

CHAPTER FOUR

Establishing the Quality of Movement

Introduction

The purpose of this chapter is to provide a description of points of reference for different qualities of movement for the performance of the forward roll. These “benchmarks” are established for a range of performances. This process was undertaken to provide a basis upon which to examine other movement assessment perspectives.

There are two sections in this chapter. The first section provides details about the concept of movement quality and a description of how the levels of quality for the forward roll were established for this study. The second section seeks to apply four different assessment perspectives to the data collected in order to determine their relevance or fit.

ANALYSIS OF MOVEMENT QUALITY

This section explores three hypothesized “levels of competency” referred to as *low*, *medium* and *high* quality in the performance of the forward roll. Preference is given here to the term “quality” rather than “ability” as the latter term is commonly linked to a permanent state (Magill, 2001; Ping & Lee, 1998; Schmidt & Lee, 2005).

Determination of Movement Quality

This subsection describes the movements of three individuals, who were selected following the analysis of the total sample ($N=117$) to exemplify a range of movement quality. Following this description, illustrated examples, of each of the three levels of quality, for individuals performing the forward roll are provided. The examples commence with a low-quality performance, followed by medium-quality and finally a higher-quality performance.

The descriptions of the forward roll relate to three identified elements. For the purpose of this thesis they are, termed, *sequences* and comprise a *beginning*, a *bridging* and an *end*. The descriptions of the sequence data mainly employ anatomical terminology as exemplified by Luttgens, Deutsch, and Hamilton (1992, pp. 627-633).

The beginning sequence commences when the participant stands ready at the edge of the gymnastic mat immediately prior to the forward roll, and ceases when the participant's feet leave the surface. The bridging sequence occurs after the beginning sequence and includes that part of the roll when the participant's body is in the process of rotation. The end sequence begins at the end of the rotation and finishes when the participant's feet touch the surface, including the rise to a standing position, and/or when the roll stops.

For each participant, the analysis was undertaken using a frame-by-frame scrutiny of digitally recorded continuous visual images for each individual. The images in each of the figures represent part of a continuum of images, and viewing should be undertaken in the direction of the arrows.

Low Quality Performance

According to Croft (personal communication, 2006) a poor score (and hence a poor quality performance) is the equivalent of an Australian Gymnastics Federation (AGF) competition score that ranges from approximately 6 to 6.5 points. A score within this range would be awarded if the performer demonstrated gross deviations from the ideal.

Figure 4.1 presents a series of nine pictures, depicting a performance of low quality. The pictures have been selected to represent a sequence of movements across the performance of a forward roll.

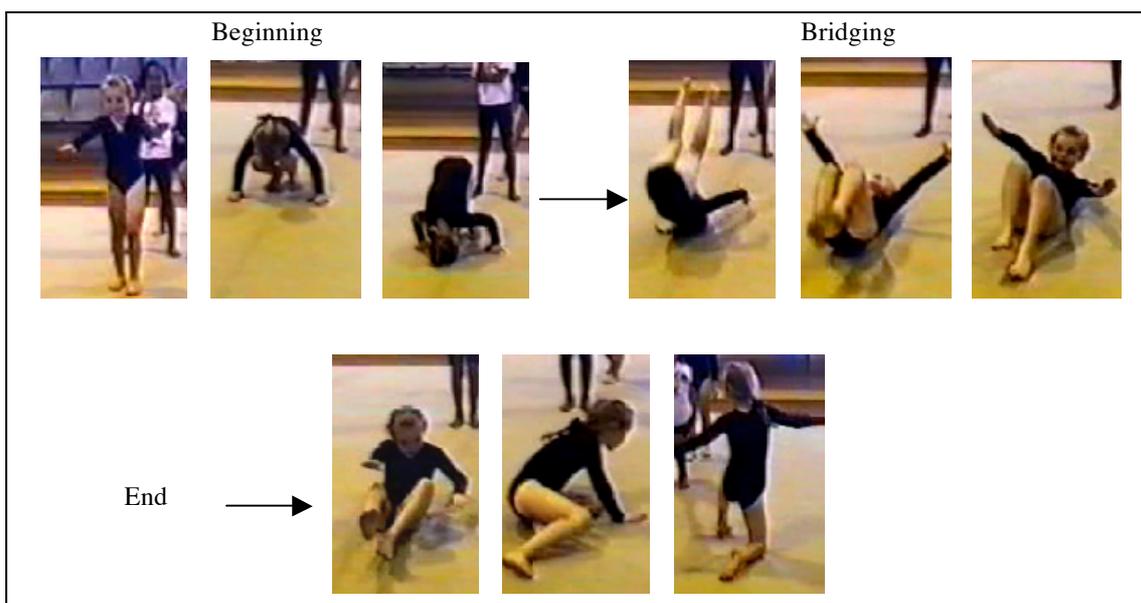


Figure 4.1: Example of a Low Quality Performance

The first three frames in Figure 4.1 show that at the beginning of the roll there is a lack of body tension, one foot is placed in front of the other and the eyes are focused down towards the surface. The performer placed her hands wide of the shoulders and the top (crown) of the head in contact with the surface. In addition, there are five body points of contact with the surface.

The three frames for the bridging or middle sequence show this performer has little control over the rotation, and the legs are extending (straightening) from an initial flexed (bent) position. She lands on the surface with a “flat back”; the arms abducted (away from) the shoulders and the knees flexed. She has lost momentum and the roll stops. The position of the legs and feet is inconsistent, with one foot in front of the other, she leans to the left, and the arms are abducted (situated wide of the shoulders).

The final three frames in the series indicate the participant is unable to rise to standing without the use of arms or hands and assistance from a change in the position of the legs. The participant lost momentum towards the end.

Medium Quality Performance

A medium quality performance is represented by a score of 7.5 to 8 points according to Croft (2006) with fewer deviations from the ideal than the previous poor performance. The score range may be slightly higher or lower than indicated, as the scoring system used in gymnastics can incorporate scores smaller than a one tenth deduction.

The nine frames depicted in Figure 4.2, illustrate the movements of a participant whose performance is judged to be of medium quality. The movements observed for this participant demonstrate some control, however, there are several performance errors.

