetry, which relates to performing arts, resulted in the creation of aesthetically pleasing and realistically moving marionettes. This proves that combined knowledge can have a great impact on the creation of a product and its quality. One respondent specifically mentioned that she thought the researcher's work 'could even be used for teaching in university for skeletal structure and locomotion'. This remark is perceived as a positive indication that the translation of natural movement into animated movement was successful because of the thorough and comprehensive research that preceded it.

In conclusion, the principal purpose of this study was two-fold. In the first place, the study aimed to adapt animal marionette movement through a study of animal anatomy and motion in order to achieve convincing and more realistic marionette movement. Secondly, the study aimed to design and construct five animal marionettes based on the research. This culminated in the staging of a puppet performance for an adult audience of thirty respondents to test the effectiveness of the animal marionettes in terms of realistic movement. In this regard the researcher believes the study has been successful. Respondents remarked that the movement was ‘very realistic and detailed’ and ‘more complex and lifelike’. They also mentioned the ‘variety of movements’ and ‘incredible fine movement and poise’. The majority felt an emotional connection with the marionettes and were able to willingly suspend disbelief (refer to section 4.3.3).

The study proved that realistic marionette movement extends beyond visual impact and that it can affect people emotionally and psychologically, even in the absence of other natural animal attributes. It is therefore a powerful medium to use in marionette performances with great potential to convince audiences.

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ADDENDUM A: Questionnaire

ANIMAL MARIONETTE PERFORMANCE QUESTIONNAIRE

'Marionette' refers to a specific type of puppet, while 'puppet' refers to any type of inanimate object manipulated by an external force to make an audience perceive it as possessing life of its own.

Please take a moment to complete this questionnaire in full.

1. Age:

18-39 ☐ 40-59 ☐ 60+ ☐

2. Gender:

Male ☐ Female ☐

3. How would you rate the performance?

Very poor ☐ Poor ☐ Average ☐ Good ☐ Very good ☐

4. Have you ever watched any puppetry performances in the past?

Yes ☐ No ☐

If your answer is NO proceed to <u>Question 7</u> and complete the rest of the questionnaire. If your answer is YES answer all the questions.

5. How did the marionettes (in this performance) compare, in terms of movement, with other puppets you may have seen before?

____

____

____

6. Did this difference add or detract value from your appreciation for this performance?

____

____

7. Did you feel a connection with any particular marionette(s), if so which one(s)?

____

____

____

____

8. If your answer to Question 7 was YES, what created the emotional connection with the aforementioned marionette(s)? If your answer was NO, why do you think there was no emotional connection?

____

____

____

9. At any point did you forget that you were watching a lifeless object being manipulated by a person?

Yes ☐ No ☐ Neutral ☐

What is the reason for your answer?

____

____

____

10. Compared to your own knowledge of animal movement, how realistically did the animal marionettes move on a scale of 1 to 10? (1 being **Completely Unrealistic** and 10 being **Extremely Realistic**)

____

11. What would you generally like to see in future marionette performances in order for it to make an impression on you?

____

____

____

12. Has this show changed your outlook or appreciation of marionette performances in any way? If so, how? If not, why not?

____

____

____

____

13. What is your overall impression of this performance?

____

____

____

14. Additional comments?

____

____

____

Thank you kindly for your time.

Primary investigator: Ms M Van Zyl

Study leader: Dr O Seda, Department of Entertainment Technology, Tshwane University of Technology

Co-study leader: Mr P.A. Bezuidenhout, Department of Entertainment Technology, Tshwane University of Technology

Ethics chairperson: Prof. A. Mastamet Mason, Department of Fashion Design Technology, Tshwane University of Technology

The primary investigator, Ms M van Zyl, can be contacted during office hours on her cellular phone at 072 102 4863. The study leader, Dr O Seda, can be contacted during office hours at tel (012) 382 6008. The ethics chairperson, Prof. A. Mastamet Mason, can be contacted during office hours at tel (012) 382 6079.

Should you have any questions regarding the ethical aspects of the study, you can contact the chairperson of the TUT Research Ethics Committee, Dr WA Hoffmann, during office hours at tel (012) 382-6265/46 or email hoffmannwa@tut.ac.za. Alternatively, you can report any serious unethical behaviour on the University's Toll Free Hotline at 0800 21 23 41.

