

CHAPTER EIGHT

Discussion of Results and Conclusion

Introduction

In this chapter the findings, and a number of issues pertinent to this study, are presented in four sections. The first section provides information about possible limitations to this study. The next section gives a synopsis of the research findings that emerged from the analysis of the data. Then the implications of the findings are offered, and lastly there are recommendations for future research.

POSSIBLE LIMITATIONS OF THE STUDY

This section provides an appraisal of possible limitations of this study. However, as there was an extensive Pilot Study, many of the initial concerns were identified and measures were undertaken to address these issues. Notwithstanding, some discussion is presented in the following paragraphs.

Profile of the cohorts

A possible limitation to this study is the claim that this investigation addressed a life-span approach to the sensorimotor mode of learning, despite not including the full spectrum of ages in the profile of the participants. There was no attempt made, nor was it possible to obtain a representative sample of participants from the general population. However, this concern is addressed in two important ways. Firstly, the data collected were representative of the variety of skill levels across all cohorts, which is sufficient to address the research questions of a life-span approach. Secondly, within each of the three cohorts of children, young adults and older adults, a full range of performances of the total continuum of unskilled to skilled movement was evident. As such, the claim that there is a life-span approach, is supported through the profile of the total cohort representing a continuum of skilled performances, which is similarly evident within each of the three cohorts.

Subsequent to the concerns relating to whether the full spectrum of participants was included in the study are issues of safety for all participants, and more broadly the ethics governing the conduct of this research. Of specific concern was whether the performance of the forward roll, beyond the age of the oldest participant in this study (i.e., 48 years of age) would have presented issues related to safety. With increasing age, meeting the demands of physical performance becomes problematic (Gordon,

Gonzalez-Mestre, & Garrett, 1992; Nieman, 1995; Shephard, 1998). This assertion was further reinforced by Ketcham and Stelmach (2001) who indicated that aging was accompanied by impairments in sensorimotor functioning. Therefore the claim that the study represents a lifespan approach can be justified on the grounds that the study embraces the lifespan for individuals who can safely engage in the gymnastic skill of the forward roll.

Furthermore, ethics approval was granted on the basis that data gathering was conducted in a safe manner. As such it was not feasible to collect data outside the locations other than those chosen for this study. Overall, the focus of the study was to have as wide a range of ages, and skill levels, as possible given the context of the study within the constraints outlined in the ethics approval process. The wide range in the quality of the performances of participants was evident in the MAMQ: FR and SOLO analyses, which demonstrated the full range of responses from each cohort.

In addition, the chosen skill was relevant to all participants. Specifically, the children were all members of a gymnastics club, and for the young adult and older adult cohorts the skill was part of their formal training, as they would be required to teach it as part of a normal Physical Education programme.

Design features

In the design of this study, the standardisation of the video-camera location in relation to the performer was acknowledged as being highly desirable. Standardising the equipment and setting during the data collecting process is methodologically predisposed to high levels of reliability for both the data and subsequent results. Standardisation could only be accomplished in two ways, either by transporting a standardised set of equipment to three different settings or to bring all participants to one location. Both of these proposals were not possible due to the ecological nature of the research. It was considered to be more important for participants to be filmed under conditions that were the most naturalistic. This approach therefore, allows for the results of the study to be applicable to the individuals performing the skill in settings, similar to those from which the data were collected. In educational research, an ecological approach is considered to have greater applicability for educators than to have data generated under laboratory conditions.

Due to the varied constraints of each data collection site, video recording equipment could not always be placed in the optimal position. This situation was due to an

agreement made with the managers of the Gymnastic clubs that the collection of data would not interfere with the normal coaching routine. Although this problem was overcome through the willingness of some participants to remain after formal sessions, in order to be videotaped, it was difficult to gather data for all participants in the same way. However, because of the manner in which the data were analysed, filming from a position that differed slightly from a standardised position was found to not pose any known threat to the findings of this study.

Overall, the study produced results that contribute to the assessment of the sensorimotor mode of learning, which clearly differentiates this work from prior investigative studies. For example, the use of three cohorts from differing age groups represents a new approach that has not been attempted previously in research related to the quality of movements for the forward roll. A broad developmental continuum is a strong and unique feature of this research.

SYNOPSIS OF THE RESEARCH FINDINGS

The research findings relate to analysis techniques, which are summarised under the following subheadings: Four perspectives; Framework; Cross-cohort; Rasch and SOLO.

Four perspectives

A video-analysis of the movements for all participants ($N=117$) who performed the forward roll was undertaken. Each individual's movements were initially described in terms of their performance when compared to the gymnastic "ideal" as described by George (1980).

From this initial analysis, nine individuals, consisting of three from each cohort – children, young adults and older adults, were purposively selected for a further fine-grained study. Using descriptions from three additional perspectives used to "measure" the forward roll, which were the Developmental Phases of Robertson and Halverson (1984) the Developmental Stages of Gallahue and Ozmun (2006) and the Levels of Proficiency of Graham, Holt/Hale and Parker (1998) assessments were undertaken to determine how well each instrument described the performance of each of the nine purposively sampled participants. The results of the analysis of these three approaches found that no single perspective could describe the observed movements, for the purposive sample. This finding answered the first research question, which related to the success, or otherwise, of the measurement instruments, when they were

applied to the performance of the forward roll, across the lifespan. As a consequence a different format for assessing movement quality, applicable across the lifespan was conceived.

Framework

A new framework was constructed, designed specifically to measure the quality of movement for the forward roll for individuals with an age range between 4 (children) and 48 years (older adults). Titled the Model for Assessing the Movement Quality of the Forward Roll (MAMQ:FR), this framework required the forward roll to be subdivided into three hypothetical sequences; beginning, bridging and end. Within each sequence a number of movement elements were identified. These were termed indicators, which were further divided into smaller observable discriminating sub-stages, termed descriptors. The use of these three constructs, but more specifically the indicators and descriptors, permitted greater discrimination between different qualities of performance than those used in the four previous instruments. This framework is applicable to the analysis of the forward roll for individuals presenting a wide age range as conducted in this study. This finding answered the second research question, which was concerned with the characteristics of an instrument designed to assess the forward roll when performed across the lifespan.

Cross-cohort

The application of the MAMQ:FR framework to the performances of all three cohorts revealed that movement similarities existed between the cohorts. These similarities were expressed through the framework's descriptors when applied to the performance of the forward roll. The observable components for the forward roll are comparable for children, young adults and older adults, that is, across the "lifespan" of those individuals who could safely complete the roll. This finding addressed the third research question regarding whether the observable components for the forward roll are the same for children, young adults and older adults.

Rasch

The method for determining the quality of a movement using the MAMQ:FR framework is unique to this study. To add veracity to the findings that the framework provided a way of identifying the quality of movement, and could also provide a means by which comparisons of individuals across cohorts could be undertaken, the indicators and descriptors were coded. These coded data were subsequently subjected to analysis using the *Quest* statistical package (Adams & Khoo, 1993), which is based

on the Rasch (1960) analytical technique. Results revealed that data fit the underlying construct, indicating that data codes for the participants were representative of varying levels of the quality for the performance of the forward roll. The acceptable indices of the data fitting the model, reinforced the validity of the MAMQ:FR.

An innovative advancement in the way *Quest* (1993) data were presented was devised, using pictures to replace numbers for item fit statistics. “This is a unique way of presenting Rasch data” (personal communication, Bond, 2005). The successful use of Rasch modelling, via *Quest* software to analyse the quality of movements, has not been employed in research concerning the investigation of the levels of quality in a motor learning activity prior to this study. These two main advantages of Rasch have provided a bridge between the MAMQ:FR and SOLO.

SOLO

The MAMQ:FR was also scrutinised from a developmental theoretical perspective. The Structure of Observed Outcome (SOLO) model was used as a platform to determine whether SOLO cycles and levels were apparent when an individual performed the forward roll. Firstly, an examination of the forward roll, from a sequences perspective, was undertaken, and a description of the SOLO cycles and levels was forthcoming.

However, because of the MAMQ:FR framework’s large number of descriptors, an alternative instrument that could be applied to the forward roll, specifically from a total body configuration approach was constructed. The components of this instrument, termed, the SOLO Observation Checklist (SOC) were based upon the most discriminating aspects of the MAMQ:FR. This checklist was applied to the performance of the forward roll, providing a research-based demonstration of the SOLO cycles and levels evident in children, young adults and older adults. An application of the SOLO model’s cycles and levels to the sensorimotor mode learning was achieved. These findings answer the fourth research question, which was whether the SOLO model was an appropriate tool for assessing participants’ performance, representing a diverse developmental range. The SOLO Observation Checklist was a critical element in this first study that provides research based evidence that mapped the cycles and levels in the sensorimotor mode of learning for the SOLO model.

IMPLICATIONS OF THE FINDINGS

This section provides an outline of how the findings may be applied to educational practices, specifically, within the realm of physical education. Secondly an examination of the theoretical implications of this study is undertaken.

Practical Applications for Education

The MAMQ:FR and the SOC have provided instruments that permit practitioners to assess a sensorimotor skill across the lifespan. The important practical aspect, specifically, of the MAMQ:FR is shown in the output from *Quest*, particularly the item fit map, which permits the teaching practitioner, and others such as sports coaches, physiologists and so on, to determine the difficulty of the steps for each “part” of a movement skill.

This thesis provided a method of employing visual images to show, not only what each “level of performance” looks like, but also the real “gap” in terms of logits, between one level of the performance and the next. To this end moving an individual from one “place” to another can be seen both in terms of how difficult the task may be as well as what the next level of performance looks like. Sport coaches and physical education teachers can take advantage of the visual medium to learn about their athletes’ performance, to teach and to correct errors. This pictorial item fit map representation can be found in Chapter 7.

Furthermore, the use of images that can still accurately demonstrate the step difficulty and level of quality of a particular movement may be applied, not only in gymnastics, but also to a number of movement applications where the difficulty level separating the quality of a movement is paramount. Such applications may be particularly helpful for coaches and athletes for sports such as diving and dance. The possibility also exists for this procedure to be extended to an examination of medical and paramedical procedures such as in physiotherapy where images of individuals in various stages of recovering from injury may be used to illustrate the difficulty of achieving different movements during recovery. An advantage of pictures over numbers, in this context, is that what needs to be done can be observed directly, and an appreciation of how difficult (or easy) it is to achieve the next step is instantly available. Such visual images are underpinned by the item step difficulty output

from the application of the Rasch model to data that represents a broad age continuum and skilled performances of varying movement quality.

An important question regarding teaching practice is “What needs to be known to enhance teaching and learning of a sensorimotor skill?” The solution can be addressed through providing the learner with information about how to attain crucial aspects of the skill, and the movement expectations at a given level of structural complexity. This thesis provides a checklist, based on the SOLO model, which was designed to assist teachers to help students learn a physical skill. The SOLO levels and cycles have been identified, and described, for the forward roll. These levels and cycles can be used, by a teacher or coach, to enhance learning as opposed to the students’ own learning processes, even though these two facets are interactive.

