

CHAPTER SIX

Performance Indicators Across Cohorts

Introduction

In the previous chapter a new framework was described, which was designed to assess of the quality of the forward roll. The underpinning data used in the framework emerged from analysis of the indicators and their descriptors for each sequence.

This chapter addresses the third research question, namely, whether the observable components for the forward roll are the same for children, young adults and older adults. In order to achieve an answer to this question a comparative analysis and an interpretation of the performance indicator data, across all cohorts, for the forward roll, was undertaken. Following is a synopsis of cross-cohort comparisons, and an analysis and interpretation of the findings. The data for each of the three sequences of the roll are depicted in both tabulated and graphical format, thereby, providing two ways of viewing the results of the analysis.

There are the five sections in this chapter. Each section includes, initially, a full description of the data comparisons between the indicators and descriptors. The analysis commences with the beginning sequence for all cohorts in section one. The subsequent two sections provide a description of the bridging and end sequences of the roll. Sections four and five provide an overview of the findings and the conclusion.

BEGINNING SEQUENCE DATA

This section provides a description of the analysis of the participants for the beginning sequence of the forward roll. A single subsection provides information about the cross-cohort comparative data for each indicator. The total number of participants whose movements match each beginning sequence descriptor within each indicator is shown in Table 6.1. These data are presented for, the *Hand position* (Indicator 1), *Arm/elbow flexion* (Indicator 2), *Head position* (Indicator 3), and *Number of Contact points* (Indicator 4).

TABLE 6.1: BEGINNING SEQUENCE FOR ALL COHORTS

Indicator Number	Indicator Name and (Code)	Descriptor and (Code)	Number for each cohort		
			Children (n=24)	Young adults (n=45)	Older adults (n=48)
1	Hand position (BAH)	Shoulder width (sw)	11 (23%)	2 (8%)	3 (7%)
		Close to shoulder width (c)	14 (29%)	15 (63%)	18 (40%)
		Wide of shoulder width (w)	23 (48%)	7 (29%)	24 (53%)
2	Arm/elbow flexion (BEA)	Straight (st)	8 (17%)	1 (4%)	0 (0%)
		Bent back (bb)	13 (27%)	18 (75%)	30 (67%)
		Elbows bent laterally (sb)	27 (56%)	5 (21%)	15 (33%)
3	Head position (BHT)	No contact (nc)	14 (29%)	8 (33%)	8 (17%)
		Back of head (ba)	13 (27%)	10 (42%)	19 (43%)
		Crown (top) of head (cr)	21 (44%)	6 (25%)	18 (40%)
4	Number of Contact points (BCP)	Two	4 (8%)	1 (4%)	0 (0%)
		Four	19 (40%)	16 (67%)	22 (49%)
		Three	3 (6%)	1 (4%)	5 (11%)
		Five	22 (46%)	6 (25%)	15 (33%)
		More than Six	0 (0%)	0 (0%)	3 (7%)

Note: The percentages are rounded to the nearest whole number, and those numbers bolded indicate the highest value for each cohort.

Table 6.1 provides data that show the majority of children in the beginning sequence of the forward roll, for the indicator Hand position, placed their hands on the surface *wide of shoulder width*. The most frequent descriptor for Arm/elbow flexion was *elbows bent laterally*, that is, the arms were abducted at the shoulder and the elbow bent laterally greater than 90°. The *crown (top) of the head* contacting the surface was the most frequent position observed for the indicator Head position. The most common Number of contact points was *five*.

For young adults, the Hand position, *close to shoulder width* was the most commonly observed position. The most frequent Arm/elbow flexion position was the arms slightly flexed at the shoulder and the elbows *bent back*. The *back of the head* was the contact position for the majority of this cohort. The most common number of contact points was *four*.

In the case of older adults the majority positioned their hands on the surface, *wider than shoulder width*. However, there were some commonalities with the younger adults, for example, the Arm/elbow flexion position, the Head position and the Number of contact points.

Across Cohort Comparisons: Beginning Sequence

This subsection presents the data for the four indicators of the beginning sequence of the forward roll in graphical format. The graphs for the descriptors for each of the three cohorts were plotted using numerical data from Table 6.1. Following each graph an explanation and interpretation is offered.

Indicator 1(Beginning Sequence)

The Hand position for children, young adults and older adults for each of the three descriptors is shown in Figure 6.1. There are three descriptors, *Shoulder width*, *Close to shoulder width* and *Wide of shoulder width*.

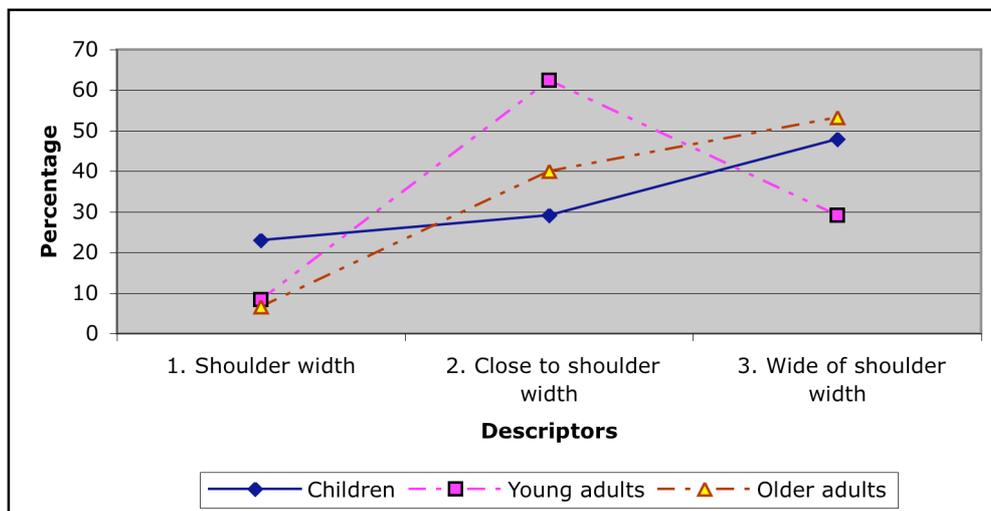


Figure 6.1: Comparative Hand Descriptors for Children, Young Adults and Older Adults