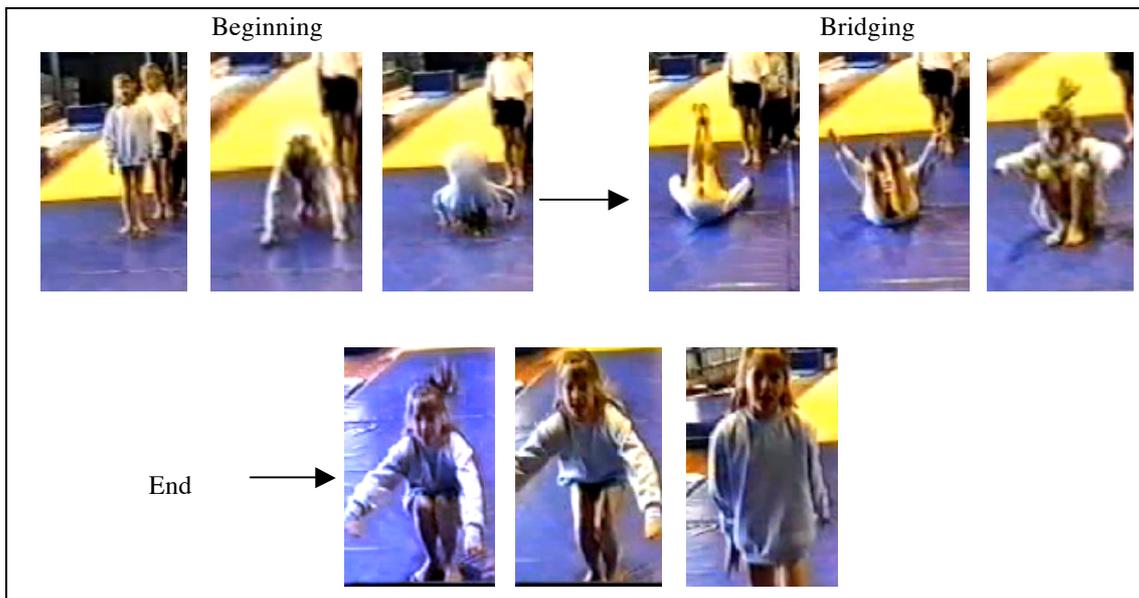


Figure 4.2: Example of Medium Quality Performance

The three beginning frames in Figure 4.2 highlight a lack of body tension, however, the feet are placed together. Next, the participant is observed placing her hands near shoulder width on the surface and the final frame in the beginning sequence shows the back of the head in contact with the surface, and there are four points of contact.

The three frames for the bridging sequence show the legs are extended and the participant has some control over the rotation she has a slightly rounded back, the arms wide of the shoulders and the knees are commencing to flex. The participant has maintained momentum and the feet are together and close to the buttocks.

The final three frames for the end sequence show the participant using the upswing of the arms. She rises to a standing position and maintains stationary indicating control and balance has been achieved.

High Quality Performance

High quality performances are characterised by the absence of obvious deviations from the hypothetical ideal. Such performances would score above 8.5 points, within a system that uses 10 points as a maximum.

Figure 4.3 shows a participant's performance that matches the description of high quality. The movements observed for this participant demonstrate superior control, style, and are virtually error free.

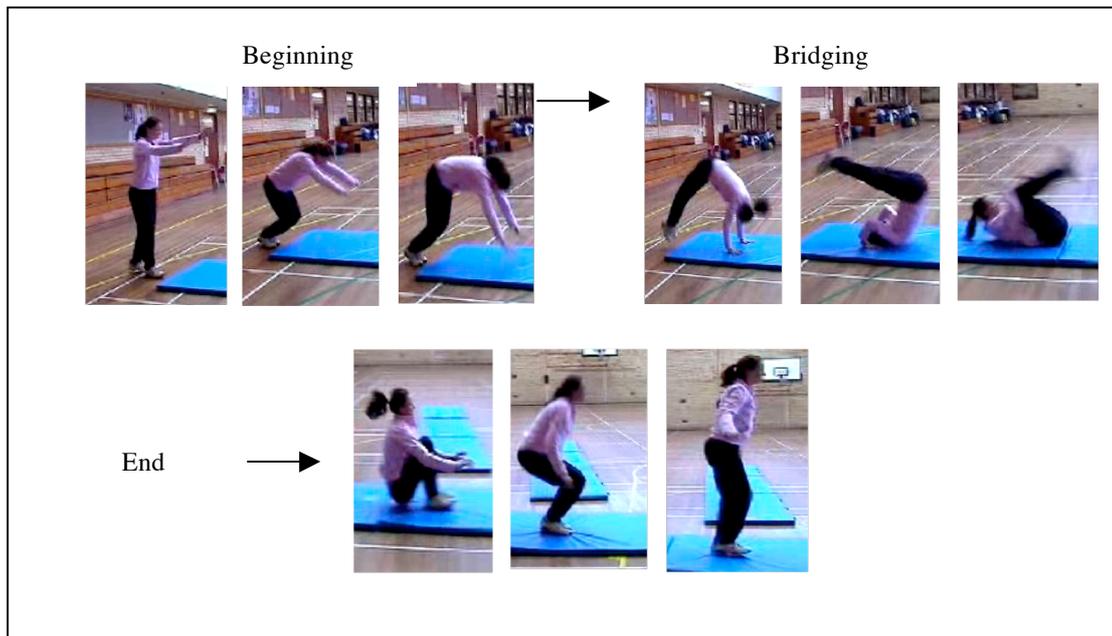


Figure 4.3: Example of High Quality Performance

Commencing with the three frames in the beginning sequence the performer displays body tension indicated by extended legs and arms, with the head in an anatomically neutral position, the feet are placed together. The performer is observed flexing the knees in preparation for launching the body, and the hands are close to shoulder width apart. There is controlled descent towards the surface.

The middle section frames, show that just as the participant's feet leave the surface the hands are making contact with the surface. The body weight is supported by the arms, which remain shoulder width apart. The participant has control over the rotation, the shoulder line is the point of contact (not the head) and the legs are extended. The participant has maintained momentum with demonstrated control, the back is "dished" (slightly rounded), arms remaining shoulder width apart and the knees are commencing to flex.

The final three frames in the series show the participant rising to stand, with the centre of gravity placed directly over the base of support, the feet are together and close to

the buttocks. She is seen maintaining “good form” and attains a balanced standing position.

Conclusion

The discriminating factors for each performance were based upon the variations between observed movements and the descriptions of the ideal performance (George, 1980) of the roll. All initial classifications, whether low, medium or high quality, were judged by the researcher and two expert gymnastics judges from Location B, namely, Maunder (personal communication, 2006) and Croft (personal communication, 2006).

Poor quality performances were characterised by inefficient, sometimes “stop-start” movements. Variations were evident between one performance of the roll and subsequent performances and movements lack smooth transitions from one sequence to the next.

Medium quality performances, which may be termed “average” are characterised by fewer errors and a “neater” more complete execution of the roll. Performances are reasonably consistent from one attempt to the next.

The performances judged to be high quality demonstrate precise movements, which show consistency from one performance of the roll to the next, regardless of the time interval between performances. Movements are biomechanically efficient and aesthetically pleasing.

CASE STUDIES: A COMPARISON

The purpose of this section is threefold. The first is to provide one example from each cohort, which represents one different quality of performance. That is, one case study from the children’s cohort, one from the young adults and one from and the older adults. Two additional examples of case study analyses, representing different qualities from each cohort can be found in Appendix I for children, Appendix J for young adults and Appendix K for older adults. The next purpose of this section is to demonstrate how the processes of analysis were completed. The final intent is to detail how different perspectives, employed in the analysis of the forward roll, compare with the performances of the sample of individuals within this study.

Within this section there are three subsections. The first subsection includes one exemplar case study from the children's cohort; the second subsection involves a performer from the young adult cohort and the third section the older adult cohort. Pseudonyms are used for all participants.

Comparative Case Study Analysis: Children

Each of the case studies commences with a time-based *Movement Transcript* of the performance, followed by a *Pictorial Perspective* comprising nine pictures, three from each sequence of the forward roll. Next a *Movement Description* of an individual's performance, shown in tabulated format is provided. The tabulated descriptions of each movement are presented as a summary and include observational notes. Both the descriptions and images are presented in chronological order, although some actions occur simultaneously, and commence with the beginning sequence, followed by the bridging and end sequences.