Information obtained using SOLO is also useful for assessment, as it “allows teachers to gain an insight into where instruction might most profitably directed” (Pegg, 2003 p. 247). However, the application of SOLO to pedagogy requires the teacher to acknowledge that in reaching a particular level, all preceding SOLO levels are implied. There must also be a realisation, on the teachers’ part, that other intervening factors are present. For example, an individual may have already reached their movement ceiling and in this instance the teacher, with an appreciation of the SOLO levels and cycles, can construct experiences for this individual through the provision of alternative experiences at the same SOLO level and cycle. Appendix S contains additional information that the Physical Education teacher may find useful, when attempting to understand some of the reasons why individuals adopt particular movements, when performing the forward roll.

For learners who possess physical and/or psychological attributes that permit continuing progression through the SOLO levels, knowing the characteristics for the next higher level is of paramount importance to the teacher. However, knowing “how” and “what” needs to be done to accomplish progression to the next SOLO level does require expertise. Suffice to say, because higher-order responses incorporate skills from lower levels, the major determinants of performance are *how much* and *how well* the student has grasped the relevant precursory, sometimes termed “lead up” skills. Preliminary or lead up movement experiences are required to achieve a particular skill. Without lead-up type activities the individual may not grasp the skills and discriminations necessary for higher-level performances.

Theoretical Implications

The sensorimotor mode of learning has been investigated within this thesis. The findings indicated there are at least two SOLO learning cycles within this mode. In addition, there is sufficient evidence, to demonstrate that the sensorimotor mode embraces the beginning of a continuum, within the SOLO model. However, sensorimotor learning applies specifically to the initial organisation of the brain, the formulation of ideas and development of language skills. Future development of the individual requires the merging of the sensorimotor mode with the broader aspects involved in motor development, which is embraced under the standard of the psychomotor domain. This domain of learning has applicability across the lifespan of the individual (Gallahue & Ozmun, 2006). The term psychomotor mode may be a more appropriate term for the SOLO model's underpinning mode of learning.

Consideration also needs to be given to the issue of whether a nexus exists between the SOLO model of learning, the model of skill acquisition proposed by Fitts and Posner (1967), and Dynamic Systems Theory of motor control. Firstly, the SOLO model appears to be compatible with the three-phase model of Fitts and Posner (1967). As reported elsewhere in this thesis, a continuum of learning has been shown to exist within that model, that is, the individual moves through three phases, termed, the cognitive, associative and autonomous. The presence of SOLO cycles and levels within each phase of the Fitts and Posner (1967) model are, by deduction, a *fait accompli*. Therefore, the application of the SOLO model may provide a deeper understanding of the Fitts's and Posner's continuum.

Secondly, the Dynamical System Theory (DST) is based upon the idea that individuals possess their own unique preferred patterns of movement, which can change after a particular threshold is reached through the application of an external or internal perturbation (i.e., a factor that created a disturbance to the usual pattern). In addition, the theory acknowledges that affordances (e.g., favourable characteristics inherent within an individual) can also assist the individual to change. The other main hypothesis associated with DST is that the body is comprised of self-organising systems. This means that the body is capable of adjusting and changing movement patterns that replace old ones without a large input from the central nervous system.

Notwithstanding, SOLO is based upon a constructivist approach, whereby individuals only exhibit a different learning pattern when a new stimulus, such as a movement

scenario, has been accommodated and assimilated. This thesis provided evidence that individuals demonstrate similar patterns of movement when performing a movement skill, across much of the lifespan. However, there were numerous factors, such as somatotype, flexibility and proportionality, to name but a few, that resulted in changes to movement patterns, despite previous learning. These changes illustrated within a SOLO context showed how an individual modified their preferred pattern of movement to meet the requirements to perform a basic gymnastic skill. The same deductive logic can be applied to the connection between the phases as suggested by Fitts and Posner (1967) and Dynamic Systems Theory, therefore a connection between these concepts can be established.

RECOMMENDATIONS FOR FUTURE RESEARCH

The practical and theoretical implications of the findings may be utilised in future research. Some suggested studies may include:

- Undertaking similar studies, employing a SOLO perspective for a range of fundamental movement skills (FMS), and within different contexts. Skills such as running, jumping, skipping and hopping.
- Collecting and analysing additional data to ascertain whether a third SOLO learning cycle may be evident for activities where the forward roll is used in conjunction with various gymnastic apparatus. This can be accomplished by including gymnasts whose speciality may include vaulting or the beam.
- Examining the relationship between the sensorimotor and the ikonic modes of learning. This would involve the collection and comparison of interview data, coded in SOLO terms, with data pertaining to movement.
- Applying pictorial data associated with Rasch to other movement skills to allow greater accessibility to the varied nature of skill acquisition across the developmental range. This recommendation would include a range of FMS to inform a diversity of individuals from primary school-aged children, to elite sports coaches as well as other movement related disciplines, including physiotherapists involved in remediation and injury recovery.

CHAPTER CONCLUSION

This investigation was concerned with how individuals learn when operating within the movement domain. An examination of four instruments that have been used to assess movements, specifically for the skill of the forward roll in gymnastics revealed a need for an alternative instrument to determine the quality of the movement. That

these instruments were not a success, when applied across the lifespan, was largely attributable to the fact that they were designed mainly for use with children.

As this thesis was also designed to explore the chosen fundamental motor skill for participants across the lifespan, a new approach, which involved the construction of an alternative assessment model, capable of examining the quality of movement for a wide age range, was conceived. This new framework was termed the Model for Assessing the Movement Quality for the Forward Roll (MAMQ:FR).

The underlying construct of the MAMQ:FR was supported by the application of Rasch statistical software; *Quest* (Adams & Khoo, 1993). The output confirmed that the framework's underlying construct measured the quality of movement. Also emerging from a scrutiny of the output was an innovative way of presenting data, involving the use of images in place of numerals for the Fit map. This is a useful adjunct to the way these data could be accessed by the wider population, particularly those professions that rely on visual data to inform teaching, learning, and performance enhancement

Finally, through the application of a modified version of the MAMQ:FR, an instrument was developed, applicable to the forward roll from a whole body perspective. This additional tool, the SOLO Observation Checklist, was an outcome of the MAMQ:FR that assisted in reaching the conclusion that cycles and levels could be mapped within the sensorimotor mode of learning of SOLO.

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APPENDIX B
Sample Forward Rolling Checklist – Multiple Observations

Initial Phase, Arm Action Component

Name/Date/Trial										
Level/step										
1 Head support										
2 Head/arm support										
3 Arm support										

Initial Phase, Leg Action Component

Name/Date/Trial										
Level/step										
1 One-leg push										
2 Two-leg push										

Completion Phase, Arm Action Component

Name/Date/Trial										
Level/step										
1 Little assist										
2 Incomplete assist										
3 Continual assist										

Completion Phase, Head/Trunk Action Component

Name/Date/Trial										
Level/step										
1 Head/trunk lag										
2 Partial head/trunk lag										
3 No head/trunk lag										

Completion Phase, Leg Action Component

Name/Date/Trial										
Level/step										
1 Knees extend/hips extend										
2 Knees flex/hips extend										
3 Knees flex/hips flex										

Client Profile

I: A/IL										
C: A/HT/L										

APPENDIX C

Permission Letter/Consent Form For Children

Researchers Personal Details here.

Dear Parent/Caregiver,

As part of a research undertaking whilst enrolled as a student at the University of New England, Armidale, in the degree of Master of Education (Hons) I am investigating the link exists between motor skills (in this case the forward roll) and the learning cycles that exist in an already established taxonomy, i.e., an established classification termed the SOLO taxonomy.

As part of this research project it is necessary to videotape a number of persons whilst they are attempting to perform a forward roll. The videotaping will be conducted during normal gymnastic practice sessions in the presence of their regular coach. Videotaping will be conducted over a number of sessions on different dates and at different times.

As part of ethical requirements for the conduct of research I am seeking your permission to videotape your child/charge from a number of different perspectives, for the purposes of skill analysis, at a later date. The analysed data will form a significant part of the research thesis.

Please be assured that the identity of your charge will remain confidential in any data findings and that gathered information will be kept in a secure location, in a locked cabinet at the University, within the School of Education. Note, also, that the researcher has completed a Prohibited Employment Declaration form with the NSW Department of School Education, the University of New England and the NSW Gymnastics Association.

Your child/charge is free to withdraw from the research project at any time. If your child/charge experiences any difficulty that may occur as a result of participating in this project, counselling is available from your local community health provider or the University Counselling service.

This project has been approved by the Human Ethics Committee of the University of New England (Approval No. HE02/058).

Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at the following address:

Research Services
University of New England
Armidale, NSW 2351.
Telephone: (02) 6773 3449 Facsimile (02) 6773 3543
Email: Ethics@metz.une.edu.au

My contact details are listed above, should you wish to discuss this proposal further.

Yours sincerely,

John Haynes.
Lecturer in Physical Education and Sport Studies
Room 76 Milton Building.
University of New England
Armidale 2351.

.....
Consent Form.

I (as parent/guardian/care giver) have been provided with a copy and have read the information contained in the Information Sheet for Participants and any questions I have asked have been answered to my satisfaction. I agree to the participation of my child in this activity, realising that I may withdraw permission at any time. I agree that research data gathered for the study may be published, provided real names are not used.

I(name of parent/guardian/caregiver) give
permission for my child/charge(Name).....(age)
to be videotaped whilst performing the fundamental motor skill known as the forward
roll, as part of a research project being undertaken by Mr. John Haynes, who is currently
a student at the University of New England, Armidale.

Signed.....(parent/guardian/caregiver)

Date/...../.....

Contact details.....
.....

APPENDIX D
Research Approval Notice

Fiona Prater, 20/3/02 2:48 PM +1100, Re:

1

X-Sender: fprater@metz.une.edu.au
Date: Wed, 20 Mar 2002 14:48:50 +1100
To: John Haynes <jhaynes2@metz.une.edu.au>
From: Fiona Prater <fprater@metz.une.edu.au>
Subject: Re:
Status:

John

Here is the outcome of the HREC's consideration. Your approval number is: HE02/058.

Prof J Pegg/Dr S Dickson/Mr J Haynes

Going SOLO with the forward roll: an examination of the sensorimotor model

The Committee approved this application with the following conditions:

- (i) The researchers to obtain assent from the children by way of a modified consent form which includes the following: "I have had this research project explained to me and I agree to participate and have a video tape made when I do a forward roll".
- (ii) The Information Sheet for Participants to explain to the children how they will be video taped i.e. front/back and side views while doing a forward roll.

Good luck with your research!

Regards
Fiona

Ms Fiona Prater
Research Ethics Officer
Research Services
University of New England,
Armidale NSW 2351
Phone: (02) 6773 3449, Fax: (02) 6773 3543
Email: Ethics@metz.une.edu.au

APPENDIX E

Transcripts of Interviews

Interview transcripts from Location A: children

If you were to do a forward roll how would you? This question they could not answer

Laruen – 10 years of age.

- J: How do you do a forward roll?
L: easy, I'm good at them
J: why?
L: I do them on my bed at home
J: How do you do them?
L: hands down, chin to chest – tight

Enja – 10 years of age (this is her first week)

- J: How do you do a forward roll?
E: shrugg
E: Position myself well – not hurt myself
J: How"
E: the correct way the teachers tell me
J: tell me about that
E: I put my hands in front and put my chin to chest – push off with legs.