Figure 6.1 highlights that children exhibit a larger incidence of the “ideal” hand position than either of the two other cohorts. The majority of young adults placed their hands in a position close to shoulder width. For children and older adults the most salient feature is the third descriptor, namely, hands placed wide of shoulder width as the preferred position.

Explanation and Interpretation

For this sample, the reason children placed their hands, at the ideal shoulder width, is because a number ($n=11$) of this cohort were trained in gymnastics. This justification was provided by Maunder (personal communication, 2006), a nationally accredited elite gymnastics coach and judge at the location where these individuals practised gymnastics.

Conversely, the young adults and older adults were not privy to expert assistance, based on the analysis of interview data. In addition, they may have been unaware of the mechanical advantage that shoulder width arm position affords.

Those children who placed their hands close to shoulder width (descriptor 2) were in transition, from the lower quality to the higher quality. Further practice, additional learning, biomechanical and physiological changes due to growth and development, such as arm and shoulder strength, is a prerequisite for a higher quality performance. Younger adults, based on subjective observation, were generally athletic, appeared confident in their ability to perform the skill. The close to shoulder width position of the hands points to the fact that they lacked the knowledge of more refined movements typical of their highly trained counterparts from the children's cohort, but at the same time were aware that a more stable base was acquired with the hands closer to shoulder width.

The young adults, during interviews, recalled previous experiences of this activity from secondary school physical education experiences and from participating in gymnastic activities in the past. Similarly, some older adults were aware of the fact that when the hands are placed in a more "appropriate" slightly wider than shoulder width, a better base of support is afforded.

Placing the hands wide of shoulder width (descriptor 3) was preferred by 48% of children. This preference is due to the physical capacities of a younger, and less experienced sub-group within the cohort. Children were also concerned with losing balance and thus control (Packard, 2004; Wickstrom, 1983). Placing the hands well away from the mid-line of the body permits the head to be nearer the surface. The younger adults displayed greater strength and efficiency in their movements, however, they demonstrated less confidence, and 29% placed their hands wide of shoulder width. In contrast, 53% of the older adults placed their hands wide of shoulder width. This difference is due to a perceived inability to control the descent of the head to the surface. A desire to place the head as close to the surface as possible before rotation, in an attempt to avoid losing control and sustaining an injury, explains these results. This information is also reflected in the interview data.

Indicator 2 (Beginning sequence)

The Arm/elbow flexion position for children, young adults and older adults for each of the three descriptors for this indicator, is shown in Figure 6.2. The three descriptors are, *Straight*, *Bent back* and *Bent laterally*.

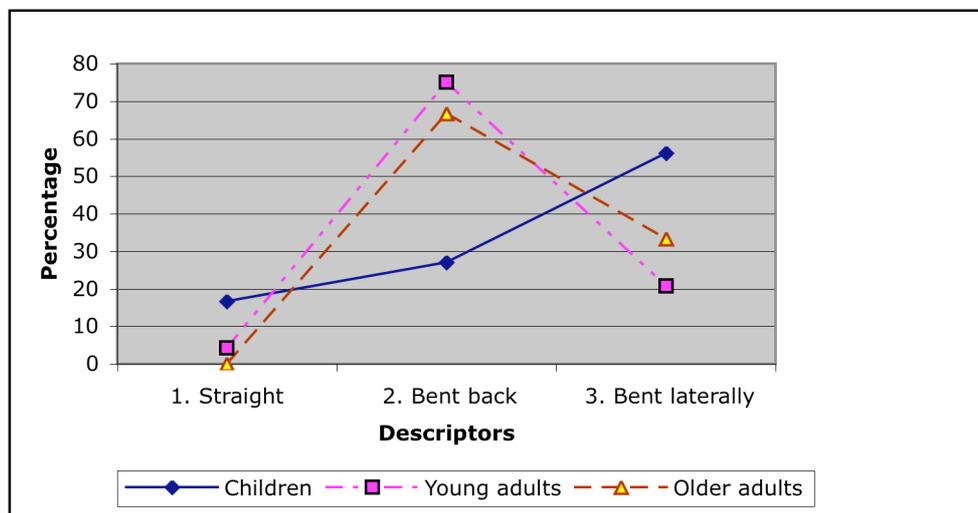


Figure 6.2: Comparative Arm/elbow flexion Descriptors for Children, Young Adults and Older Adults

A strong similarity in the slopes of the lines, shown in Figure 6.2, exists between the younger adults and the older adults. Children provided a contrast, both for descriptor 2, in which they demonstrated a greater percentage of the highest quality performance descriptor, that is, arms forward flexed at the shoulders and elbows extended (Straight), as well as for the poorest quality, specifically, descriptor 3 (Bent laterally).