Following the movement description of the forward roll, a *Perspective Analysis* is provided, encompassing the Gymnastic Perspective of George (1980) that is based on the accuracy and level of gymnastic skill displayed by the performer. This instrument is used as the "base line" measure for this study, because it is considered by gymnastic coaches to possess the most comprehensive details regarding a "perfect" performance for each skill in gymnastics (personal communication, Maunder, 2000). The next perspective is the Developmental Phases of Robertson and Halverson (1984), then the Developmental Stages of Gallahue and Ozmun (2006) and finally the Levels of Proficiency Graham, Holt/Hale and Parker (1998).

This subsection provides descriptions of one case study, given the pseudonym 3A (Claire) from the children's cohort. Her performance is deemed as being high quality. Data were gathered at Location B. The details of two additional case studies from this cohort, 1A (Aimee) whose performance was low quality and case study 2A (Betty) who represents an example of a medium quality performance, can be found in Appendix I.

Case Study: Claire (3A)

At the time that Claire's data were recorded she was a 12-year-old female who had attended gymnastics practice sessions for several years. She was judged by club officials to be an elite gymnast. Claire performs within the competitive levels system at AGF State and National competition level within Australia.

Movement Transcript

The following description is based upon temporal sequencing. The performance was analysed using the CD facility of an “Apple MacIntosh” computer. This system permitted the use of the “stop frame” feature, such that 25 individual frames represented one second of elapsed time. This subject was viewed from a lateral aspect (the right side).

In Table 4.1 the column headed “Observation number” represent points in time when a change in a movements’ configuration is noted. “Elapsed time” shows the time, in seconds, that each observation encompasses. For example, Observation number 2 and 3 both took place within a time frame of one second (0:01), similarly Observation numbers 4 to 6 took place over a time period of the following second (0:02) and Observation numbers 7 to 10 took place in the third second (0:03) of the total performance. The “Description” depicts the movements, couched largely in anatomical terms, observed to occur during the performance.

TABLE 4.1: TIME BASED MOVEMENTS: LATERAL ASPECT

Observation number	Elapsed time (seconds)	Description
1:	0:00	Prior to Start: Standing stationary. Arms by sides. Head/eyes horizontal.
2:	0:01	Head/eyes horizontal. Shoulders even. Simultaneous forward shoulder flexion of arms (shoulder width apart). Left arm raised minimally higher than right. When arms reach 90 degrees flexion, knees begin to flex.
3:	0:01	Head/eyes looking straight ahead. Back remains vertical. Arms remain at 90 degrees flexion until full knee flexion achieved.
4:	0:02	Neck flexes slightly at the same time as arms/hands move towards surface at point when maximum knee flexion reached. Hips and knees extend as body leans forward towards surface.
5:	0:02	Eyes focused on surface between hands. Hands touch surface simultaneously. Arms straight. At moment fingers touch surface, hips/back raised above horizontal, legs straighten together, ankles plantar flex simultaneously, and provide some propulsion. Body weight is transferred from feet to hands.
6:	0:02	Arms remain straight and head/ back moves past line of hands in control.
7:	0:03	Neck flexes just before shoulders contact surface. Hips 90 degrees flexion (piked position). Arms straight and flat on surface. Legs remain together and straight.
8:	0:03	Arms and legs remain straight as subject rolls along slightly curved back from shoulders to hips. As head leaves surface the hands also leave surface when body approximately 45 degrees. At this point legs are vertical. Body continues to rotate.
9:	0:03	Arms are almost vertical, remaining straight and continue forward, in a forward extension arc. When lumbar spine touches

10:	0:03	surface, knees flex. Body continues to rotate. Arms are now horizontal and straight in front, (90 degrees forward flexion) shoulder width apart. Subject balanced momentarily on buttocks. Feet contact surface simultaneously and are together.
11:	0:04.	Body weight is on feet and buttocks leave surface. Hips and knees extend. When knees are 90 degrees arms are also forward flexed 90 degrees.
12:	0:04.	Head/eyes horizontal. The straight arms continue to forward flex at shoulder. Wrists slightly pronated. Body is straight (Vertical). Knees continue to extend and subject stands.

Individual pictures of Claire’s performance, taken from a video clipping, are shown in Figure 4.4 and the attenuated description of her performance of forward roll, which apply to each picture, is provided in Table 4.2.

Pictorial Perspective

The following series of nine pictures in Figure 4.4 show an individual from the children’s cohort performing the forward roll. The first three images are taken from the beginning sequence, the next three from the bridging sequence and the final three from the end sequence.

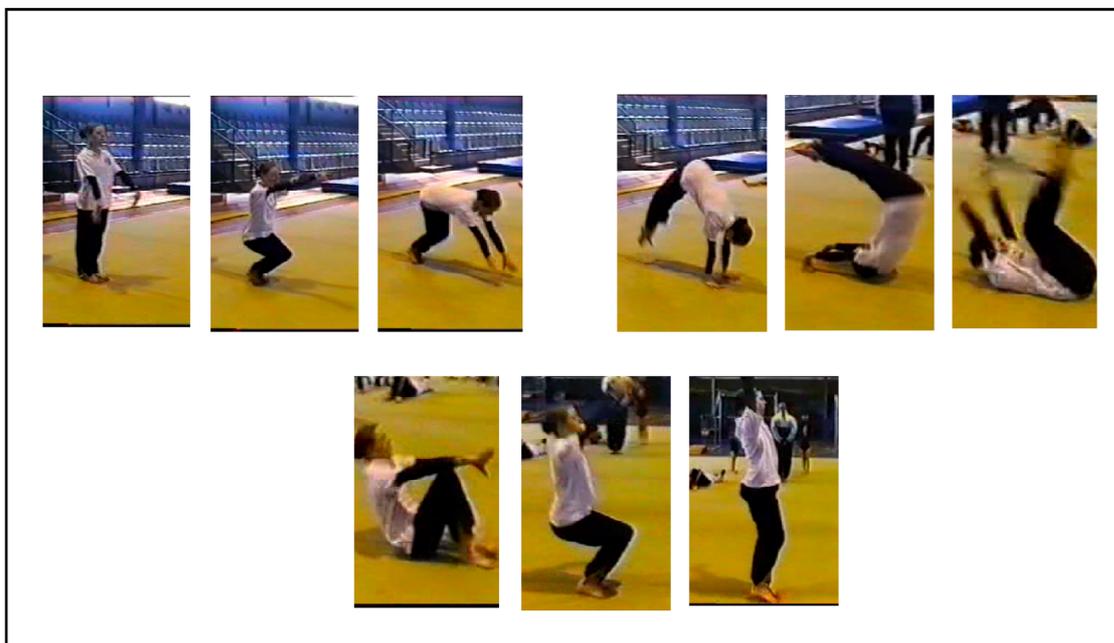


Figure 4.4: High Quality Performance

The pictures in Figure 4.4 that provide “snap shots” from the performance of the roll represent specific instances that are critical for analysis. They were chosen to demonstrate three “landmark” points within each sequence.