Girl One – n/a years

- J: How do you do a forward roll?
G1: legs straight with chin to chest

Nicholas – 5 years of age

- J: How do you do a forward roll?
No answer

Tina – 6 years of age (pink)

- J: How do you do a forward roll?
T: don't know

Megan – 5 years of age

- J: How do you do a forward roll?
M: feet
Head, on feet and roll

Nicholas – 6 years of age

- J: How do you do a forward roll?
N: hands on mat – tuck head and roll

Hanna – 4 years of age

J: How do you do a forward roll?
H: it's just like a front flip
J: can you explain that?
H: don't know – shrug

Talia – 4 years of age

J: How do you do a forward roll?
T: shrug
J: what would you do if you were telling someone else how to do a forward roll?
T: feet – put them on mat ... chin down and roll

NB: This is the point where interviewer adapted question. Up to this point when children were asked about how to do a forward roll they couldn't provide an adequate answer. When asked to "tell me if they were teaching another person in the group – what would they say"... the responses were more meaningful.

Louis – 9 years of age

J: if they were teaching another person in the group – what would they say?
L: not quite sure

Hanna – 9 years of age

J: me if they were teaching another person in the group – what would they say?
H: hands down
Head
Then do the roll
J: What do you think about when you do a fwd roll?
H: trying not to do that too quickly or too slowly
J: how would you do that?
H: I'm not sure

Lauren – 7 years of age

J: tell me if they were teaching another person in the group – what would they say?
L: bend down, head over, nose to knee roll over

Chaunette – 7 years of age

J: if they were teaching another person in the group – what would they say?
C: shrug – could not respond

Sam – 6.5 years

J: Tell me if they were teaching another person in the group – what would they say?
S: tuck chin in – through feet together and push

Interview transcripts from Location C: young adults (Wednesday 8th May 2002).

Sonah – 22 years of age

J: If you were going to do a forward roll, what sorts of things would you think about before you did the roll?

S: um, positioning of feet and um the crouch down smooth tucking of the head, follow through, enough follow through to push yourself up onto your feet.

J: Ok can you tell me about your positioning of your feet first please?

S: they should be shoulder width apart and feet um placed in the direction of the forward roll.

J: and your head, how would that be?

S: um looking down at where you are looking to land – that's before you are going to take off and when you take off you should be in a tucked position with your chin down on the chest

J: arms in a tucked position or the head in a tucked position?

S: head, sorry

J: that's fine and if you were to do the perfect roll, what would that look like?

S: um just smooth, smooth takeoff um, equal pace right through the movement and um enough movement to push you up onto your feet at the end.

J: Ok to get up onto your feet at the end, how would you actually achieve that 'enough movement'.

S: by pushing off with your hands – and um when you are circulating around, push back with your hands again to push yourself up.

J: and if you were going to teach someone to do a forward roll, what are a couple of the points you would emphasise.

S: um, just be practicing the rocking of the actual roll, with a partner, cradling the head and also the um push down in the squat position, say, practice standing up, going down get the balance.

J and how do you think your performance would be different from someone who was in the Olympic games performing that position, what do you think would be the difference.

S: a lot of difference, there - um probably, it would have spring in it I don't know really, hard question.

J: just tell me about the spring then.

S: they sort of wouldn't do it with thinking – they'd go straight into it – whereas my thinking that was that I was thinking about what was involved in forward rolls.

J: and what was the first thing that you thought about before you did your forward roll?

S: probably, the position of the feet – and where my hands were going down on the mat –

J: and after that?

S: the head – I'm always conscious of the head because it can hurt if you're not landing in the right spot.

J: OK thanks very much.

Jared – 19 years of age

- J: OK Jared, can you tell me how to do a forward roll?
- Ja you place your hands down in front of you, hands spread it out, neck - chin tucked into your neck to make sure you don't hurt your neck, um feet backwards – push off with your feet and pull your head under so you get a nice roll and roll over.
- J: and if you were in the Olympic games, how would your roll differ from what you did **then** compared with if you were watching an Olympic athletes?
- Ja: huh?
- J: how would your roll be different from Olympic athletes?
- Ja: I don't know I guess just mostly the precision of the roll even though I know the basic principles there is probably a lot of precision lacking in the way I do it.
- J: and how do you think you would achieve that precision?
- Ja: a lot of hard work obviously, I'd probably need technical coaching to get that more really technical side down and a lot of practicing I suppose.
- J: and before you did your roll, what were you thinking about?
- Ja: Not stuffing it up really, I was thinking about what I learned about in first year P. E. Just trying to get the roll right and doing the best I could.
- J: Okeydokey. And in the 'best you could, was that in form, or neatness, or speed or what sort of attributes?
- Ja: anything really, - neatness mostly, I just wanted to try to get it over without it being too sloppy and get over reasonably quickly as well.
- J: Ok, thank you very much

Interviews with young adults conducted prior to teaching the forward roll instructions; first year students enrolled in the B.Ed. (May, 2002).

Dominca – 18 years of age

- J: when you do a forward roll, what do you think about?
- D: um try to keep my head underneath my shoulders and tucking my legs underneath my chin.
- J: Ok and when you tuck your chin down, what do you think about, what do you do?
- D: rolling
- J: and if you were an Olympic athlete, and you were doing a perfect forward roll, how would it be different from yours do you think?
- D: that it would have practice maybe – and um I would have learned the correct technique
- J: can you elaborate on technique a bit more for me please?
- D: um don't know
- J: what about their style
- D: um they would have a lot better style and um they'd be more correct in what they are doing rather than me – who has just done it back in primary school and I actually haven't done gymnastics.
- J: so when was the last time you did a forward roll before today?

D: probably year 6!
J: so was that about six years ago?
D: yep
J: and if you were going to teach someone how to do a forward roll, what would you tell them?
D: um tuck their head under and their knees just under their chin and um, hands on the mat.
J: fantastic, thanks a lot.

Kelly – 21 years of age

J: and when was the last time you did a forward roll?
K: probably primary school.
J: that was about seven years ago?
K: and the rest – probably 10 because I was in year 6
J: OK and what do you think about – before you did that forward roll what were you thinking about.
K: not letting my head sort of touch it – to protect my neck kinda thing yep– the landing whether it was going to hurt – and trying to make it soft.
J: and how do you think you can try and make it soft?
K: um not letting, like ... control all my movements so I don't like just fall – otherwise it is going to hurt.
J: and how did you actually try to control those movements?
K: um, just the body tuck – kinda thing – just as you are going over, so just hold yourself in – in a ball kinda thing.
J: and if you were to do the perfect roll in the Olympics games what do you think your forward roll would actually look like? If you were an expert?
K: If I was an expert? I guess everything would sorta be together. Your legs would be together; um your arms would be sorta by your sides kinda thing. And just in a tuck – like a ball.
J: Ok, and if you were to teach someone to do a forward roll, what would you tell them
K: um I guess when you put your hands down, Um make sure your head sorta doesn't touch and try and tuck in and under and more so your back sorta touches otherwise if you hit it with your head, your neck can go either way. And um for the first time support their back as they are going over and then as they get more and more confident – just put your hand there – not touching them but just as a guide – and take your hands away when you think they are confident enough to do it themselves.
J: thank you very much for that.

Vanessa – 18 years of age

J: when was the last time you did a forward roll?

V: last year sometime – probably, September,

J: about a year ago

V: yeah,

J: and what were you thinking about when you were doing a forward roll?

V: I was thinkin make sure I roll through my spine because I know that from dancin that's something that I sorta don't do properly enough.

J: OK, and if you were to do a perfect roll, in say the Olympic games, what, could you describe what that perfect roll would look like.

V: it would be tucked in nicely, and it would be finishing nicely with perhaps feet together, something like that.

J: and if you were to teach someone to do a forward roll, what would be a couple of points you would make to them?

V: to bend your knees firstly to get down low to the ground, and then probably your chin to your neck – make sure that it was going through every single little bone in your spine and then probably I do it with one foot in front of the other to get up – that's easy.

J: thanks very much

Claire – 18 years of age

J: OK Claire what were you thinking about when you were doing that forward roll?

C: finding my feet as a dancer, I always think of my feet.

J: and how do you achieve that?

C: by basically stretching, stretching the inner arch muscles of the feet and making sure that the achilles tendon is clenched and that the toes are fully like stretched out and pointing toward the ground and my heels are facing the ceiling.

J: was there anything else other thing besides your toes that you were thinking about?

C: that basically that I have a problem of flattening my back like when I turn um - roll over so I have to make sure that I am rolling over on my shoulders and not on my back or my neck

J: and if you were to do the perfect roll, what do you think that would look like?

C: basically, being able to bend your knees at the beginning but straightening them during the roll to have the perfect angle and then getting back up using bent knees again and then straightening up into the same position that you started off in.

J: ok and if you were actually teaching someone to do the forward roll what are a couple of points you'd pick up?

C: uum, basically that you can either start with two feet or one foot at a time, tucking your chin to your chest and rolling on the back of your shoulders but on your back and not on your neck um If anyone was having difficulties turn the head a little bit to one side and roll on the one part of the shoulder that wasn't tender or sore. Basically in the roll, keeping as small as possible and having as much momentum as possible so you can get

back up and bending your knees to roll – straightening them during the roll – and bending them to get back up and try to going back to the original start position that you start from.

J: On that thing of momentum, how do you get enough momentum do you think?

C: by pushing off from your arms and by using the quadriceps in the bending process so sometimes kids use runups or just walking up and sort of taking the stuff by slightly jumping which can be a bit dangerous because they start to roll on their neck or do an absolute flip in the air.

J: thanks very much

Adam – 18 years of age

J: and when was the last time you did a forward roll?

A: aw a couple of months ago.

J: and what were the circumstances of that?

A: umm in a martial arts class we did a forward roll as a roll for self-defence

J: so as a protection measure sort of thing! OK, so, what were you thinking about when you were doing a forward roll right then?

A: um to start off to support myself so I don't hurt the back of my neck and then to just get through and stand on my feet.

J: can you tell me a bit about how you would support yourself?

A: um I put my hands down first – and then I allowed my neck to roll across so my neck didn't actually touch the mat and just ... followed through

J: and to get back up on your feet, what did you do?

A: just the momentum and I put my hands down to push myself up

J: so you used your hands to push yourself up?

A: that's right

J: so if you were to do a perfect forward roll, how would it be different from the one you just showed me?

A: um I'm not really sure

J: and if you were in the Olympic Games and watching an event, how do you think what you saw there would be different from what you just did then?

A: it would be a bit more professional – like, everything - the form would be perfect and yeah!

J: Okey dokey, and if you were to teach someone to do the forward roll what would you tell them – a couple of things.

A: Just about safety, how to support themselves and um, just go through in a natural motion and don't put your hands out and just go through in a normal motion.

J: ok thanks very much

Carmen – 20 years of age

J: when was the last time you did a forward roll?

C: gee I can't remember, sometime in early high school

J: about 9 years ago?

C: yes, that would be right

J: and what were you thinking about when you did that roll

C: um it was like going back to high school and um, not high school – but primary and in year six – and yeah it was fun.