Explanation and Interpretation

The ideal position for the hands (descriptor 1) was demonstrated by 17% of the children, again reflecting the fact that many of this cohort had been engaged in gymnastics for some time. The elite gymnasts were aware of the requirements in terms of the preferred biomechanical and aesthetic form and had been instructed to demonstrate this position. In addition, they had the skill and physical capabilities to maintain this posture. Within this sample 4% of young adults and no older adults achieved a high-quality performance. This situation is possibly related to previous learning experiences. The elementary form of the roll is usually taught in the school setting by teachers who permit bent arms to be used (personal communication, Maunder, 2000).

Furthermore, people from the young adult and older adult cohorts had similar reasons for adopting the bent back position (descriptor 2). It is easier, and appears safer to lower the head to the surface with the elbows flexed dorsally (bent back). The large disparity in the percentage of children, relative to young adults and older adults, is due to the fact that some of the children (27%) had not reached the milestone of being able to maintain the straight position.

The explanation for the 56% of children, who exhibit descriptor 3, is that children in this position, coupled with a wider hand position, permits the closest possible location of the head relative to the surface. Children are “top heavy as the head is large in proportion to the body” (Gallahue & Ozmun, 2002, p. 113) which means they are prone to losing their balance, a situation they attempt to avoid. In addition, their neuromuscular system is not well developed (Tanner, 1978). By bending the elbows greater than 90° the head can be nearer the surface, than if the arms are straight.

In contrast, the body systems’ functionality and proportionality of young adults allowed them to place the hands in a position closer to the head. In the case of the older adults, Shephard (1998) commented that as individuals age their relative strength diminishes and thus they are less physically strong, resulting in less confidence. As a consequence, older adults tended to locate their head closer to the surface for the purposes of control.

Indicator 3 (Beginning sequence)

The head position indicator for children, young adults and older adults showing each of the three descriptors is shown in Figure 6.3. These are, *No contact*, *Back of the head* and *Crown of head*.

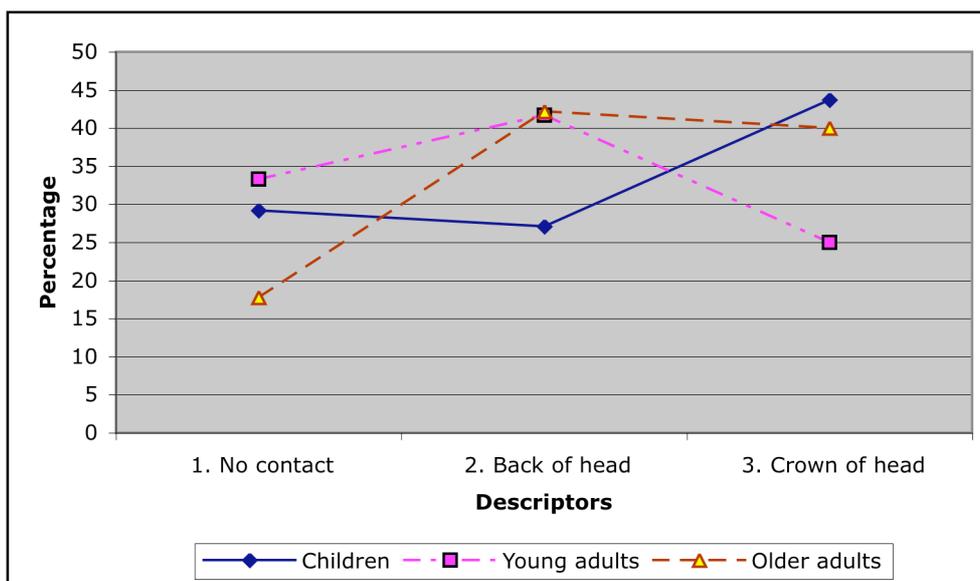


Figure 6.3: Comparative Head Descriptors for Children, Young Adults and Older Adults

Figure 6.3 shows that descriptor 2 has the same percentage for younger adults and older adults. The most desirable head position (No contact) is more evident in young adults and children. The data for young adults indicated relatively few of this cohort placed the top of the head (crown of head) on the surface.

Explanation and Interpretation

The absence of head contact (No contact) for children (29%) in this sample is indicative of a high-quality performance. In contrast, the method of achieving No contact for young adults (33%), is different from that displayed by children, whereby the position of the arms/elbows permits the participant to allow the head to slip “through” between the arms during the early part of the rotational movement.

When interviewed it was apparent that the younger adults were well versed in the safety requirement of not placing the head on the surface, in addition, they have the physical capabilities, such as strength and coordination, to achieve descriptor 1. Fewer older adults (18%) have No contact as a possible result of waning strength (Shephard, 1998) poor knowledge of technique and lack of confidence, however, 42% of this sample of older adults displayed the descriptor, Back of the head, thus awareness of their own capabilities and safety issues was evident. In addition, interview data revealed a concern about placing the head on the surface to avoid possible injury.

Approximately half (44%) of the children’s cohort used the top of the head (crown of head) as a pivot point. This was due to their inability to support the body weight with the arms. Notably, once the arms are placed wider than shoulder width and the elbows are bent laterally at more than 90°, the participant who is lacking in arm strength, has no other biomechanically based option than to place the top of the head on the surface. The reason why some children (older and more experienced) did not place their head on the surface can be explained by the dichotomous nature of this sample. For those older adults, 40% of whom demonstrate descriptor 3, which is similar to the children’s cohort, do so because both hand placement and arm/elbow position did not permit any other option, for biomechanical reasons. There were fewer younger adults (25%) who show the descriptor, Crown of head on the surface.