ADDENDUM B: Information Leaflet and Informed Consent

ADAPTING MARIONETTE MOVEMENT THROUGH THE PHYSIOLOGICAL STUDY OF ANIMAL MOTION

Primary investigator: Ms M van Zyl, B Tech (Performing Arts Technology)

Study leader: Dr O Seda, D Phil, Department of Entertainment Technology, Tshwane University of Technology, Pretoria

Co-study leader: Mr P.A. Bezuidenhout, M Tech, Department of Entertainment Technology, Tshwane University of Technology, Pretoria

Ethics chairperson: Prof A. Mastamet Mason, Department of Fashion Design Technology, Tshwane University of Technology, Pretoria

Dear potential research participant/puppeteer,

You are invited to participate in a research study that forms part of my formal M Tech-studies. This information leaflet will help you to decide if you would like to participate. Before you agree to take part, you should fully understand what is involved. You should not agree to take part unless you are completely satisfied with all aspects of the study.

WHAT IS THE STUDY ALL ABOUT?

The purpose of this study is to analyse how physiological motion can be harnessed to create more realistic motion and/or movement in puppetry. In other words, this study aims to create a more effective link between the physiology of animal skeletal movement and puppetry. The researcher is of the opinion that, for purposes of puppet-making, merely observing the movement of an animal is not as effective as fully understanding the animal's anatomy and mode of locomotion.

The researcher aims to construct five marionettes based on physiological research of animal skeletal motion. The effectiveness of the study of animal motion in puppet construction will be confirmed by means of a short marionette performance for a medium-sized adult audience. At the end of the performance members of the audience will be requested to complete open-ended questionnaires in order to describe their experience.

WHAT WILL YOU BE REQUIRED TO DO IN THE STUDY?

The marionette performance will be held at the Longstreet Art Lovers art gallery in Waterkloof, Pretoria over the course of two evenings. Participants are expected to arrange their own transport to and from the location.

If you decide to take part in the study, you will be required to do the following:

- To sign an informed consent form.
- To manipulate three marionettes during the performance of approximately 30 minutes.
- To be available on requested dates to practice with the marionettes.

ARE THERE ANY CONDITIONS THAT MAY EXCLUDE YOU FROM THE STUDY?

You will not be eligible to participate in this study if you are not available to practice with the marionettes and to perform on the performance nights.

CAN ANY OF THE STUDY PROCEDURES RESULT IN PERSONAL RISK, DISCOMFORT OR INCONVENIENCE?

The study and procedures involve no foreseeable physical discomfort or inconvenience to you.

WHAT ARE THE POTENTIAL BENEFITS THAT MAY ACCRUE FROM THE STUDY?

The benefits of participating in this study include *inter-alia*:

- You will make a significant contribution in assisting the researcher with her MTech studies.
- You will make a significant contribution towards animal marionette research in South Africa.
- You will make a significant contribution towards research outputs at the Tshwane University of Technology.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR OTHER INCENTIVES FOR PARTICIPATING IN THE STUDY?

Please note that you **will not** be paid to participate in the study. You will be expected to provide a free service. You will not receive a promotion or be demoted by your participation in the study. However, light refreshments will be served on the evenings of the performances.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THIS STUDY?

Your participation in this study is entirely voluntary and discretionary. You have the right to withdraw at any stage without any obligations, penalty or future disadvantage on your part whatsoever. You do not have to provide the reason/s for your decision to withdraw. Please note that you are not waiving any legal claims, rights or remedies because of your participation in this research study.

HOW WILL CONFIDENTIALITY AND ANONYMITY BE ENSURED AND MAINTAINED IN THE STUDY?

Only the researcher and her supervisors will have access to the study. Your participation will be totally anonymous and under no circumstances will your identity be revealed to third parties. In addition, no one inside or outside the study panel, including the research ethics committee, will be able to connect your participation to you in any recognisable way. The results of this study might be published in a scientific journal and/or presented at scientific meetings, but again without revealing the identity of any research participant.

IS THE RESEARCHER QUALIFIED TO CARRY OUT THE STUDY?