J: and if you were to do a perfect forward roll, how would it be different to the one you did then?

C: a perfect one?

J: if you were in the Olympic games say?

C: no, I don't think I would be ever.

J: how would yours be different? Or how would theirs be different?

C: Theirs would be heaps better because they've got have a lot of experience and they practice every day and I hardly ever do it and like the last time I did it was 19 years ago. Yeah!

J: if you were to teach someone to do a forward roll, what would you tell them?

C: I'd tell them to do the forward roll? Put two hands on mat - bob down and then have your head down first and sort of lift yourself up and yeah?

J:

C: and then yeah, that that's it!

J: how would you tell the to say, stand up?

C: how would they stand up? - Like after the roll?

J: yes

C: have the two legs - sort of use it as for balance – like to support your whole body – to lift your whole body up.

J: sounds pretty good to me – thanks!

Matthew – 19 years of age

J: when was the last time you did a forward roll?

M: in year 10 when I did gymnastics and stuff

J: are you pretty experienced?

M: No not really, just swan dives and stuff like that.

J: so what were you thinking about as you did that forward roll or just before it

M: it probably looks really seedy on camera – but um I sorta - I couldn't actually remember how to do one – like I was sorta trying to work out whether you had to put your hands down or stuff like that –yeah

J: so what conclusion did you come up with?

M: that I had to put my hands down I'd hurt my neck, otherwise

J: so you tried to protect your neck

M: ahh yet, a bit more than normally

J: so if you were to teach someone how to do a forward roll, what would you actually tell them? What sorts of points?

M: I'd tell them to duck down into a ball first, put their hands down and push up and out tupa-thing - so they can roll and stand up and have fun

J: so having fun is part of it

M: yes, having fun is the best part of it.

J: OK how do you think you could get them to stand up? What sort of things would you tell them so they could go through the roll and actually stand up?

M: Just sort of push themselves forward and up and so they could get enough momentum so they could get up on their feet and up
J: what sort of qualities do you need to get enough momentum?
M: push out from your hands – really hardish not too hard so that you would topple over - sort of thing you have to work out after a after a few goes before you can do it.
J: did you work it out?
M: ah yeah, after about the fourth one.
J: and what did you work out?
M: that you just push out – hahah nothing really, just A subconscious thing – how much effort you have to put in
J: so it is force or something like that?
M: your brain sort of subconsciously works out after each go it'll say like it will say, "sorry no, that was too much and a you don't realise you're doing it but you do it".
J: thanks a much

Sam – 19 years of age

J: When was the last time you did a forward roll other than today?
S: probably year 10
J: and how long ago was that?
S: about 4 years
J: what were you thinking about when you did that roll? What sorts of things were you thinking about?
S: mmmh not a lot – just trying to remember what I'd done before hand and if it would still work
J: and what sort of things were they?
S: hands down flat, tuck your chin to your chest – roll over on your back of your neck and down your spine.
J: and if you were to do a perfect forward roll – watching the Olympic games, how do you think your roll would be different if you were in the Olympic games?
S: I have absolutely no idea I don't know what types of forward rolls they do
J: okey dokey – and if you were to teach someone to do a forward roll what points would you mention to them.
S: probably the tucking the chin into the neck otherwise they would do some serious damage – and the hands on the ground for a bit of stability and make them roll over a bit more.
J: thank you

Ernie – 19 years of age

J: Ok Ernie, when was the last time you did a forward roll?
E: about a year ago – about this time.
J: what were the circumstances of that?
E: I thought I did it pretty well
J: no... where were you =- what were you doing?
E: I was here - during this class (repeat student)
J: and what sort of things were you thinking about doing a forward roll this time

E: umm just not trying to break my neck
J: so how did you try to stop that from happening
E: just tuck my chin into my chest and rolled over
J: so why do you think it is important to tuck your chin in?
E: so you don't hurt your neck.
J: and how did you manage the roll over?
E: um – body force and weight
J: and if you were going to teach someone the forward roll what sort of things would you think of about that
E: um just tell them to tuck their chin in to their chest and tell them to put their hands forward just above their head and that's about it.
J: Tell us a little bit more about where to put their hands forward above their head
E: um just so it supports their neck a little bit more
J: Is that for safety reasons?
E: Yep
J: Thank you very much

One week prior to these interviews these first year B.Ed students had been give instructions about how to teach a forward roll to children.

Alex –19 years of age

J: When was the last time you did a forward roll?
A: Apart from last week in PE, probably when I was in year 6
J: And what was the circumstances of your Year 6 experience?
J: what were you doing – a gym lesson?
A: ahahah yea, a gym class
J: was that at a school
A: yes,
J: and what sort of school was that
A: a public primary school
J: and what were you thinking about then when you were doing a forward roll?
A: ah um try not to hurt myself I think (laughter)
J: yes,
A: yes, not hurt my back or my neck
J: and what did you do to try and stop that?
A: um put my hands down first, and try to land with my shoulders first and tuck my neck under rather than go on my head but I went on my head – at that time
J: and if you were to do that roll again, how would you do it differently?
A: I could try to tuck myself up more
J: and if you were going to teach someone how to do a forward roll, what would you say to them?
A: to put their hands down first and then to try and ...I'd don't know if this is right, tuck their head in so that their shoulders come down first.
J: and is there any other part of the roll you would concentrate on besides the beginning?

A: um maybe the 'getting up' or something - I'm not sure
 J: so how do you think you could try to get them to stand up?
 A: try to land with their both feet together and stand up with both feet together
 J: and anything that could assist that
 A: um maybe using their hands ...I'm not sure
 J: and if you were actually competing in the Olympic Games, how do you think your performance would be compared with them – what would be the difference between your performance and an Olympic performer doing that roll?
 A: they are professional – and I haven't been taught properly – how to properly do a forward roll maybe
 J: and how would they look like?
 A: they would probably look really elegant and graceful – I just sort of all arms and legs all together. (laughter)

Becky – 18 years of age

J: and Becky when was the last time you did a forward roll besides today?
 B: um actually did it in Touch Training on Tuesday afternoon
 J: and why would you do it then?
 B: After a dive for the try-line
 J: and before that
 B: ahh probably about in year 6
 J: and what were you thinking about when you were doing this forward roll today?
 B: um it just took me back to when I was in Year 6 ahh it gave me um ... back to present – it reminded me of having fun again.
 J: Oh that's good
 B: yes
 J: and what sorts of things did you do to get over in that roll
 B: I just ensured my head was in the right position so I didn't hurt my neck and I ensured that my legs were tucked up and my arms were out straight and to bring me up to a starting position again
 J: tell me a bit more about your arms – what did you do to get yourself to stand up
 B: I pretty much just straightened them out and out in the front to bring me up
 J: and if you were going to teach someone to do a forward roll, what would you tell them?
 B: pretty much the safety issues first about their neck and how their legs are positioned and how they can stand up properly... um keep themselves in a ball until their legs hit the ground again and then reach up in the air to bring themselves up and standing again.
 J: why do you think it is important for them to stay in a ball?
 B: um so they can roll over and they can get back up again – because if they are not in a ball, their legs just flop down on the ground and they're just sitting there.
 J: tell me a bit more about their legs – what do they have to do with their legs
 B: bend them up to their chest and then as they come up they bring their chest back up to their knees and then up –
 J: thank you very much.

Interviews of first year B.Ed students 14th May 2002

Michael – 18 years of age

- J: and Michael, when was the last time you did a forward roll
M: probably I'd say Year 6
J: and that was four, six years ago?
M: yes,
J: and what were you thinking about when you did that forward roll
M: ah not much, just a few 'flash backs' I suppose – you know, yeah,
J: what do you think is important?
M: getting the right technique – you know – your neck and that – it's very important that you don't do an injury and that
J: and can you tell me a bit more about what you are trying to do with your neck
M: aaw you're supposed to hold it a certain way – that they showed us – and um tucking it down on your chin um and I probably wasn't doin
J: and if you were to be performing in the Olympic games, as a forward roll, how do you think that forward roll would be different to your forward roll
M: I'd have to say very different – yyeah a lot more basic – whole technique and that – just getting me out of it – yeah a lot more training I suppose for that –
J: what do you mean how you would come out of it
M: just how I would – the momentum - I jump up and that I suppose in the Olympic games they are much fitter – just a lot more flexible probably
J: can you tell me a bit more about 'this momentum thing?'"
M: um aaw I'd probably do it a lot slower and yeah, just forward roll is the beginning of doing somersaults sort of thing so for more advanced stages an that it gets a bit more developed.
J: and if you were going to teach someone how to do a forward roll, what points would you emphasise?
M: the safety aspect – that is very important and proper technique and that would be my main points
J: can you tell me a bit more about what you think the proper technique is?
M: um – aw well, feet together, I think you are supposed to have your chin down and um hands flat and sort of tuck over and come out of it with two feet and hands out – that is just about it.
J: thanks very much

Lee – 41 years of age

- J: and what were you thinking about when you did that forward roll
L: I was concentrating really hard (laughter)
J: what were you concentrating on?
L: making sure that the back of my head hit... went on the floor first – like that back of my shoulders

J: if you were going to teach someone to do a forward roll what points would you emphasise

L: the points I would emphasise – making sure that the shoulders are what would hit the mat first, and I would stand beside them and make sure they actually did that – actually make sure their chin was tucked in and being a mother – I’d make sure those type of things – because I am fearful of neck injuries

J: and if you were to compare your performance to that of an Olympian, how do you think it would be different.

L: I’m pretty cool – I’m pretty amateurish – not professional - yeah

J: what would the difference be do you think?

L: um they’d know exactly what they were doing – don’t have to concentrate – it would come naturally yeah

J: so what did you actually concentrate on?

L: what did I concentrate on?

J: yes, apart from your neck

L: making sure that I actually did the somersault

J: and how did you do that?

L: just positioning myself in the right position I suppose

J: I’ll ask just one more question, so what other parts of the roll besides your head and neck were you concerned about? And getting over – how did you get over

L: aah how did I get over?

J: yes

L: that was momentum I think – but umm my big scary thing is just getting up and not making a fool of myself or falling over

J: and how did you do that?

L: I crossed my front legs – I crossed my legs when I went to get up

J: so you know about crossing your front legs

L: yes it sort of comes natural

J: and the momentum thing – can you tell me about that

L: if I knew the language I probably could – I don’t know – it just happens when I go to roll.

J: so you just let gravity take its course

L: yes,

J: thanks lee – thanks very much

Hayden – 21 years of age

J: and when was the last time you did a forward roll

H: a week ago when I was in PE

J: and before that?

H: two years

J: what were you thinking about when – before, or during that forward roll?

H: just to tuck – get your head under and yeah that’s it – just spring up to your feet

J: can you tell me a bit more about the tuck then?

H: um just make sure that the head is under – that I hit on the back of my neck and once you hit on the back of the neck – you just continue rolling

J: and the spring to your feet – what is that one

H stay on the balls of your toes and actually get some pushoff with forward momentum – not just straight up.

J: can you tell me a bit more momentum – how did you maintain that.

H that is what happens – when you hit the back of the neck – you keep rolling you tuck yourself into a ball and you keep rolling - it is not about leaning backwards or anything and.