Indicator 4 (Beginning Sequence)

Figure 6.4 depicts number of contact points for children, ranging from two to more than six, for young adults and older adults for each of the five descriptors for this indicator. They are, *Two, Four, Three, Five, and More than Six*.

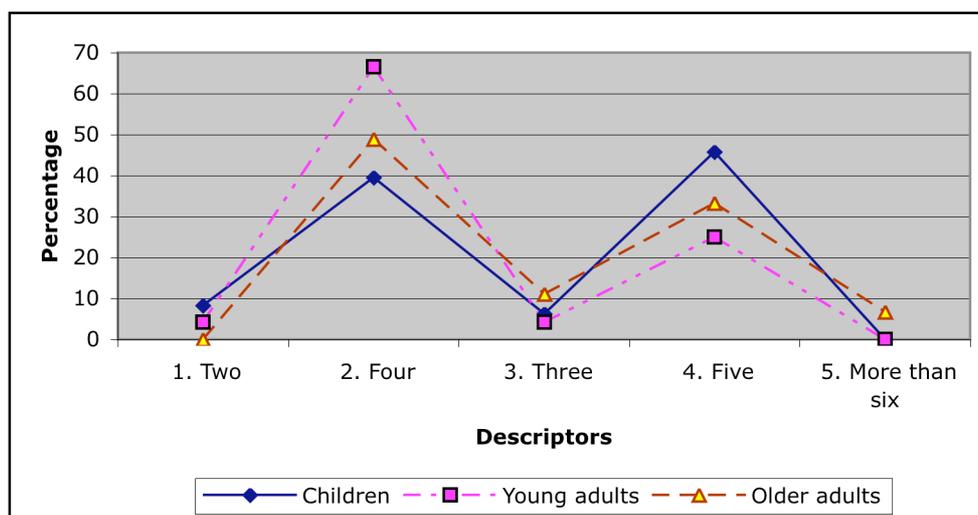


Figure 6.4: Comparative Contact Point Descriptors

The percentages, in Figure 6.4 demonstrate a similar pattern for all cohorts. The most common number of contact points for children was five, and for both adult cohorts the number was four. The most desirable contact point number was two. Although a low percentage of children had the highest percentage for descriptor 2 (the highest quality), they also had the highest percentage adopting five contact points (low-quality).

Explanation and Interpretation

Descriptor 1 for this indicator involves a “flight phase” which requires knowledge of the skill’s requirements, control and practise in order to be performed with success. In addition, knowledge of the requirements of a high-quality forward roll gymnastics are required (George, 1980). As such, 8% of this sample of children and 4% of younger adults achieved this quality of movement for this indicator.

A similar pattern of results emerged for descriptors 2 and 4, whereby all cohorts showed a similar percentage peak. This situation can be explained by two factors. Firstly, the “most” common starting point for the roll (4 contact points) was hands and feet on the surface, which provides a stable base of support for the commencement of the rotation. Secondly, the placement of the head on the surface can provide additional stability (5 contact points) and in most cases extra support for a controlled stable launch into the rotation.

Three contact points (descriptor 3) implies that one leg was raised and used to assist in the rotational aspect of the roll. If the participant is stationary with the hands and one foot on the surface, having the one leg being raised and moving can either provide momentum for rotation dynamically (Hay, 1978, p. 152) and/or permit the centre of gravity to be moved forward towards the head and over the hands (Schembri, 1983, p. 15). Both these scenarios permit the facilitation of rotation.

More than Six contact points, evidenced in 7% of the older adult cohort results from a number of factors. These include, poor temporal planning, little movement conceptualisation, lack of kinaesthetic sense coupled with an apparent lack of sensory motor learning opportunities.

Overall, for the beginning sequence, the children’s cohort demonstrated the lowest quality movements for all four indicators. The main similarities were, the hand positions between the children and the older adults, the arm/elbow positions for the beginning sequence of the young adults and the older adults, and the number of contact points for both young and older adults.

BRIDGING SEQUENCE DATA

This section presents a summary of the bridging sequence of the forward roll for each cohort of performers. However, because of the similarity of the process of analysis to the beginning sequence, this section and the section that follows, describing the end sequence are presented in an abbreviated format. The graphs for the indicators are presented together, in a single figure, which is followed by an explanation of the data and reasons for the findings.

The bridging sequence is examined using the two indicators, the *Hip/knee* and *Shoulder/arm positions*. Table 6.2 shows the number of participants from each cohort whose particular movements fit each descriptor.

TABLE 6.2: BRIDGING SEQUENCE FOR ALL COHORTS

Indicator Number	Indicator Name and Code	Descriptor and (Code)	Number for each cohort		
			Children (n=48)	Young adults (n=24)	Older adults (n=45)
1	Hip/Knee (MHK)	Straight bend contact (sbc)	20 (42%)	4 (17%)	5 (11%)
		Remain bent (bt)	11 (23%)	19 (79%)	39 (87%)
		Bend then straighten (bs)	3 (6%)	1 (4%)	0 (0%)
		Stay straight (ss)	14 (29%)	0 (0%)	1 (2%)
2	Shoulder/Arm (MSA)	Straight arms 180°+ arc (as)	20 (42%)	10 (42%)	12 (27%)
		Arms bent, straighten (little impetus) (af)	8 (17%)	8 (33%)	21 (46%)
		Arms open to 'V' shape (av)	12 (25%)	0 (0%)	0 (0%)
		Arms rotate with body may straighten (ar)	4 (8%)	6 (25%)	7 (16%)
		Arms rotate onto forearms (ae)	4 (8%)	0 (0%)	5 (11%)

Note: The percentages are rounded to the nearest whole number, and those bolded indicate the highest value for each cohort.