Movement Description

The following description shown in Table 4.2 is based upon sequence of pictures found in Figure 4.4.

TABLE 4.2: GENERAL DESCRIPTION FOR CLAIRE

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none">• commenced to raise her arms to shoulder height• had a rigid body and the torso was vertical• flexed her knees which then extended• forward flexed her neck• demonstrated a “flight” phase• made surface contact with her upper back but did not flex the elbows	<ul style="list-style-type: none">• moved her hips (on rotation) in front of (over) the shoulders her body formed an open “L” shape• flexed her hips and knees simultaneously, late in the rotation	<ul style="list-style-type: none">• positioned her feet under her body• rose to standing with her arms extended overhead• had a fully extended body shape

In Table 4.2 each dot point represents a temporal arrangement for the sequence of movements, as well as general observational points that may have happened at the same time as a planned movement. For example, the final dot point for the beginning sequence indicates the performance “did not flex elbows” is an anecdotal observation that indicates a measure of quality to the description.

Perspective Analysis

An analysis of the performance for this individual’s case study from the children’s cohort is presented from four perspectives. These perspectives are the (i) Gymnastics (George, 1980) (ii) Developmental Phases (Robertson & Halverson, 1984) (iii) Developmental Stages (Gallahue & Ozmun, 2006) and (iv) Levels of Proficiency (Graham et al., 1998),

Gymnastics perspective (George, 1980)

This participant showed minimal variation from the description of the ideal skill (gymnastic) form. Where discrepancies were evident the degree of variation was slight, and could best be explained in terms of this participant’s individual “creative flair”. The lack of deviations, from what was regarded as being the ideal form led to the conclusion that Claire’s skill level when performing the forward roll was *high* quality.

Developmental Phases perspective (Robertson & Halverson, 1984)

During the initial phase Claire exhibited all the characteristics of a *Step 2* performance for both head and arms as well as for leg components of the roll. In a similar way, for

the completion phase, the arm action component showed continual arm assistance. This was evidenced when the arms left the surface immediately the shoulders engaged the weight of the individual's body.

In addition, the head and shoulders left the surface just after shoulder contact and the head and trunk continued moving forward and upward. The analysis indicated that these performances fit into the *Step 3* descriptions. The leg action component was also a *Step 3* categorisation, as the knees commenced to flex just after the hips began their forward-downward movement. The hips maintained a degree of flexion throughout the roll, but did not commence moving into a more flexed position until after the buttocks contacted the surface. The participant displayed the most advanced form for all components for both phases.

Developmental Stages perspective (Gallahue & Ozmun, 2006)

The recorded observations using this model do not reflect the level of skill at which this participant performed, for the following reasons. This participant's head did not contact the surface, the neck flexed just before the shoulders contacted the surface, however, this model's description indicates that at the *mature* stage the head should touch "very lightly". The participant's arms were coordinated for the entire movement and used to assist with the maintenance of the roll, through force production, which was an indication that the *mature* stage had been achieved. The body did not achieve a tight *C* position during the roll except in the final phase when the knees flexed to approximately 90°. The participant's body remained in an open arc for most of the roll. It is interesting to note, however, that the body shaping (*C* shape) for this perspective differs from the ideal proposed for the skill based model.

The comparison of observed data indicated this participant could be classified at the *mature* stage, within this perspective. The criteria employed in this model are not applicable to elite/high quality of performances.

Levels of Proficiency perspective (Graham et al., 1998)

This participant displayed some of the features described for the *control* level, such as having the chin tucked, the hips high and the shoulders carrying all of the body weight. However, this participant was observed informally, showing the characteristics of the *proficiency* level and capable of performing aerial rolls and utilising a variety of apparatus. Data presented in Table 4.3 provides a comparison between the four types of analysis.

TABLE 4.3: SUMMARY OF ALL PERSPECTIVES FOR CLAIRE

Case N^o “Claire”	Gymnastic Skill	Developmental Phases	Developmental Stages	Levels of Proficiency
3A	High	I (i) Step 2 (ii) Step 2 C (i) Step 3 (ii) Step 3	Mature	Control (No data re; Proficiency level)

Note that Claire could not be classified at a higher level in the Proficiency perspective, because data, which could be used to determine whether she had reached that level, were not collected.

Conclusion

This conclusion refers to all three case study analyses for this cohort. Details of two additional case studies from the children’s cohort, one classified as poor and one medium quality, also analysed from the four different perspectives, are provided in Appendix I. The performances of these participants were analysed in the same way as the example provided for the high quality, that is, using a number of anatomically based descriptions of joint and limb movements. Secondly, in depth comparisons were undertaken using three additional perspectives.

From a Gymnastic perspective the three participants within the children’s cohort demonstrated a wide range of skill, from beginner to “expert” performances. One participant, Aimee (1A) demonstrated differences from trial to trial in a number of aspects of her performances, however, execution of the “finer points” of the skill were lacking. Betty (2A) provided another example of an individual, who displayed performances that tended to be only slightly different from trial to trial, but still lacked “good form” whereas Claire’s (3A) performance, which was analysed in the previous sub section, demonstrated well-executed and consistent movement patterns for each trial.

The Developmental Phases perspective allowed a “grading” of the performance of the roll for each participant. The various components could be mapped, and possibly used as a discriminator for low, medium or high quality. Aimee (1A) and Betty (2A) showed out-of-phase components to varying degrees, whereas Claire (3A) was judged to be high quality using the skill based model, she displayed advanced “form” for all the phases. Thus, with this evidence the possibility exists that the component approach may be used in a similar way as the skill (Gymnastics) based model.

The Developmental Stages perspective was useful in determining whether a component “lag” occurred. This instrument was used to distinguish between *initial*, *elementary* and *mature* behaviours. However, there was a contrast between the *mature* and the *ideal* performance, specifically for Claire (3A) – the gymnast considered to be at the elite level by the experts at the gymnastics club (Location B).

The Levels of Proficiency instrument also allowed for a determination regarding the various. Aimee’s (1A) performance indicated that she was between levels. Betty (2A) had achieved *control* level, however, further data would be needed to ascertain whether the *proficiency* level had been achieved. Claire (1A) was also at the *control* level, however, information gained from informal observation would place the participant at the *proficiency* level. This instrument has broad applicability and appeared to be a useful tool for determining the teaching cues required to assist an individual to achieve the next level. The grading of individuals within each level is not apparent. There is no mechanism to differentiate between one individual and another within each level.

Comparative Case Study Analysis: Young Adults

This subsection provides descriptions of one case study from the young adult cohort. This participant, Ewen (2B) was selected to demonstrate a medium quality performance. Descriptions of the performances for two additional case studies from this cohort, case study Debbie (1B) demonstrated a low quality, whilst Fiona (3B) a high quality performance. Details of the analysis of these two participants can be found in Appendix J.

A similar format to that provided for the children’s cohort is adopted for young adult case study. Commencing with the Movement Transcript and concluding with and various Perspective analyses.

Case Study 2B: Ewen

When the data were recorded, Ewen was aged nineteen years and was enrolled in a teaching degree at Location C.

Movement Transcript

As for the previous case study the following description provided in Table 4.4 is based upon temporal sequencing and was filmed at Location C. This subject was viewed from a lateral aspect (the right side).