J: if you were to teach someone to do a forward roll – what points would you emphasise

H: we'd start off pretty slow and bend knees and head down – hands behind the ears and then we'd go from there we'd make sure that the hands would hit the ground with the back of the head and I'd push them over the first time and then we'd go from there.

J: and if you were to watch an Olympic performance how do you think it would be different from yours.

H: I'd know that my legs would be straighter – probably get more air and it would be more a dive roll than a forward roll – um yeah it would be more professional – finish beautifully

J: thanks

Georgina – 18 years of age (ex-competitive gymnast)

J: when was the last time you did a forward roll other than today?

G: two weeks ago in PE

J: and before that

G: probably when I was little – I don't know how old I was probably 10 or something

J: and what were the circumstances when you did a last one – at a gym club was it?

G: yes, in Gunnedah

J: and what were you thinking about when you did that roll

G: not much – just trying to make it straight and stand up straight at the end

And roll properly

J: and how did you try to stand up at the end?

G: keep feet together and put my arms up

J: and roll properly – what does that mean

G: tucked under properly and that whole process of it

J: and if you were to compare your performance of that of an Olympian, how do you think it would be different

G: theirs is probably a bit neater – or precise

J: and if you were to teach someone a forward roll – what would you tell them?

G: it would depend on the age – if they were young age I would get them to put their hands down and hold their neck and I'd just spot them – I don't know how actually - I have to teach that next week I have to teach a forward roll

J: what do you think is important other than the hand and head placement in a forward roll?

G: the rolling – make sure their head is under and they don't hurt it really

J: thanks Georgie

Interview transcripts from Location C: older adults who attended Residential School Thursday 4th April 2002

Choral – 33 years of age

- J: when was the last time you did a forward roll besides today?
C: about 3 years ago
J: and what were the circumstances of that?
C I was teaching my daughter how to forward roll
J and what sort of things did you actually say to teach her how to do that?
C I showed her the position to start that and when I first told her –um feet together, squat, head forward onto the chest and roll the shoulders forward and try to get the back of the neck to touch the mat. Put yourself into a ball and then give yourself a good pushoff so you can get your momentum going
J yes, Ok. And if you were actually competing in the Olympic games and I said you were a world expert in forward rolling, what would you think about.
C my finish
J Ok – can you tell me a bit more about that
C um finishing with my feet together and (inaudible)... Usually with your arms forward.
J so, with a nice ending – what do you think of first?
C standing with my feet together and the ? / touching .. and the back of the neck and then giving my...but not too much that....?
J fantastic great

Paul – 40 years of age

- J and when was the last time you did a forward roll besides today?
P probably about 4 or 5 years ago with my seven year old
J were you teaching him how to roll were you?
P no, he was teaching me how to roll
J and so what did he say
P um he put a whole heap of pillows and cushions on the floor – he had been practicing on his own stuff – he could do a forward roll but he could not do a backward roll...and I said I would like to know how but he showed me how to do a forward roll which was basically, he would do it and he'd say you go ahead and do it dad - I would go ahead and do it – basically copy him and um...
J so what would you think about first when you were doing a forward roll – when you did it four years ago?
P I was probably concerned with what would happen with my neck, and my back and things like that – that I would put them out of joint ... so I was concerned with the physical safety type stuff.
J so what did you do to overcome that?
P uuum I took it very, very slow and not at the rate that a seven year old would do it – so, I wouldn't copy him at the rate he would do it. I didn't copy him at the same rate

J and what was the first thing you thought about doing the roll apart from the back of your neck? What else did you think about?

P I supposed that initially, I don't think I was thinking about anything at all but I'm sure I did – because I did today...

J so what did you think about today then

P Today I was sort of thinking about how do you do this going back to again... like going back to the technique – back to high school when we did it then – like I couldn't remember but I think there was a technique...umm – like feet together (check)

J is that what you were thinking about today?

P yes, yeah - feet together

J is that what you did –

P no I don't think I had my feet together

J well we'll have a look at the video and compare that

P I don't think I did actually... aah .

J yeah

P so that was going through my mind... it just seemed to happen – thanks very much – that is great.

Penny – 28 years of age

J OK Penny, when was the last time you did a forward roll?

P about 12 months

J and what were the circumstances of that

P I have two little girls and they do them and I was doing them

J oh ok that's good – so today what was the first thing you were thinking about doing the roll

P putting my hands down on the mat

J can you tell me more about that then

P um I was thinking about putting my hands down on the mat and then I thought about tucking my head – my chin sort of onto my chest and then I thought about .. sort of..flicking over to keeping my head under and after that I didn't really think about it. It just happened. End up on my feet – not thinking about it ...

J so if you were going to teach someone how to do a forward roll what would you tell them?

P umm I'd tell them to ummm ummm perhaps I would start on ...? And put their hands down on the mat and .tuck their head - . chin to chest like I did... and would you help them roll over?

J you can but I'll show you that a bit later...

P uum and I would tell them to push with their legs... over...push themselves over - I

J Ok that is fine thankyou.

Genelle – 36 years of age

- J when was the last time you did a forward roll other than today?
G a while ago
J a long time?
G probably more than ten years
J and when you did a forward roll today what were you thinking about?
G when I was going into the roll? (yes) getting that back - my head down... so I don't land on your neck - or land on the top of your head
J and how did you stop that from happening?
G I'd take a good run up – land on my hands and flip over
J and if you were actually..
G so you'd land on here – on the shoulders
J so if you can actually going to teach someone a forward roll what would you tell them?
G um initially, I'd probably tell them to stand still and tuck right up in a ball – um do the similar things we were doing this morning – (in class) um with sport and then if I was teaching them I'd make sure they land on their shoulders not on your neck or your head – and practice that and deconstruct it a bit.
J OK thanks

Tracey – 38 years of age

- J when was the last time you did a forward roll other than today
T I think I was about 14 or 15 in high school
J what were the circumstances of that? Was it a gymnastics lesson?
T it was.
J OK and when you did the forward roll today, what did you think about doing before you did it?
T can I remember how to do it
J yes
T remembering how to curl up into a ball before I hit the floor and watching where my head was.
J can you tell me more about the “tucking into a ball”?
T uumm just remembering to get down low and to curl up and to make sure that your head didn't hit the mat.
J Ok, and how did you stop your head from hitting the mat?
T well I ended up landing on the back of the neck – I can still feel it (laughter)
J a bit tight it is?
And if you were going to teach someone how to do that how would you ...
T aw look well, they'd have to keep their chin on their chest, put their head right down between their legs if they can - and just do a gentle little tilt and a gentle roll from there. And That's how I would teach it but also their balance– like the little ones can go off on a shoulder and that's when they can do some damage to their necks.
J thanks very much Tracey

Julie – 48 years of age

- J When was the last time you did a forward roll?
JU about 10 or 20 years ago
J What was the circumstances of that
Ju it was about 10 or 15 years ago when I was playing with my kids
J and what did you think about when today you started to do a forward roll?
Ju I was anxious that I wouldn't know how to do one again. But um it just comes back to you – it's like riding a bike.
J what was the first thing that you thought about when you did that?
Ju the first thing I thought about was I think it was just putting my hands down and after I done it I was thinking about what a good feeling it gives me in the tummy - was
J just tell me a little bit more about your hands then. What did you do with that?
Ju stick them down in front of me on the mat.
J that was it – what about your finishing?
Ju I can't I don't do anything with my hands...
J if you were actually teaching someone to do one, what would you tell them?
Ju to begin with?
J yep
Ju Umm to put their hands down on the mat and put their weight on their arms.
J ok
Ju and then to put their top of their head down.
J ok thanks very much

Leah – 25 years of age

- J tell me the last time you did a forward roll?
L oh gosh, about when I was 16
J and the circumstances of that were...
L um I (inaudible) probably...?
J in the playground oh ok
J if you were going to teach someone to do a forward roll what would you tell them?
L oh um I need to watch myself a little bit – keep my head tucked in and make sure that your hands could take a bit of the pressure initially ...(Inaudible) /// shoulder and keep your head clear?? ???
J is that what you thought about today.. like when you were standing at the end of the mat... what was the first thing you thought about when you were standing at the end of the mat today
L whether I could get back up again.
J ok
L Um just to give myself enough momentum to be able to roll all the way back up
J how did you do that?
L (inaudible suggestion from John) no no, ..?? I pushed off quite heavily with my legs...?

J OK

Russell – 41 years of age

J and when did you last perform a roll?

R the last roll was probably when I was 13

J OK – and what was the circumstances of that

R doing gym at school and having a PE teacher who had us doing all sorts of things – and forward rolls were one of those things – that was the last time...

J OK so if you were in the Olympic games, and what would you think about when you were doing a forward roll?

R the main thing I would think about is to tuck the chin down so you don't break your neck. (laugh) put the hands in front as well. There is always a certain element of fear when you're coming to do a forward roll you know there is an element of the unknown and so you're just thinking how you can protect yourself and especially (inaudible)...

J fair enough.. Can you tell me a bit more about your hands then?

R um - yeah well, – I think the first thing that touches the ground is the hands and so that gives you a sense of support and then I think it gives you a sense of safety as well like tucking the chin and keeping the body bunched up and roll successfully.

J yeah well how did you go anyway?

R No bad not bad - I don't think it was too bad (upbeat) I don't think it was too back actually

J If you were to do it again, how would you change it?

R aah well I think that the first time you do it after 20-30 years and it's going to be a bit sloppy, so you just think of the same basic principles and you try to be a bit more mindful of them and then...

J ok then

Rebecca – 30 years of age

J when was the last time you did a forward roll other than today?

R probably about 15 years ago

J and when you were doing a forward roll today, what were you thinking about?

R trying to stay straight

J OK – and how did you try and do that

R umm just by trying to keep my body lined up. I guess by putting my head down first and hoping that I didn't swing to either side and try to keep control of my legs

J and if you were to perform in the Olympic games, that forward roll, what would you do to change the roll.

What would you be looking for in your Olympic Performance?

R I would try to be tighter.

J Ok

R so and I would have more control over my body and I wouldn't flop around as much.

J Ok and if you were going to teach someone how to do a forward roll what would you tell them?

R umm to tuck their head in more and um and to use their whole body to get the propulsion not just the head
J great thanks

Jennifer – 25 years of age

J when was the last time you performed a forward roll other than today?
Je in primary school –
J and how long ago would that be?
About 10 years
Je yes,
J Ok right and what did you think about when you were doing a forward roll then
Je I thought at first – oh my god, can I do it (laugh) and then I thought – am I going to look stupid and after I did it the first roll – I thought Oh my god, am I doing it right and am I going to hurt my neck.
J so if you were going to teach someone how to do a forward roll what would you tell them?
Je I'd tell them to tuck their head in more than what I did (laugh) and I don't know whether you're supposed to keep your head off the mat or not and I'd have to find that out - or what your hands are supposed to be doing (while you're in the forward roll) =- I wasn't really sure.
J so how did you try to keep your head off?
Je I don't think I've ever...I sort of put my hands down – and that way – and my body went over that way a bit - I think my head touched too much
J Ok and if you were an Olympic Athlete at the Olympic games for gymnastics how would you do a forward roll there?
Je probably start differently – and then go down and I'd make sure I came back up straight and like stood more at the end stand more at the end rather than how I did it
J thanks Sarah!!.