The following points were noted from information contained within Table 6.2:

- For children there was a peak in numbers at the higher end of the descriptor hierarchy, for both Hip/knee and Shoulder/arm positions.
- Younger adults clustered around the higher-level descriptors. The most frequent descriptor for the Hip/knee was flexed knees and hips, which was maintained throughout the roll.
- The older adults showed a trend towards high-quality performances, but slightly lower on the descriptor continuum, than children or younger adults.

Across Cohort Comparisons: Bridging Sequence

The following subsection presents the data for the bridging sequence of the forward roll, using the information contained in Table 6.2. The indicators are shown in Figure 6.5 with the descriptors for the three cohorts in Graphs 1 and 2.

Indicators for the Bridging Sequence

Figure 6.5 shows the four descriptors for the indicator Hip/knee indicator in Graph 1. These are: *Straight bent straight*, *Remain bent*, *Bend then straighten* and *Stay straight*. The five descriptors for the Shoulder/Arm indicator in Graph 2 are: *Arms in arc*, *Arms bend then straighten with no impetus*, *Arms rotate with body*, and *Arms onto forearms*.

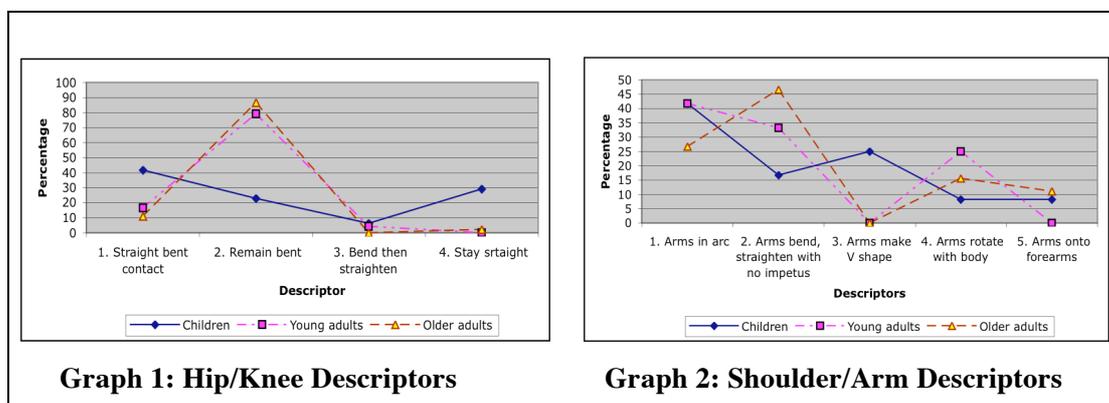


Figure 6.5: Bridging Sequence Comparisons

The graphs in Figure 6.5 show indicators for the bridging sequence of the forward roll. Each graph shows a comparison between the descriptors. An explanation of the results for this sequence is summarised in the following paragraphs.

Explanation and Interpretation: Bridging Sequence

The children, who demonstrated the highest-order descriptor for Hip/knee position in Graph 1, were sub-elite gymnasts (i.e., those who were moving towards selection at in a national team) demonstrating the retention of previous learning. The younger adults and older adults, who demonstrated this descriptor, revealed through interviews that they were involved in some form of gymnastic training during their youth.

The reason for the wide difference in percentages, for the occurrence of descriptor 2 (i.e., legs bent) in Graph 1 is that the children's movements, performed in the beginning sequence, did not permit them to be in a position to make and maintain a bent knee during rotation. In contrast, young adults and older adults were generally aware that "rolling into a small ball" is the simplest position to adopt in order to maintain rotation. It is also probable that physical educators have taught this action, for various reasons, including safety considerations, as part of elementary gymnastics lessons in schools (Department of Education Queensland, 1971, p. 19).

For children maintaining a straight leg position, or bending and then straightening the legs, the most likely cause is a lack of abdominal strength associated with an inability

of the leg muscles to prevent the legs attempting to travel in a straight line due to centripetal forces (Hay, 1978, p. 163). Muscular strength and neuromuscular development are also major contributing factors (Tanner, 1978). None of the younger adults or older adults presented this action.

In a similar way to the Hip/knee indicator (Graph 1) the children who demonstrated descriptor 1 in Graph 2, for the Shoulder/arm position, were well-trained gymnasts. To achieve the straight-arm position and then rotate the arms forward in an arc requires practise, kinaesthetic awareness, control, and neuromuscular coordination. Older adults did not demonstrate similar percentages of this higher quality descriptor due to issues related to proportionality and other perturbances, such as reduced joint flexibility and body girth.

The second descriptor shown in Graph 2, namely, arms bend, straightening but no impetus (i.e., their actions did not add any rotational force to the rotation) meant an inability to coordinate the arms with the rest of the body in the rotational process. This action was an attempt to move the centre of gravity forward over the base of support (the feet and buttocks) and also to maintain momentum.