TABLE 4.4: TIME BASED MOVEMENTS: LATERAL ASPECT

Observation number	Elapsed time (seconds)	Description
1:	0.00	Start. Subject walks towards designated rolling surface. Neck slightly ventro-flexed with eyes focused down approximately one metre to the front. Subject stops walking when the safety mat surface is encountered. Arms are by sides in neutral position, slight elbow flexion. Legs and feet are slightly apart.
2:	0.01	Eyes focused on mat. Head slightly flexed. Hip flexion commences. When hips reach approximately 60 degrees of flexion, the shoulders forward flex and knees also commence to flex. Subject's body continues to move towards the surface.
3:	0.02	Head remains relatively horizontal. Eyes focused straight downward in line with a point mid way between the hands. Elbows flex to approximately 70 degrees. Just prior to hands making the wrists hyperextend and are placed flat on the surface. At this time the head is approximately 60 cm from the surface. The back is curved. Hips are flexed to approx 130 degrees. Knees flexed to approximately 70 degrees. Heels leave the surface.
4:	0.02	Neck very slightly flexed. Hands are placed on the surface. Wrists are hyperextended to 80 degrees. Head is approximately 15 cm from surface. Elbows flexed to 90 degrees. Back is slightly curved. Hips are flexed to approximately 130 degrees. Knees start to extend to approximately 170 degrees. Feet leave the surface. Ankles slightly plantar flexed. Roll is initiated.
5:	0.02	Roll continues, with neck ventro-flexed. Shoulders contact surface. Elbows flexed at 90 degrees. Very slight curve of the back. Hips extend slightly. Knee flexion 90 degrees. Legs wider than shoulder width apart at the knees and ankles. Ankles assumed an anatomically neutral position.
6:	0.02	Roll continues. Head leaves surface as soon as upper back touches, Hands leave surface at this point (Spine approximately 45 degrees). Elbows flexed and wrists hyperextended to 90 degrees. Back is curved C shape. Hip flexion is approximately 100 degrees. Knee flexion 90 degrees. (lower legs are vertical). Ankles are in anatomically neutral position.
7:	0.02	Rotation continues along curved back. Head in neutral position, eyes focused horizontally forward. Arms extend at the shoulder. At this point the subject is balanced on buttocks as the heels contact the surface. Hip flexion is 130 degrees. Knees flex to 120 degrees.
8:	0.02	Starting to stand. Head remains neutral. Eyes focused forward. Straight arms forward flex to 90 degrees (arms horizontal in front). Then left arm abducts when the hips are flexed at 100 degrees but are extending. At this point the knees are flexed at 90 degrees, and are extending.

- 9: 0.04 Standing. Head neutral, eyes focused forward. Both arms abduct and flex at the elbows then shoulders forward flex and the elbows extend. Subject stands and loses balance slightly, taking a step backwards, before walking forwards.
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The following pictures in Figure 4.5 and the descriptions of Ewen’s performance of the forward roll, in summary format, are shown in Table 4.5.

Pictorial Perspective

The following series of nine pictures in Figure 4.4 show an individual from the young adult cohort performing the forward roll.

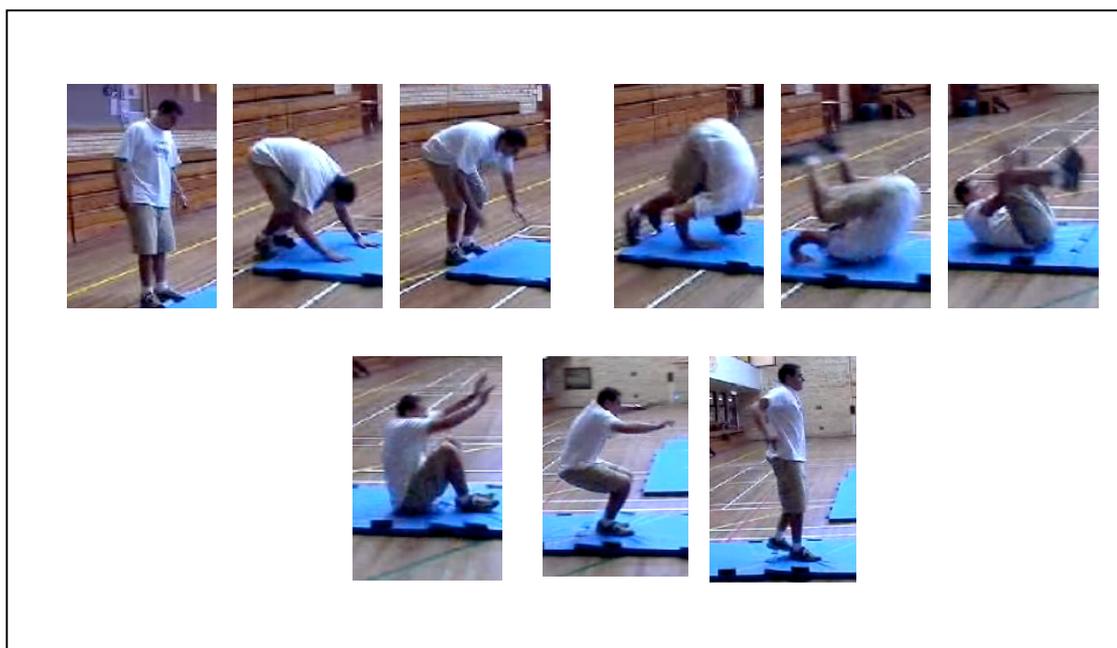


Figure 4.5: Medium Quality Performance

The images in Figure 4.5 show three pictures from each sequence. Each picture is a “snap shot” of the total performance.

Movement Description

The following description provided in Table 4.5 is based upon analysis of the videotaped performance of the roll.

TABLE 4.5: GENERAL DESCRIPTION FOR EWEN

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • started with his arms by his side, in the anatomically neutral position • tucked his chin • slight elbow flexion • placed all of the body weight on his shoulders • had slightly separated (laterally) legs and feet • started the decent by flexing at the hips • descended towards the surface with his head leading the action • forward-flexed his shoulders and the knees commenced flexion when • his hips reached approximately 60° flexion • applied force to the surface evenly using both legs 	<ul style="list-style-type: none"> • performed the roll in a tight C position • did not have head or trunk lag • used his arms to assist with force production • began to flex his knees just after the hips began the forward-downward movement 	<ul style="list-style-type: none"> • did not place his feet under the oncoming body weight • achieved a standing position • lost balance on achieving the standing position • countered the loss of balance, on standing, by flexing the elbows to approximately 90°

The attenuated description of Ewen’s movements, shown in Table 4.3, present his movements in the order in which they occur, for each sequence. Of note is the flow and precision of this medium quality performance.

Perspective Analysis

A description of this analysis is presented under the four appropriate perspective headings.

Gymnastic perspective (George, 1980)

Ewen displayed several movements, which deviated from the ideal in a number of aspects. These deviations include hip and knee flexion, adopting a tight C position (deviating from the ideal slightly curved position; a shape that facilitates “peaking” in the upswing phase) and not placing the feet under the body’s centre of gravity. It is noteworthy that this participant did not use the head as a pivot point. Ewen’s performance was deemed to be *medium* quality.