Sonny – 42 years of age (female)

J when was the last time you performed a forward roll other than today?
S probably 20 years
J and what were you thinking about just before you did that forward roll?
S keep – watch out for my neck – I was worried about my neck
J so how did you try and protect your neck
S I made sure that when I put my head down – like I didn't kind of go down onto my head.. and so when I put my head down, I tucked my head under - I went down on my hands – keep my head tucked in - on my head and roll under...???
J so what else did you do to stop yourself from rolling on your head
S uum try to think about where my arms – like where my shoulders and arms were and try to keep myself straight and so that was what I was worried about.
(Inaudible)
J so if you were an Olympian performing the forward roll, what would you do in that forward roll?

- S I'm assuming there'd be a lot more energy in it than there was in mine – it would be far more dynamic than what I did and I probably wouldn't be thinking about it – I would have done it 1,000 times so many times – it would be much more natural I wouldn't be thinking about it. – Wouldn't be thinking about putting my head down, my neck I'd just do it!
- J thanks very much

Kim – 33 years of age

- J when was the last time you performed a forward roll other than today?
- K probably 10 years ago
- J and if you were going to teach someone to do a forward roll what would you tell them?
- K I would tell them to come up to the mat – ummm bend down to the squat position – tuck their chin to their knees and press their weight onto their hands and roll forward.
- J and if you were an Olympian and performing in the Olympics, how would you perform it?
- K how would I perform it?
- J what qualities would it have?
- K um I'd have more speed and be more stylish finish -
- J and what would a good finish be like?
- K (laughing) – a good standing position – like coming up and coming up to a standing position and looking strong
- J looking strong and tight?
- J ok agreed – thanks

Liz – 35 years of age

- J when was the last time you did a forward roll – besides today?
- L a long time ago – probably 19, strike – it would have to be 20 years ago...
- J when you starting to perform your forward roll what were you thinking about
- L I hope I can do this without injuring myself.
- J and what sorts of things did you do to stop from injuring yourself?
- L I took great care of my knee because it's really bad and it's heavily taped up so I couldn't actually bend it when I rolled – which made it difficult but at least I knew it wasn't going to do it any damage.
- J if you were going to teach someone to do a forward roll, what would you tell them?
- L make sure they put your hands down and tuck their neck down and chin down to their chest to protect their neck - and not land on their head.
- J and how would that teaching of performance differ from and Olympic Performance.... What would you expect of an Olympian to do in a forward roll
- L an Olympian wouldn't actually touch the ground with their head at all – they would tuck it right under – whereas a child would probably put their head down and roll from their head downwards.
- J thanks
- L no worries

End of tape.

APPENDIX F
Adult Information/Consent Form

Research Project Title; Going SOLO with the Forward Roll.
Participant Information Sheet

Dear Participant,

As part of a research undertaking whilst enrolled as a student at the University of New England, Armidale, in the degree of Master of Education (Hons) I am investigating the link that exists between motor skills (in this case the forward roll) and the learning cycles that exist in an already established framework. In this particular case, the framework that is being used is the Structure of Observed Learning Outcome (SOLO) Model.

As part of this research project it is necessary to record an interview with a number of persons and then videotape them whilst they are attempting to perform a forward roll.

What will be required of the participant should they consent to take part in this study?

I am seeking permission to record an interview and videotape you for the purposes of skill analysis. The recordings will take place during normal practical lectures. Each of these interview/videotaping sessions will take about to ten minutes. You are reminded that participation in this research is entirely voluntary and you may withdraw at any time.

Privacy and confidentiality.

The Human Ethics Committee of the University of New England (Approval No HE02/058) has approved this project. The Human Ethics Officer of the University can be contacted on 02 67732449 for further details, if required. Data from this study will be stored in a locked cabinet and destroyed after 5 years. Results of the study may be published in a thesis, scientific journals and conference papers, but there will be no information identifying the participants by their name or their location.

If you have any further question or concerns about this study, you can contact me on the phone number on the bottom of this sheet. Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at the following address

Research Services
University of New England
Armidale, NSW 2351.
Telephone: (02) 6773 3449 Facsimile (02) 6773 3543
Email: Ethics@metz.une.edu.au

Thank you for taking the time to read this information sheet.
Yours sincerely,

John Haynes.
Lecturer in Physical Education and Sport Studies
Room 76 Milton Building.
University of New England
Armidale 2351.

.....
Consent Form.

I (as adult/ parent/guardian/care giver) have been provided with a copy and have read the information contained in the Information Sheet for Participants and any questions I have asked have been answered to my satisfaction. I agree to the participation of my child in this activity, realising that I may withdraw permission at any time. I agree that research data gathered for the study may be published, provided real names are not used.

I(name of parent/guardian/caregiver) give
permission for my child/charge(Name).....(age)
to be videotaped whilst performing the fundamental motor skill known as the forward
roll, as part of a research project being undertaken by Mr. John Haynes, who is currently
a student at the University of New England, Armidale.

Signed.....(adult/parent/guardian/caregiver)

Date/...../.....

Contact details.....
.....

APPENDIX G

Transcript of Selected Interviews

‘R’ (female) aged 30 years.

Transcript for Interviews from Residential School 2002: Location C

Thursday 4th April 2002

Transcript

Analysis Notes

- J when was the last time you did a forward roll other than today?
- R probably about 15 years ago
- J and when you were doing a forward roll today, what were you thinking about?
- R trying to stay straight and really wanting to have a go
- J OK – and how did you try to stay straight and do that?
- R umm just by trying to keep my body lined up. I guess by putting my head down first and hoping that I didn’t swing to either side and try to keep control of my legs
- J and if you were to perform in the Olympic games, that forward roll, what would you do to change the roll?
What would you be looking for in your Olympic Performance?
- R I would try to be tighter.
- J Ok
- R so and I would have more control over my body and I wouldn’t flop around as much.
- J Ok and if you were going to teach someone how to do a forward roll what would you tell them?
- R umm to tuck their head in more and um and to use their whole body to get the propulsion not just the head
- J great thanks

Previous experience

Subject indicates motivation to try the forward roll

‘R’ (male) aged 41 years

- J and your last roll?
- R the last roll was probably when I was 13
- J OK – and what was the circumstances of that?
- R doing gym at school and having a PE teacher who had us doing all sorts of things – and forward rolls were one of those things – that was the last time...
- J OK so if you were in the Olympic games, and what would you think about when you were doing a forward roll?

Previous experience

R the main thing I would think about is to tuck the chin down so you don't break your neck. (laugh) put the hands in front as well. There is always a certain element of fear when you're coming to do a forward roll you know there is an element of the unknown and so you're just thinking how you can protect yourself and especially (inaudible)...

Aware of safety

Reference to fear

J fair enough ... Can you tell me a bit more about your hands then?

R um - yeah well, - I think the first thing that touches the ground is the hands and so that gives you a sense of support and then I think it gives you a sense of safety as well like tucking the chin and keeping the body bunched up and roll successfully.

Reference to safety

J yeah well how did you go anyway?

R No bad not bad - I don't think it was too bad (upbeat) I don't think it was too back actually

J If you were to do it again, how would you change it?

R aah well I think that the first time you do it after 20-30 years and it's going to be a bit sloppy, so you just think of the same basic principles and you try to be a bit more mindful of them and then...

J ok then

LE (female) aged 35 years

J when was the last time you did a forward roll - besides today?

L a long time ago - probably 19, strike - it would have to be 20 years ago...

Previous experience

J when you starting to perform your forward roll what were you thinking about

L I hope I can do this without injuring myself.

Reference to injury

J and what sorts of things did you do to stop from injuring yourself?

L I took great care of my knee because it's really bad and it's heavily taped up so I couldn't actually bend it when I rolled - which made it difficult but at least I knew it wasn't going to do it any damage.

J if you were going to teach someone to do a forward roll, what would you tell them?

L make sure they put your hands down and tuck their neck down and chin down to their chest to protect their neck - and not land on their head.

Aware of safety

- J and how would that teaching of performance differ from and Olympic Performance.... What would you expect of an Olympian to do in a forward roll
- L an Olympian wouldn't actually touch the ground with their head at all – they would tuck it right under – whereas a child would probably put their head down and roll from their head downwards.
- J thanks
- L no worries

Interviews of first year students 14th May 2002

LR (female) aged 41 years

- J: and what were you thinking about when you did that forward roll
- L: I was concentrating really hard (laughter)
- J: what were you concentrating on?
- L: making sure that the back of my head hit... *Aware of safety*
went on the floor first – like that back of my shoulders
- J: if you were going to teach someone to do a forward roll what points would you emphasise
- L: the points I would emphasise – making sure that the shoulders are what would hit the mat first, and I would stand beside them and make sure they actually did that – actually make sure their chin was tucked in and being a mother – I'd make sure those type of things – because I am fearful of neck injuries *Reference to fear*
- J: and if you were to compare your performance to that of an Olympian, how do you think it would be different.
- L: I'm pretty cool – I'm pretty amateurish – not professional - yeah
- J: what would the difference be do you think?
- L: um they'd know exactly what they were doing – don't have to concentrate – it would come naturally yeah
- J: so what did you actually concentrate on?
- L: what did I concentrate on?
- J: yes, apart from your neck
- L: making sure that I actually did the somersault
- J: and how did you do that?
- L: just positioning myself in the right position I suppose

J: I'll ask just one more question, so what other parts of the roll besides your head and neck were you concerned about? And getting over – how did you get over

L: aah how did I get over?

J: yes

L: that was momentum I think – but umm my big scary thing is just getting up and not making a fool of myself or falling over

J: and how did you do that?

L: I crossed my front legs – I crossed my legs when I went to get up

J: so you know about crossing your front legs

L: yes it sort of comes natural

J: and the momentum thing – can you tell me about that

L; if I knew the language I probably could – I don't know – it just happens when I go to roll.