Descriptor 3, the arms making a 'V' shape during the concluding stages of the rotation, particularly for this sample of children, was due to the attempt to implement the gymnastic 'style', taught during gymnastics coaching sessions. The abduction of the arms into a wide 'V', rather than maintaining arms close to body-width, allows the less adept subject to maintain balance, in a similar way that a "tight rope" walker uses their arms or a long bar to assist them to maintain balance.

The arms rotating with the body (descriptor 4) means the elbows remained flexed throughout the first half of the rotation and then extended. This action reflects the desire to control the rate of rotation through the release of the degrees of freedom of the elbow joint. The additional impetus provided by thrusting the arm adds to the complexity of the rotation. The final descriptor in Graph 2 of the arms remaining flexed at the elbows, followed by their placement on the surface, does add to the stability of the performer by eliminating any lateral (sideways) movement.

Overall, the bridging sequence was examined and presented in tabulated and graphical format. For each indicator, descriptor comparisons were made between each cohort. Reasons for the similarities and differences between the cohorts were offered. For the bridging sequence the main similarities between the three cohorts were, the Hip/knee

actions of both the young and older adults, the Shoulder/arm descriptors for children and young adults. In addition, the young adults demonstrated the overall lowest quality for the bridging sequence.

END SEQUENCE DATA

The following section outlines the data for all cohorts for the end sequence. This sequence is examined using three indicators, *Feet position*, *Final leg movements*, that is, leg movements at the conclusion of the rotation, and *Final rotational movements*. Table 6.3 shows the number of participants whose particular movements demonstrate each descriptor.

TABLE 6.3: END SEQUENCE OF FEET POSITION AND FINAL MOVEMENTS FOR ALL COHORTS

Indicator Name	Indicator and Code	Descriptor and Code	Number in each cohort		
			Children (n=48)	Young adults (n=24)	Older adults (n=45)
1	Feet position(EFT)	Close to buttocks (cb)	24 (50%)	8 (33%)	12 (27%)
		Away from buttocks (ab)	24 (50%)	11 (46%)	21 (46%)
		Inconsistent (in)	0 (0%)	5 (21%)	12 (27%)
2	Final leg movements (ELM)	Together (lt)	20 (42%)	7 (29%)	8 (18%)
		Knees/feet apart (kfa)	16 (33%)	14 (58%)	16 (36%)
		Legs separated (ls)	12 (25%)	3 (13%)	21 (46%)
3	Final rotational movements (ERM)	Rising to standing unaided (ru)	18 (39%)	6 (25%)	1 (2%)
		Balance lost (lb)	6 (11%)	11 (49%)	5 (11%)
		Roll momentarily halts (sm)	4 (8%)	1 (4%)	1 (2%)
		Hands used to assist rising (uh)	8 (17%)	5 (21%)	29 (65%)
		Roll stopping completely (rs)	12 (25%)	1 (4%)	9 (20%)

Note: The percentages are rounded to the nearest whole number, and those bolded indicate the highest value for each cohort.

From the information contained within Table 6.3, for the end sequence of the forward roll the following points were noted:

- The first indicator (Feet position), showed a strong match, in percentage terms, across all descriptors, for each cohort
- Each cohort demonstrated different final leg movements.
- Two of the three indicators (Final leg movements and Final rotational movements) did not show a corresponding highest percentage match for any cohorts.

Across Cohort Comparisons: End Sequence

The following subsection presents the data for the end sequence of the forward roll, using the information contained in Table 6.3. The indicators are shown in Figure 6.3 with the descriptors for the three cohorts in Graphs 1, 2 and 3.

Indicators for the End Sequence

Figure 6.6 shows the three indicators and their descriptors for the End sequence. Graph 3 shows the indicator Feet position, and the indicators, which are: *Close to buttocks*, *Away from buttocks* and *Inconsistent*. The are three descriptors for the Shoulder/Arm indicator in Graph 4 which are, *Legs together*, *Knees or Feet apart* and *Legs separated*. The third indicator is termed Final rotational movements, which has five indicators. These indicators are *Rising to stand unaided*, *Balance lost on standing*, *Roll stops momentarily*, *Applies force with hands* and *Roll ceases*,