Developmental Phases perspective (Robertson & Halverson, 1984)

Analysis revealed that Ewen displayed no developmental delays in any of the components being observed. The arms and hands accepted the body weight, and the chin was tucked. Both legs applied force to the surface evenly. The arms assisted with the maintenance of momentum and continued to assist in a forward-upward

direction until and after the body weight was above the feet. There was no head or trunk lag. The knees began to flex just after the hips began their forward-downward movement. Each of these descriptions placed the participant at the highest phase for each component, specifically *Step 3*.

Developmental Stages perspective (Gallahue & Ozmun, 2006)

All the characteristics of a *mature* performance were displayed. These included the head leading the action, the back of the head not contacting the surface (it was the participant’s upper back at the shoulder line). The body remaining in a reasonably tight *C* position, the arms assisting with force production. Momentum was largely maintained, however, the participant lost balance on achieving the standing position.

Levels of Proficiency perspective (Graham et al., 1998)

Observation of the filmed trials revealed that Ewen displayed the features described for the *control* level, such as having the chin tucked, hips high and the shoulders carrying all of the body weight. Table 4.6 presents a summary of the analysis of the four perspectives.

TABLE 4.6: SUMMARY OF ALL PERSPECTIVES FOR EWEN

Case N ^o “Ewen”	Gymnastic Skill	Developmental Phases	Developmental Stages	Levels of Proficiency
2B	Medium	I (i) Step 3 (ii) Step 3 C (i) Step 3 (ii) Step 3	Mature	Control (No data re; Proficiency level)

The summary provided in Table 4.4 indicates that Ewen meets some of the criteria to be classified within a particular perspective. However, for the Levels of Proficiency, data relevant to the most advanced level were not collected.

Conclusion

The skill performances of the three young adults, with an average age 18.7 years, were analysed, by comparing observed movements with George’s (1980) gymnastic perspective. Details related to two additional performances within the young adult cohort may be found in Appendix J. To aid process of analysis, descriptors of joint movement capabilities suggested by Luttgens et al., (1998) were used. These participants displayed performances that tended to be slightly different from trial to trial. Some participants appeared to be “more aware” of what constituted “good” performance and attempted to change some components to accommodate perceived shortcomings between trials.

The Developmental Phases perspective allowed the various components of the roll to be mapped. However, this instrument's original intention was to determine developmental components for the forward roll, and in the case of young adults could only be used as a discriminator for low quality. Debbie (1B) showed the full range of stages, from Step 1 for the initial leg component through to Step 3 for both components of the completion stage. The other two Ewen (2B) and Fiona (3B), however, showed no component lags and thus an alternative method of assessment seems to be required.

The Developmental Stages perspective of Gallahue and Ozmun (2006) could be used to distinguish initial from elementary and mature movement. However, once the mature stage was reached this instrument lacked the descriptions necessary for further analysis.

Graham et al., (1998) instrument was not as useful as a tool for classification purposes for the young adult sample as it was originally designed for use with children. All the young adults were at the *control* level of proficiency. Further data would be necessary to confirm whether these participants could achieve the final level of proficiency that can be applied the roll in a number of different contexts.

Comparative Case Study Analysis: Older Adults

This section provides descriptions of one case study, from the older adult cohort, that of case study 1C (Gail) who is low quality. For the descriptions of two other participants from the older adult cohort, namely, the medium quality performance of Harry (2C) and for Ingrid (3C), a high quality performance, see Appendix K.

The same format that provided for the previous two case studies is adopted for this case study. Commencing with the Movement Transcript and concluding with the Perspectives Analysis.

Case Study 1C: Gail

Gail was a thirty-year-old female at the time the data were recorded. At this time she was enrolled as a student in a teaching degree at University and data were collected during the time she attended a residential school.

Movement Transcript

The following description provided in Table 4.7 is based upon temporal sequencing and was filmed at Location C. It is noteworthy that this subject took seven seconds to

complete the forward roll. This subject was viewed from a lateral aspect (slightly obliquely and from the right side).

TABLE 4.7: TIME BASED MOVEMENTS: LATERAL ASPECT

Observation number	Elapsed time (seconds)	Description
1:	0.00	At the start the subject stands at end of safety mat area. Eyes focus on surface approximately one and a half metres from start position. Arms by the sides in anatomically neutral position. Trunk vertical. Legs straight, and feet together.
2:	0.01	Eyes focus on mat approximately one metre from feet. Neck slightly ventro-flexed. Arms move from anatomically neutral to a few degrees of forward flexion. Hips start to flex. Feet parted approximately 30 cm. Subject steps forward on right foot.
3:	0.01	Subject descending to surface. The head remains neutral. Eyes focused approximately one metre in front. The fingertips make contact with the surface approximately 45 cm in front of the toes. Hip flexion is now 130 degrees and knee flexion 120 degrees (the subject is in a “crouched” position). Heels are off the surface and body weight is on the ball of the foot.
4:	0.01	Head is neutral. Eyes focused down approximately one metre in front. The subject continues to flex the knees until they contact the surface (kneeling position). The arms are straight, but elbow flexion occurs on hand contact with the surface. The wrists are radially flexed approximately 20 degrees. Hip flexion is approximately 100 degrees. The neck flexes.
5:	0.01	The head is lowered to the surface through elbow flexion. The arms are abducted laterally and the elbow flexed slightly more than 90 degrees. The wrists are radially flexed. The top of the head contacts the surface and the neck ventro-flexed. Hips are flexed 90 degrees, and superior to (higher than) the shoulders. Knee flexion is 90 degrees and the feet in a neutral position. The subject is balancing on the top of the head, the hands, both knees and the toes.
6:	0.02	Rotation commences. The neck is flexed and the subject’s weight is transferred to the head and hands. This is achieved through knee extension. The feet leave the surface.
7:	0.02	Rotation continues and the neck is hyperflexed under the body weight. With the neck in extreme flexion the subject’s shoulders and upper arms contact the surface. The hips are flexing. The knees separate (abduct) and flex. The subject continues to roll along a flat back.
8:	0.03	Continuation of roll. The head and hands leave the surface when the lower back makes contact. The hips are flexed at 145 degrees. The knees are separated laterally and flexed at 90 degrees. The lower legs are vertical. Ankles in anatomical neutral position.
9:	0.03	Continuation of Roll. The head is aligned with the spine and moves in unison with the rotating body. The upper arms remain in contact with the surface whilst the forearms are being inwardly rotated. Hips are flexing. The knees are parted and flexed at more than 90 degrees. The right leg has rotated slightly faster than the left. Feet are in neutral position. Legs are parted.
10:	0.03	Continuation. Head is in neutral position. Spine is slightly laterally flexed to the right. The arms continue to rotate and the hands

		contact the surface lateral to the buttocks. The hips are flexing to reach 120 degrees. The knees are parted and flexed slightly more than 90 degrees. The heels contact the surface.
11:	0.05	Starting to stand. Head in neutral position. Eyes focused slightly down. Subject is balanced on hands and feet. Back is vertical. Hip flexion stops momentarily, then resumes briefly. The buttocks are lifted off the surface.
12:	0.06	Standing. The head rotates laterally to the left along with the spine. The right arm is lifted from the surface. The subject is balanced on the left hand and both feet. The right arm continues to forward flex. The hands leave the surface
13:	0.06	Standing. The neck is slightly dorsally flexed. The head and body is turned to the left approximately 20 degrees from the original line of the roll. The left hand applies downward force to the surface. The back is slightly curved. Hip flexion is approximately 120 degrees. Knee flexion approximately 100 degrees. The subject is now in a semi-crouched position. Feet are flat (neutral position) on the surface.
14:	0.07	Standing. The head remains in a neutral position. The arms are straight and forward flex at the shoulders, to approx 20 degrees (the left arm to approximately 25 degrees). Then the arms are adducted back to the subject's sides but remain abducted to approximately 10 degrees. The hips and knees continue to extend. The subject stands, then stops momentarily and takes two steps forward (in preparation to perform a second roll).