J; so you just let gravity take its course

L: yes,

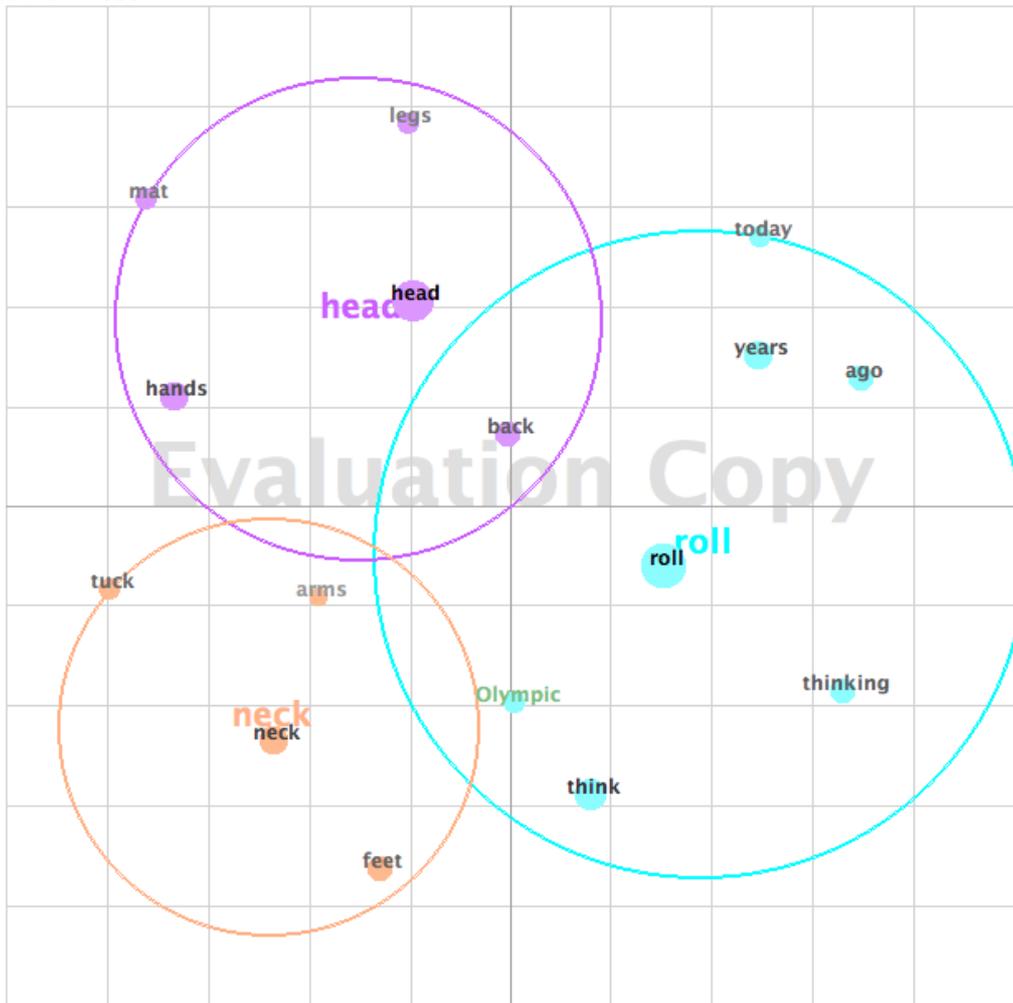
J: thanks lee – thanks very much

Reference to fear

APPENDIX H

Leximancer Theme Map

Iterations = 1000



APPENDIX I

Two Additional Children's Cohort Case Studies

Aimee (1A)

Aimee is a seven-year-old female and, she had entered the sport of gymnastics 4 months prior to the data being gathered, and attended the recreational gymnastics component of the club's program once per week (Maunder, 2000).

Movement Transcript

The following description, shown in Table 1 is based upon temporal sequencing and was filmed at Location B. This subject was viewed from an anterior (front) aspect.

TABLE 1: TIME BASED MOVEMENTS

Observation number	Elapsed time (seconds)	Description
1:	0:00	Start. Eyes/head focused slightly downward towards surface. Arms are just below shoulder height. Moves both ankles.
2:	0:00	Body tilts forward as arms (straight) move towards surface, in front of the body, as knees flex.
3:	0:01	Eyes/Head shift focus slightly closer to body as head/shoulders move closer to surface. Full squat position with full knee flexion.
4:	0:01	Just eyes/head focus directly downwards prior to hands contacting surface. Both elbows flex slightly. Full hip and knee flexion.
5:	0:01	Neck flexes and hands contact surface. Top of head contacts surface well in front of line of hands. Elbows bent at 90 degrees (to allow head to contact surface?). Hips flexed. Legs abducted approximately 25 cm.
6:	0:01	Subject balanced on top of head and hands, elbows bend to 90 degrees. Buttocks move to max. height. Hip flexion approximately 90 degrees. Knee extension approximately 140 degrees.
7:	0:01	Head remains in line with back as body rotation occurs. Knees remain flexed with ankles apart. Hands leave surface when body at 45 degrees to surface. Hip flexion 90 degrees.
8:	0:02	Head remains in line with spine Eyes focused vertically upwards. Arms are straight but wide apart. Roll continues and whole of back contacts surface almost simultaneously. Back arches slightly prior to lumbar spine contacting the surface. Subject 'bounces' slightly. As legs (slightly bent 145 degrees)) reach vertical the legs adduct. Ankles plantar flex.
9:	0:02	Head remains in line with back. Eyes focused vertically. Rotation continues. Knees flex to 90 degrees. Hips flexed 90 degrees. Arms 2x shoulder width apart, vertical and straight.
10:	0:02	Head remains in line with back. Eyes focused vertically. Left arm first (straight) is lowered from vertical to a position beside left hip but does not touch surface. Then Right arm (straight) is lowered to level with right hip but slightly higher than left arm. Right foot contacts surface before left foot. When left foot contacts surface right foot is lifted off surface. At the same time as left foot contacts surface neck flexes and shortly after left foot is lifted from surface and legs are straightened together (to act as counter balance). Hips flex until trunk is vertical.

11:	0:02	Neck is flexed. Knees flex again with right knee flexing to a greater extent than left.
12:	0:03	Neck is flexed. Eyes focused at mid thigh. Both arms are horizontal and extended in front of body. Subject balanced on buttocks. Left knee flexed at approximately 90 degrees. Right knee flexed at approximately 140 degrees.
13:	0:03	(From 12). Head turns to left. Left arm is lowered laterally towards surface, elbow flexes, and hand is placed on surface to the side and to the rear of the subject. Immediately before the left hand contacts the surface the right arm (straight) is swung (horizontal flexion of the shoulder) across the body and the right hand is placed on the surface in front of the subject's left knee. As the right arm passes over the right knee both the right leg, torso and head turn to the left, following the rotation of the arm. Right arm remains horizontal momentarily. Simultaneously with the left arm movement the left leg (flexed) moves laterally (left) and continues to be flexed. Lateral rotation of the leg continues until the calf of subject's left leg is resting on the surface at more that 100 degrees from the original line of the roll.
14:	0:04	The subject's body/head is turned 135 degrees away from the line of the original roll. The arms are straight and the hands are placed on either side of the left knee. The subject is now resting on the left buttock, thigh and lower leg. The thigh of right leg is flexed and resting on top of the left ankle and the lower part of the right leg is resting on the surface.
15:	0:04/0:05.	The subject's head and body rotate 180 degrees from line of original roll. Weight is transferred to lower left leg and hands. Subject moves right leg along surface to be parallel to left leg; hands/arms are lifted off the surface. Subject is facing almost in the direction she came from. Subject crawls on knees, stands, takes a step back and raises arms above head.

As a beginner Aimee's performances of the roll by did not differ substantially from one trial to the next with regard to gross movement patterns. There were differences, however, from trial to trial in a number of finer aspects of performances. The attenuated descriptions, for each sequence, of Aimee's performance of the forward roll are show in Table 2.

TABLE 2: GENERAL DESCRIPTION FOR AIMEE

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • hyperflexed her arms above the head • lacked body tension and body was not extended • showed no flexion at the hips until the hands made contact with the surface • placed the top of the head on the surface well in front of the hands and she balanced on the head and hands • adopted a loose 'C' shape 	<ul style="list-style-type: none"> • lowered her upper body towards the surface through extensive elbow flexion • flexed the neck ventrally • maintained hip flexion of approximately 90° and knee extension of approximately 140° • tended to maintain the original "push off" position with her legs • maintained an open 'C' body shape 	<ul style="list-style-type: none"> • moved her arms forward (anterior) when her back made contact with the surface • extended her knees • rotated the head and body 180° from the line of the original roll. • transferred her body weight to the left leg and hands and she

- | | | |
|--|--|--|
| <ul style="list-style-type: none"> at the beginning of the roll • demonstrated coordinated arm action • did not tuck the chin to the chest • used the head as the pivot point • partially accepted the body weight on the arms and hands • adopted a wide base of support with the hands, which were placed towards the feet with elbows abducted at angle of approximately 90° • flexed the knees at 90° • pushed off equally with the legs • lacked balance | <ul style="list-style-type: none"> • had a “low body” profile and the buttocks did not reach a high point above the head • did not use the arms to assist momentum • maintained hip extension • demonstrated head and upper back lag • made contact with the floor with the whole of the dorsal surface almost simultaneously • arched the back slightly prior to the lower back (lumbar region) contacting the surface • contacted the surface and hip extension increased • “bounced” slightly on her back | <ul style="list-style-type: none"> crawled on her knees • ceased to roll and she was unable to stand for several seconds |
|--|--|--|
-

In Table 2 each dot point represents a temporal arrangement for each sequence, 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 “lacked balance.” This anecdotal observation adds a measure of quality to the description.

Perspectives 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 and Halverson, 1984) (iii) developmental sequences (Gallahue & Ozmun 2006) and (iv) levels of proficiency (Graham, Holt/Hale, & Parker, 1998).

Gymnastics perspective

Movements lacked the body tension and shape required for an “ideal” or “best” performance. There was lack of joint flexion for some actions and excessive flexion for others. The body did not conform to the ideal curved hollow shape, which affected actions during the end sequence, such as being unable to rise to a standing position.

This participant, when viewed from the gymnastic skill based perspective displayed movements that were consistent with that of a beginner or of low quality in the performance of this skill.

Developmental Phases perspective

Analysis of the Developmental Phases perspective showed that for the initial phase of the roll, the *head and arm action component* very closely approached the description for *Step 2*.

For the leg action component placed Aimee into *Step 2* of the model. For the completion phase the action, the *arm component* indicated that Aimee had reached *Step 2*. In contrast, for *the head and trunk component* Aimee was deemed to be at *Stage 1*. Analysis of the *knee and hip component* put her into *Step 1*.

Developmental Sequences perspective

It was observed that the arms did assist and were coordinated for the beginning and middle part of the roll. Only for the final part of the roll, the subject did not coordinate the arms. This appeared to be characteristic of the *elementary stage*. The body did achieve a loose ‘C’ shape, required for this perspective, at the beginning of the roll as there was full hip and knee flexion, but was unlike the tight ‘C’ shape, characterising the *elementary stage*.

During the middle phase of the roll Aimee’s body shape remained quite open. She uncurled to a flat position, and with the roll continuing the whole of the back contacted the surface almost simultaneously. Her back arched slightly prior to the lumbar region contacting the surface. Aimee bounced slightly on their back. Due to the lack of coordinated action, at the conclusion of the roll, the subject was probably unable to perform a second roll. This was exemplified by the observation that the subject’s head and body rotated 180° from the line of the original roll. Weight was transferred to the left leg and hands...the subject crawled on her knees. This analysis placed Aimee in the *initial* stage of the Developmental Sequence.

Aimee displayed movement characteristics of two different stages. She is classified as falling between the *initial* and the *elementary* stage of rolling for this perspective. Supporting evidence comes from the following observations; the top of her head contacted the surface well in front of the hands and the subject balanced on the head and hands. This is characteristic of both the *initial* and *elementary* stages.

Levels of Proficiency perspective

Aimee achieved the activities listed at elementary level. The *control* level cues for rolling forward include, having a rounded back, shaped like a ‘C’, and Aimee did achieve this shape. However, the chin needed to be tucked in towards the chest, which was not evident; the buttocks did achieve a high point, but the subject rolled on top of the head and not the shoulders, indicating that there was no push from the arms. “Pushing off with the hands such that the shoulders – not the back of the head – touch the surface first” (Graham, Holt/Hale, & Parker, 1998, p. 430).