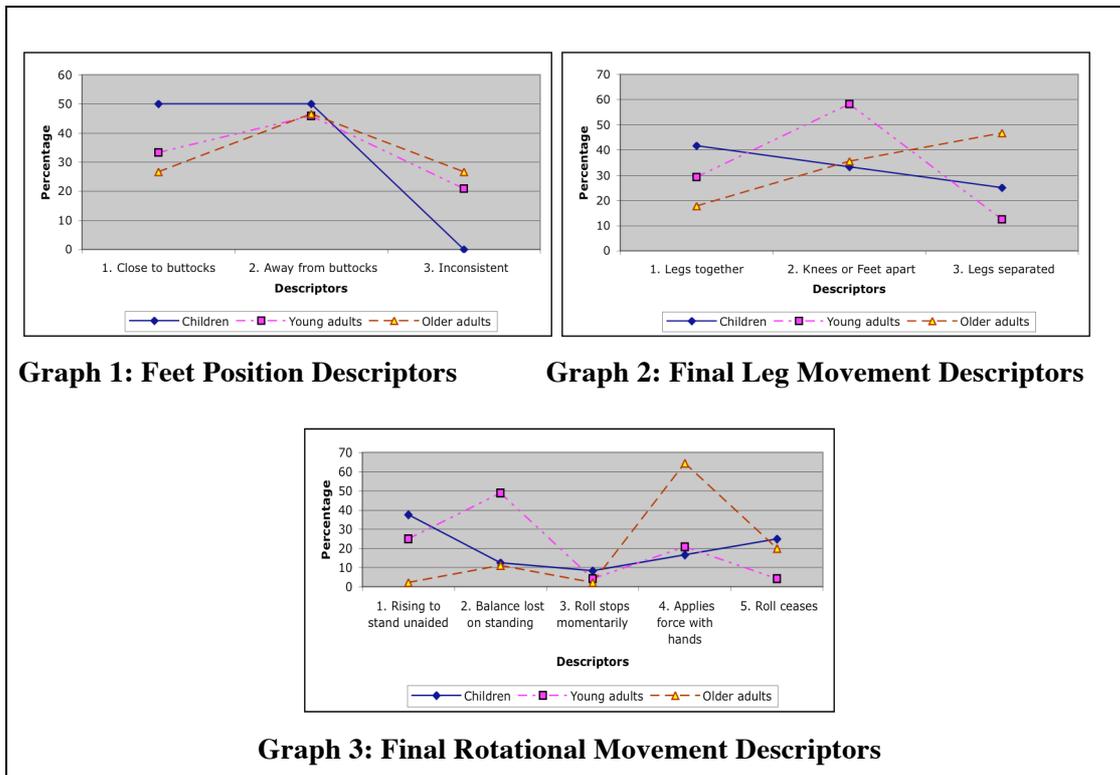


Figure 6.6: End Sequence Comparisons

Figure 6.6 depicts graphs of the three indicators for the end sequence of the forward roll. Each graph shows a comparison between the descriptors. An explanation of the results for this sequence is summarised in the following paragraphs.

Explanation and Interpretation: End Sequence

By way of explanation the difference between the percentages of each cohort exhibiting descriptor 1 for the indicator Feet position, shown in Figure 6.6: Graph 1, can be attributed to the individual's joint flexibility. The children, all of whom were members of a gymnastics club, were capable of, and taught to place the feet close to the buttocks. The older adult cohort was less flexible. A decrease in joint flexibility tends to occur over time (Kendall & Kendall, 1948). The bodily changes associated with increasing chronological age, such as increasing body mass (Gordon, Gonzalez-Mestre, & Garrett, 1992), e.g., increasing girth, reduces the capability of being able to place the feet close to the buttocks.

Children who demonstrated the highest quality descriptor for Final leg movements, in Figure 6.6: Graph 2, were elite gymnasts. However, some children with their knees or feet apart were also attempting to put the body in a better position to stand up. The majority of younger adults, separated the knees to achieve more 'forward lean' to assist with rising. By separating the knees the body is able to move forward and thereby shift the centre of gravity forward over the buttocks, beyond the base of support. Older adults were more likely to cross the legs or separate the legs longitudinally to solve the problems of rotation and rising to a standing posture.

For the Final rotational movements for each of the three cohorts shown in Figure 6.6: Graph 3, rising to stand unaided is associated with a high level of skill, and to some extent a leaner body type, and was more common in the children's group. A number of younger adults ($n=25$) also exhibited this descriptor, which, according to interview data, was associated with prior learning.

The loss of balance on rising to a standing position was due to over rotation. This is a result of having the legs in a tucked position (see Bridging sequence descriptor), which without good neuromuscular control can cause increased rotational velocity (Hay, 1978, p. 288). This factor also contributed to the relatively low percentage of the young adult cohort who ceased to continue rolling during the end segment.

Of the older adults, 64% used their hands to apply force to the surface to assist rising to stand. This action served to 'steady' the body after the rotation, and to apply sufficient force to allow forward and upward motion to continue. Individual factors such as lack of flexibility, increased girth, can affect performance. In addition,

insufficient velocity could be due to caution being exercised in the beginning and middle segments of the roll. These factors coupled with poor balance, contribute to the action of using the hands to assist rising to a standing position.

Overall, the end sequence was examined using the leg movements, position of the feet and final movements. For the end sequence the main similarities were, the feet position for all three cohorts. The older adults demonstrated the lowest quality for the end sequence.

ALL SEQUENCES FOR ALL COHORTS

This section presents an overview of the results for all cohorts, commencing with the children's cohort, followed by the young adults and then the older adults.

Children Cohort

Children, in the beginning sequence, showed that the most common position was the hands placed wider than shoulder width and the elbows bent laterally greater than 90°. The head position was usually the crown (or top) of the head in contact with the surface. There were two similar starting contact points (i.e., either four or five).

For the bridging sequence children tended to exhibit variety in the number of descriptors for the indicator Hip/knee position. The situation with regard to the shoulder/arm positioning showed a wider variety of actions than those of either of the other two cohorts. The majority of children demonstrated the descriptor depicted as a straight bent contact leg position.

The end sequence for children showed the position of the feet was evenly distributed between the two indicators, either close to or away from the buttocks. During the rise to a standing position a number of children used their hands to assist, and for some children the roll stopped. Of note was the number of children who could rise to stand unaided.

Young Adult Cohort

The majority of young adults adopted a hand position in the beginning sequence that was close to shoulder width, the elbows bent back and the head position was the back of the head contacting the surface. The most common starting position was four contact points.

For the bridging sequence, the young adults tended to maintain a position in which the knees remained flexed throughout. This tucked position, is a well-known posture encouraged by teachers to assist rotation (Department of Education Queensland, 1971).