The following pictures in Figure 4.6 and the descriptions of Gail's performance of the forward roll, in summary format, are shown in Table 4.8.

Pictorial Perspective

The pictures shown in Figure 4.6 are of an individual from the older adult cohort performing the forward roll.

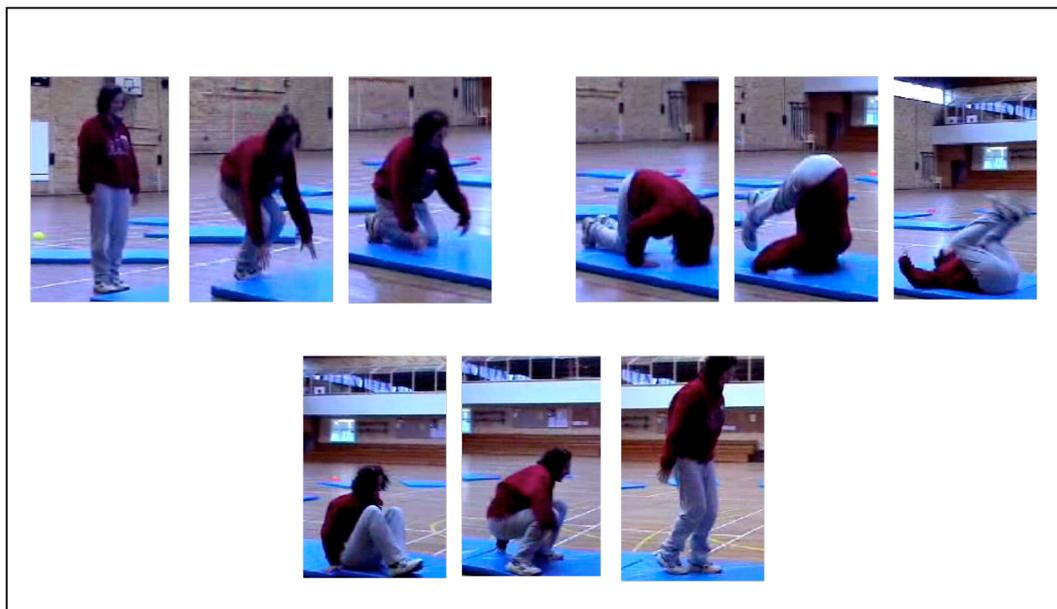


Figure 4.6: Low Quality Performance

Movement Description

The following description, provided in Table 4.8 is based upon analysis of the videotaped performance of the roll of this participant shown in Figure 4.6.

TABLE 4.8: GENERAL DESCRIPTION FOR GAIL

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none">• lacked muscle rigidity and a straight body shape• flexed her hips and her hands were placed on the surface• adopted a kneeling position (hands, feet and knees on the surface)• flexed her elbows and placed her head on the surface• placed her body weight on the top of the head	<ul style="list-style-type: none">• maintained flexed hips to approximately 90°• extended her legs, which remained extended• forced her neck into extreme ventro-flexion• started to collapse towards the surface• made little use of her arms during the middle and end part of the roll• flexed her knees approximately half way through the rotation• landed on a flat back which remained extended	<ul style="list-style-type: none">• ceased rotating• was unable to stand without assistance from the hands pushing on the surface

Table 4.8 provides a description of the forward roll of a low quality performance from an individual from the older adult cohort.

Perspective Analysis

A description of this analysis is presented using the same perspectives as the previous case study analyses.

Gymnastic perspective (George, 1980)

Gail's performance displayed none of the components that are required to be performed that would satisfy any listed criteria, when viewed from a gymnastic (skill) perspective. This participant commenced the movement action with her "hands and knees placed on the surface" that is a kneeling position and then attempted to roll, using the head as the main weight bearing point. Consequently this participant was classed *low* quality.

Developmental Phases perspective (Roberton & Halverson, 1977)

Analysis showed that for both the head and arm action component of the initial phase, the participant was at *Step 1*. However, the leg component was problematic to categorize, as elements from different stages were present. For the completion phase

a similar situation existed, one side of the body demonstrated one step whilst the other side showed characteristics of a different step.

In the initial phase very little weight was taken on the arms and hands and the participant was unable to hold the weight evenly whilst attempting to balance on the head. As a consequence the participant's body started to collapse. Gail's arm strength could be used to counteract this tendency to some degree. This was a *Step 1* classification.

The leg component of the initial phase was difficult to categorize, because at the commencement of the performance the knees were extended. Approximately half way through the roll the knees started to flex. This flexion put the participant, in the *Step 3* classification.

During the completion phase the arm action was determined to be mid way between *Step 1*, as the hands and arms were pulled off the surface, and *Step 2* because of incomplete arm assistance. There was some support from the forearms but the elbows remained on the surface. One arm displayed the pattern of *Step 2*.

Developmental Stages perspective (Gallahue & Ozmun, 2006)

This participant was at the *elementary* stage of rolling. However, some of the observed movements positioned this participant slightly more advanced, at the *initial* stage. For example, the coordinated use of the arms, a situation that might be due to the participant having well developed neuromuscular patterns and strength, resulting from experiences consistent with those of a mature adult.

However, there was difficulty classifying this participant as either *initial* or *elementary* using this perspective. The reason may reside in the fact that the perspective is largely developmental and therefore the classification of adult performers becomes problematic. These performances may demonstrate evidence that some movements may be neither age-related nor age-dependent for adults.

Levels of Proficiency perspective (Graham et al., 1998)

Levels of Proficiency varied for this participant, depending on which aspect of the roll was analysed. Some of cues for placement in *control* were present, some for a classification within the *utilization* level, and as the participant appeared to be exploring transfer of weight, some for the *precontrol* level. Classification was uncertain.

Table 4.9 presents a summary of the analysis of the four perspectives.

TABLE 4.9: SUMMARY OF ALL PERSPECTIVES FOR GAIL

Case No. “Gail”	Gymnastic Skill	Developmental Phases	Developmental Stages	Levels of Proficiency
1C	Low	I (i) Step 1 (ii) Varied C (i) Step 1/2 Step 1/2	Between Initial & Elementary	Between Precontrol & Control

Data in Table 4.9 provides a comparison between the four perspectives. This individual’s performance “fits” in between two categories for both Developmental Stages and for the Levels of Proficiency category.