The researcher is an adequately trained and qualified researcher in the field of study covered by this research project, specifically with regard to animal marionettes.

HAS THE STUDY RECEIVED ETHICAL APPROVAL?

Yes. The Faculty Higher Degrees Committee and the Research Ethics Committee of the Tshwane University of Technology have approved the formal study proposal. All parts of the study will be conducted according to internationally accepted ethical principles.

WHO CAN YOU CONTACT FOR ADDITIONAL INFORMATION REGARDING THE STUDY?

The primary investigator, Ms M van Zyl, can be contacted during office hours on her cellular phone at 072 102-4863. The study leader, Dr O Seda, can be contacted during office hours at tel (012) 382 6008. Should you have any questions regarding the ethical aspects of the study, you can contact the chairperson of the TUT Research Ethics Committee. The ethics chairperson, Prof. A. Mastamet Mason, can be contacted during office hours at tel (012) 382 6079. Alternatively, you can report any serious unethical behaviour on the University’s Toll Free Hotline at 0800 21 23 41.

DECLARATION: CONFLICT OF INTEREST

This research study was funded by the National Research Foundation. No publication prohibitions, conditions or limitations were placed on the researcher.

A FINAL WORD

Your co-operation and participation in the study will be greatly appreciated. Please sign the informed consent form below if you agree to participate in the study. You will receive a copy of the signed informed consent form from the researcher.

CONSENT

I hereby confirm that I have been adequately informed by the researcher about the nature, conduct, benefits and risks of the study. I have also received, read and understood the above written information. I am aware that the results of the study will be anonymously processed into a research report. I understand that my participation is voluntary and that I may, at any stage, and without prejudice to myself, withdraw my consent and participation in the study. I have been availed with sufficient opportunity to ask questions and I hereby declare myself prepared to participate in the study of my own free will.

Research participant's name: ________________________________ (Please print)

Research participant's signature: ____________________________

Date: ____________

Research participant's name: ________________________________ (Please print)

Research participant's signature: ____________________________

Date: ____________

Researcher's name: ______________________________________ (Please print)

Researcher's signature: ______________________________

Date: ____________

ADDENDUM C: Table of Participants

TABLE OF MARIONETTE PERFORMANCE PARTICIPANTS

This table notes the closed-ended questions of the questionnaire. Refer to section 4.2.2 *Questions* for the open-ended questions. The first column indicates each participant's assigned number; the second column the participant's gender; the third column the participant's rating of the performance; the fourth column indicates whether the participant has seen puppetry performances in the past; the fifth column whether the participant was able to perceive the marionette as having a life of its own; and the last column indicates the rating the participant attributed the performance on a scale of 1 to 10, 1 denoting least realistic and 10 denoting very realistic.

Age Group: 18 – 39					
No.	**Gender**	**Performance Rating**	**Past puppetry performances**	**Imagined marionettes having life**	**Realistic movement rating (scale 1 – 10)**
1	F	Very good	Y	Y	10
2	F	Very good	N	Y	9
3	F	Very good	Y	Y	9
4	F	Good	Y	Y	8
5	F	Good	Y	Y	6
6	F	Good	Y	Y	9
7	F	Good	N	Y	9
8	F	Good	Y	Y	7
9	M	Very good	Y	N	10
10	M	Very good	N	Y	8
Age Group: 40 – 59					
1	M	Good	N	Y	8
2	M	Very good	Y	Y	10
3	F	Very good	Y	Neutral	7
4	F	Very good	Y	Y	9
5	F	Very good	Y	Y	9

6	M	Very good	Y	N	8.5
7	M	Very good	Y	Y	9
8	F	Very good	N	Y	9
9	M	Very good	Y	Y	8
10	F	Very good	Y	Y	8
Age Group: 60+					
1	M	Very good	Y	Y	8
2	F	Very good	N	N	8
3	M	Very good	Y	N	8
4	F	Very good	N	N	8
5	M	Very good	Y	Neutral	8
6	M	Very good	Y	Y	8
7	M	Very good	Y	Y	10
8	F	Very good	N	N	8
9	M	Very good	N	Y	8
10	M	Good	Y	N	8

Table Addendum C: Table of Participants