The end sequence of the roll revealed that the majority of the young adults positioned their feet away from the buttocks. Also, as part of the rise to stand, a number of young adults used hands to assist with the maintenance of forward motion.

Older Adult Cohort

Older adults adopted a hand position that was slightly closer to the midline than either the children or younger adults in the beginning sequence. The majority adopting a position whereby the hands were placed wider than shoulder width with the elbows bent back. The number of contact points at commencement was “four”.

For the bridging sequence the majority of older adults maintained flexed knees throughout the roll. This position was generally accompanied by the maintenance of hip flexion.

Data for the end sequence showed that the majority of older adults positioned their feet away from their buttocks. During the rise to stand, older adults used their hands to assist them more frequently than the other observed final movements. A number of participants from both adult cohorts lost their balance on reaching the standing position.

Table 6.4 provides a summary of information pertaining to the percentage of each cohort who displays a particular descriptor.

TABLE 6.4: SUMMARY OF MOST COMMON DESCRIPTORS

Sequence	Indicator	Descriptor (Code)	Percentage of each cohort		
			Children (n=48)	Young adults (n=24)	Older adults (n=45)
Beginning					
1	Hand	Shoulder width (sw)	23%	8%	7%
		Close to shoulder width (c)	29%	63%	40%
		Wide of shoulder width (w)	48%	29%	53%
2	Arm/Elbow	Straight (st)	17%	4%	0%
		Bent back (bb)	27%	75%	67%
		Elbows bent laterally (sb)	56%	21%	33%
3	Head	No contact (nc)	29%	33%	17%
		Back of head (ba)	27%	42%	43%
		Crown (top) of head (cr)	44%	25%	40%
4	Number of Contact Points	Two	8%	4%	0%
		Four	40%	67%	49%
		Three	6%	4%	11%
		Five	46%	25%	33%
		More than Six	0%	0%	7%
Bridging					
1	Hip/Knee	Straight bend contact (sbc)	42%	17%	11%
		Remain bent (bt)	23%	79%	87%
		Bend then straighten (bs)	6%	4%	0%
		Stay straight (ss)	29%	0%	2%
2	Shoulder/Arm	Straight arms 180°+ arc (as)	42%	42%	27%
		Arms bent, straighten (little impetus) (af)	17%	33%	46%
		Arms open to 'V' shape (av)	25%	0%	0%
		Arms rotate with body may straighten (ar)	8%	25%	16%
		Arms rotate onto forearms (ae)	8%	0%	11%
End					
1	Feet	Close to buttocks (cb)	50%	33%	27%
		Away from buttocks (ab)	50%	46%	46%
		Inconsistent (in)	0%	21%	27%
2	Final leg movements	Together (lt)	42%	29%	18%
		Knees/feet apart (kfa)	33%	58%	36%
		Legs separated (ls)	25%	13%	46%
3	Final rotational movements	Rising to standing unaided (ru)	39%	25%	2%
		Balance lost (lb)	11%	49%	11%
		Roll momentarily halts (sm)	8%	4%	2%
		Hands used to assist rising (uh)	17%	21%	65%
		Roll stopping completely (rs)	25%	4%	20%

The numbers that are shown in bold font in Table 6.4 denotes the descriptor occurring with the highest percentage, which is expressed to the nearest whole number. The descriptors are arranged hierarchically in descending order from highest to lowest quality.

The data presented in Table 6.4 shows that the highest percentage for the descriptors for the children matches with the young adults on one occasion, and with the older adults twice. The young adults match the older adults five times. There are two occasions where there is no match. There is one occasion where all descriptors match. Closer scrutiny of Table 6.4 shows when the highest and next highest percentages for each cohort are combined that for that for 7 of the 8 descriptors there are close similarities between cohorts.

CHAPTER CONCLUSION

This chapter provided descriptions, interpretations and discussion of the sequences of the forward roll across all cohorts. A summary of the findings is provided for each sequence.

For the beginning sequence the main similarities were:

- The hand positions between the children and the older adults;
- Arm/elbow positions for the beginning sequence of the young adults and the older adults;
- The number of contact points for both young and older adults.

For the bridging sequence the main similarities were:

- Hip/knee positions of the young adults and older adults;
- The shoulder/arm descriptors for children and young adults.

For the end sequence the main similarities were:

- The feet position for all three cohorts.

Other findings were:

- For the beginning sequence, the children's cohort demonstrated the lowest quality movements for all four indicators. In contrast, this cohort demonstrated the highest quality for both the bridging and end sequence indicators.
- The young adults demonstrated the lowest quality for the bridging sequence.
- The older adults demonstrated the lowest quality for the end sequence.

In this chapter the descriptors and indicators employed in the MAMQ:FR framework were used to compare cohorts. In order to reinforce the usefulness of this framework, an analysis of the MAMQ:FR from a statistical platform is warranted. The statistical approach adopted to carry out this task is based upon Item Response Theory (IRT). Such methodology has proved to be integral to the exploration of instruments, which, although not validated in and by themselves have emerged from validated instruments. The MAMQ:FR is such an instrument, as demonstrated through the data comparisons provided in this chapter.

The next chapter explores the statistical analysis of the MAMQ:FR using the ACER *Quest* (Adams & Khoo, 1993) statistical software package. This analysis has the potential to confirm that the items in the MAMQ:FR conform to fit and underlying construct (Rasch, 1960). In addition, for the purposes of comparison, the indicators and descriptors are examined from the perspective of a theoretical model based upon a qualitative developmental paradigm.