Conclusion

The participant with the pseudonym Gail (1C) demonstrated the lowest quality performance of all the case study participants from any cohort. This was borne out through analysis of the Gymnastic based perspective as well as the three developmental perspectives (in which the participant was placed within the beginning or “least developed category” for each perspective). However, there were some anomalies that allowed this participant to exhibit some “higher” forms of movement. Firstly, her apparent arm strength, allowed the participant to avoid probable injury, that is, by being able to bear most of her body weight with the arms. Secondly, there was evidence that for this individual, a discrepancy existed in the symmetry of the movements from one side of the body compared to the other side. Finally, anecdotal evidence found this individual to be intrinsically motivated to attempt the roll despite being very concerned about being injured, this motivation to complete a rotation led to her taking the unusual precaution of starting the roll from a kneeling position.

The two other case study participants from the older adult cohort (details of which two may be found in Appendix J), Harry (3B) and Ingrid (3C) displayed similar patterns of skill and development to the medium and highly ranked participants found in the case studies for young adults. Harry showed no change in movement quality from trial to trial. Ingrid showed the characteristics of an advanced performer, that is, the roll with good control and individual flair. Ingrid showed evidence of adjusting her movement behaviour (learning) during the trials. For example, her loss of balance at the conclusion of the roll was overcome after the first trial, whereas Harry did not

demonstrate a change in movement behaviour; balance was unable to be attained on all trials.

CHAPTER CONCLUSION

This conclusion has two subsections. Firstly, a discussion is offered, related to the applicability of the various perspectives, including a table, which summarises all the data. Secondly, the ensuing discussion centres on a new method of dealing with the findings that emerged from the case study data.

Addressing Research Question One: Applicability of Models

One research theme, namely, whether the current perspectives or models used to “assess” the forward roll are applicable across all cohorts required investigation is addressed. An examination of the perspectives whether expressed in terms of stages, phases or steps, showed that no single description provided an “exact fit” with the observed movements of the nine sampled cases. Table 4.10 provides data that summarises the different perspectives and the resulting classifications.

TABLE 4.10: CASE STUDY PERSPECTIVES: AN OVERVIEW

Case N ^o . Name	Gymnastic Skill <i>(George)</i>	Developmental Phases <i>(Robertson & Halverson)</i>	Developmental Stages <i>(Gallahue & Ozmun)</i>	Levels of Proficiency <i>(Graham et al)</i>
1A Aimee	Low	I (i) Step 2 (ii) Step 1 C (i) Step 2 (ii) Step 1	Between Initial & Elementary	Between Precontrol & Control
2A Betty	Medium	I (i) Step 3 (ii) Step 2 C (i) Step 2 (ii) Step 2	Between Initial & Mature	Control (No data re; Proficiency level)
3A Claire*	High	I (i) Step 2 (ii) Step 2 C (i) Step 3 (ii) Step 3	Mature	Control (No data re; Proficiency level)
1B Debbie	Low	I (i) Step 1 (ii) Step 1 C (i) Step 3 (ii) Step 3	Both elements of Initial & Mature	Control (No data re; Proficiency level)
2B Ewen*	Medium	I (i) Step 3 (ii) Step 3 C (i) Step 3 (ii) Step 3	Mature	Control (No data re; Proficiency level)
3B Fiona	High	Beyond the scope of this perspective	Beyond the scope of this perspective	Control (No data re; Proficiency level)

1C Gail*	Low	I (i) Step 1 (ii) Varied C (i) Step 1/2 (ii) Step 1/2	Between Initial & Elementary	Between Precontrol & Control
2C Harry	Medium	I (i) Step 2 (ii) Step 2 C (i) Step 3 (ii) Step 3	Mature	Control (No data re; Proficiency level)
3C Ingrid	High	I (i) Step 2 (ii) Step 2 C (i) Step 3 (ii) Step 3	Beyond the scope of this perspective	Control (No data re; Proficiency level)

* Case studies described in this chapter.

Analysis from the perspective outlined by George (1980) did not achieve the perfect fit, for any single case. This is understandable, given the nature of its intention, which is for employment as a ceiling type instrument. However, because these individuals were purposefully sampled due to their close conformity to the descriptions provided for the gymnastic perspective (i.e., they were selected as being high-level performers, using this instrument) close matches were found in the three case studies for Claire (3A), Fiona (3B) and Ingrid (3C). It must be noted that in most instances the actual performance of a forward roll in the context of gymnastics, is regarded as a “connector” action rather than as a single discrete (isolated) skill. However, beginning gymnasts are taught the forward roll as an initial elementary or fundamental skill. The forward roll used in the former manner leads to a “different” type of performance, in the latter instance as a “safety” exercise.

The Developmental Phases perspective of Robertson and Halverson (1984) incorporating Williams’ (1980) modifications provide a largely maturationalist developmental profile. Although the data were collated using children as participants, the use of this perspective may also be applied across a lifespan. A strong relationship appeared to exist between the Gymnastic based model and this model. There is a possible link between the stages within a component and their overall ability of an individual to perform a roll with style.

The criteria for both the Developmental Stages (Gallahue & Ozmun, 2006) and the Levels of Proficiency perspectives, relating to learning a skill, may be more relevant to children than either young or older adults. The latter perspective, proposed by Graham et al. (1998) is not fully explored in this thesis, as additional data would be required, e.g., to demonstrate whether the forward roll could be performed whilst

airborne or on specific gymnastic apparatus. These data were not obtained during the data collection period. It is, however, a suggestion that an additional category may be a useful adjunct to this model within its fundamental movement phase, to describe the features of a “mature” performer who can apply the skill in a variety of contexts.

Addressing Research Question Two: Best Fit of the Data

This subsection presents an alternative perspective for “assessing” the quality of the forward roll, using information that emerged from analysis of the case study data. A number of body configurations were observed that could be used in the analysis of the roll.

Within each sequence, the beginning, bridging and end, specific body movements or the position of limbs are evident for particular quality levels and for certain age groups. The examination of each sequence led to a number of more detailed body configurations. In addition, some body movements appear more critical for the performance of the roll than others. The rationale for the choice of the body positions, considered to be crucial to performance, includes the notion that a number of biomechanical principles need to be addressed in order to perform the roll in a skilled manner. The positions of various body segments, deemed essential to analysis are termed *indicators* for the purposes of this study.

Within the beginning sequence of the roll, four critical indicators emerged, which are diagnostic of the quality of a performance. These are:

1. The position and placement of the hands on the surface. The observed the hand placement for low quality performers differs from those of higher quality.
2. The position of the arms and the elbows of those of low and medium quality display different positions and configurations than those of high quality.
3. The part of the head making contact with the surface indicates the most apparent difference between the case study participants.
4. The number of body contact points at the commencement of the roll with the surface clearly delineates the different quality levels across all cohorts.

Analysis of the bridging sequence resulted in the discovery of two indicators. These are:

1. The position of the hips and knees as the individual rotates.
2. The position of the arms during rotation.

Analysis of the end sequence resulted in three indicators, which are also pointers of the quality of a performer. These are:

1. The leg movements, which are apparent towards the end of the roll.
2. The position of the feet at the end of the rotation.
3. The rotational factors that contribute to errors when attempting to attain a standing position.

The following chapter explores the indicators, and describes a framework upon which performances of differing quality, for the various cohorts, can be described.