From the Levels of Proficiency perspective the participant was placed between two levels, the *precontrol* and *control*. The conclusion was that Aimee did not neatly fit the model.

Table 3 provides a comparison between the four types of analysis.

TABLE 3: SUMMARY OF ALL PERSPECTIVES FOR AIMEE

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

Aimee (1A)) showed a number of variations from the different perspectives, as they were described, sometimes fitting between the stages and phases or showing some characteristics of a “higher” phase/stage in one component than another. Due to the age of the participant (seven years of age) it is uncertain whether the observed characteristics are those of a “typically developing” individual or an initial attempt to solve the problem of rolling.

Betty (2A)

Betty was classified as a beginner by the coaches at the gymnastics club (Location ‘B’), and she attended the recreational gymnastics component of the club’s program. She attended gymnastics practice sessions once per week for two months prior to the data being gathered in April 2000 (personal communication Maunder, 2000). The time-based descriptions of Betty’s performance of the forward roll are shown in Table 4.

Movement Transcript

The following description is based upon temporal sequencing and was filmed at Location B. This subject was viewed from an anterior (front) aspect and laterally (the right side).

TABLE 4: TIME BASED MOVEMENTS: FRONT AL ASPECT

Observation number	Elapsed time (seconds)	Description
Anterior Aspect		
0:	0.00	Prior to start. Raises heels off surface several times in bouncy action. Flexes right knee with slight outward rotation.
1:	0.01	Start. Head neutral with eyes focused straight ahead (horizontal). Followed by slight neck flexion and eyes focus down towards surface approximately 1-2 met in front. Both arms start in neutral position then simultaneously forward flex at shoulder (i.e. move slightly away from body to the front). The straight arms remain in front and continue forward flexion at the shoulder. Hips and knees flex, and continue to flex until hands touch surface. Hands/ arms wider than shoulder width.
2:	0.02	Neck continues to flex. Just prior to the head contacting the surface the elbows flex. The neck flexes so that the top of the head is pointed towards the surface. The back is approximately 45 degrees to the surface and knees are fully flexed. Subject’s ankles plantar flex (i.e. balanced on the toes).
3:	0.02	Knees extend (side view) and then back of head makes contact with the surface well in front of hands.
4:	0.03	Back of head starts the roll and it continues along slightly curved back. Hands leave surface when lumbar region of back makes contact with surface Legs are together, knees slightly flexed, and have not quite reached the vertical.
5:	0.03	Head remains in line with back. Arms (straight) continue in arc of shoulder extension. Right leg slightly abducts at the knee. Body rotation continues and knees flex to maximum.

When in up right 'sitting position' arms are horizontal. Right foot makes contact with surface momentarily before left.

(At this point the subject performs a second roll from a tight "C" position. The second roll exhibited the same characteristics as described for trial 1). Following is the description of the "stand up" segment of the second roll.

- 6: n/a. With the knees fully flexed (together) and both ankles (together) close to buttocks the subject stands and the (straight) arms move from horizontal (forward flexion) to a position by each side.

Lateral Aspect (Right side)

- 0: 0.00 Prior to Start: The standing subject looks right towards camera.
- 1: 0.01 Start: Head up, eyes focused down slightly towards surface. Whole body leans forward approximately 10 degrees.
- 2: 0.01 Eyes focused on surface approximately 1 met in front. Arms start to flex at shoulder. Hips start to flex. Knees flex. Ankles flat on surface.
- 3: 0.01 Head remains in line with back. But with continued hip flexion eyes now focus directly down ward. Arms continue shoulder flexion, 9to approx 135 degrees) as do hips (to reach approximately 110 degrees) and knees (approximately 90 degrees). As body continues its downward movement subject balances on toes.
- 4: 0.02 Eyes focused downwards past vertical (towards ankles). Wrists hyperextend just prior to surface contact. Arms flex at the elbow. The top of the head makes contact with the surface when the back is approx 80 degrees. The hips remain flexed at 90 degrees. The knees extend to 180 degrees, and leave the surface prior to the head contact. (This means the subject is taking body weight through the arms). Ankles are plantar flexed.
- 5: 0.02 Neck is slightly flexed and subject rolls no back of head, neck and shoulders. At point where fingers leave surface, the arms are straight and at 180 degrees forward flexion above head. Back is approximately 45 degrees. Hip flexion is 100 degrees. Knees neutral (straight). Ankle slightly plantar flexed. (i.e. toes pointed)
- 6: 0.02 Head leaves surface as body continues to rotate. Both the straight arms simultaneously extend forward through and arc. Back has slight curve. Hips continue to flex to approximately 130 degrees. Legs are together and knees continue to flex. Ankles start to dorsi flex. Subject rotates around buttocks.
- 7: 0.02 Head horizontal, eyes focused horizontally. Arms at shoulder 90 degrees (arms horizontal). Wrists approx 80 degrees pronation. Back vertical. Hips and knees at maximum flexion. Both feet make simultaneous contact with the surface.

8: 0.03 Head/eyes focused ahead. As for 7/- all body weight now on feet.

(At this point the subject performs a second roll, which has the same characteristics as described for the first roll and the following description applies after second roll, when body weight is taken on feet)

9: n/a Knees and hips extend, arms are lowered to the side and the subject turns right to look towards the camera.

As noted in Table 4 Betty performed two rolls in succession, which meant the final observations (i.e., Observation number 9) were made at the conclusion of the second roll.

The attenuated descriptions, for each sequence, of Betty's performance of the forward roll are show in Table 5, which include observations not evident in the temporal descriptions.

TABLE 5: GENERAL DESCRIPTION FOR BETTY

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • did not raise (forward flex) her arms. She commenced in an anatomically neutral position • flexed at the hips and the upper body moved down towards the surface • lowered her head to the surface, which was accompanied by extensive elbow flexion • placed the back (posterior) of the head on the surface which was in front (anterior to) of the position of the hands • the chin was tucked (ventro-flexed head), and the hips were elevated • took the weight of the body on hands and arms 	<ul style="list-style-type: none"> • moved her hips over the vertical plane, beyond the shoulder line • used both her legs to push touched the surface with her shoulders before the middle of the back • adopted a 'C' shape with her body • rolled along a lightly curved back • remained flexed at the hips at approximately 100° • moved her arms simultaneously for the entire performance, which assisted with rotational force • had approximately 90° of knee flexion • adopted an open body shape during the latter part of the rotation • uncurled to an 'L' shape • flexed the knees to maximum • swung the arms forward extended the elbows 	<ul style="list-style-type: none"> • flexed her knees causing the feet to be positioned under the body; this was followed by hip flexion • completed the roll was in a semi-piked position • regained a standing posture • did not use the hands to assist with standing • finished standing with her hands in the anatomically neutral position, by the sides of the body

The description of three hypothetical sequences, shown in Table 5, provides details of a medium quality performance of the forward roll. As for the previous case study, descriptions are arranged in chronological order where possible.

Perspective Analysis

A description of Betty's performance is presented under the relevant perspective headings.

Gymnastics perspective

The amount of extraneous movements, the precision and general body shape relative to what is regarded, as an ideal gymnastic performance deviated from the ideal. For example, hip flexion was accompanied by knee flexion, the she lowered her head to the surface, temporal patterning of the knees and hips were reversed. Betty's skill level in performing the forward roll was determined to represent a performance of medium quality.

Developmental Phases perspective

From a Developmental Phases perspective Betty's initial phase for head/arm component was judged to be *Step 3* and leg action *Step 2*. For the completion stage the arm, head/trunk and hip/leg actions were all *Step 2*. This meant the participant was lagging slightly in the head/arm component of the initial phase.

Developmental Sequences perspective

The participant appeared to have moved beyond the *elementary* stage of rolling for some characteristics, but had not achieved the *mature* stage for others. For example, the arms and body shape displayed characteristics of the *mature* stage. However, the head was still partly used as a fulcrum, and the body uncurled to an 'L' shape, which are characteristics of the *elementary* stage. The participant could perform a second roll in succession, which is also considered a *mature* stage action.

Levels of Proficiency perspective

Betty achieved all the cues that placed her in the *control* level of the Levels of Proficiency model. It was unclear whether this participant was approaching the *utilisation* level and no longer had to focus on rolling as an isolated skill, or whether the participant could use rolling to transfer weight onto, from, and over large apparatus. To ascertain whether this participant could achieve the *utilisation* level, further observational data of the participant attempting rolls on apparatus or whilst airborne would be required to determine whether this participant had achieved the next level of *proficiency*.

TABLE 6: SUMMARY OF ALL PERSPECTIVES FOR BETTY

Case No. "Betty"	Gymnastic Skill	Developmental Phases	Developmental Sequences	Levels of Proficiency
1B	Medium	I (i) Step 3 (ii) Step 2 C (i) Step 2 (ii) Step 2	Between Initial & Mature	Control (No data re; Proficiency level)

Data in Table 6 provides a comparison between the four types of analysis for Betty. This individual's performance fits between two categories for Developmental

Sequences perspective. In addition, Betty could not be classified beyond “control” in the Levels of Proficiency category because of additional data would be required.

APPENDIX J

Two Additional Young Adult Cohort Case Studies

Debbie (1B)

Debbie (female) was aged 19 years and a student at Hilltop University.

Movement Transcript

The following description, shown in Table 1 is based upon temporal sequencing and was filmed at Location C. This subject was viewed from an anterior (front) aspect.

TABLE 1: TIME BASED MOVEMENTS

Observation number	Elapsed time (seconds)	Description
1:	0:00	Head /eyes focused on surface approximately one metre in front. Arms slightly forward flexed at shoulders. Hips start to flex. Steps forward on right foot. Flexes left knee.
2:	0:01	Head /eyes focused on surface approximately 1/2 met in front, (where hands will eventually make contact with the surface). Arms forward flex at shoulders and wrists slightly hyperextend. Hips continue to flex and when approximately 90 deg. flexion the knees are flexed to approximately 45 deg.
3:	0:01	Eyes focused as for “2/-”. Arms move towards surface then extended back towards the feet to vertical (towards neutral). Hands approximately 10 cm above surface. Hips are flexed to approx 90 deg. Knees flexed to 90 deg. Subject balances on toes.
4:	0:01	Subject starts to stand up. Head/eyes still focused on surface. Arms slightly hyperextended. Hands at knee height. Hips and knees extend Heels return to surface.
5:	0:02	Subject commences sequence again from Step “2/-“: Head/eyes focused on surface approximately 1/2 met in front, (where hands will eventually make contact with the surface). Arms forward flex at shoulders and wrists slightly hyperextend. Hips continue to flex and when approximately 90 deg. flexion the knees are flexed to approximately 45 deg.
6:	0:02	Eyes focused on surface. Head in neutral position in line with spine. Hands contact the surface with arms in wide position. Elbows slightly flexed. Spine slightly curved. Hips flexed to approx 140 deg. Knees flexed continue to flex. Heels leave surface.
7:	0:03	With continued forward momentum the top of the head contacts the surface in front of the line between the hands. Elbows flexed at 90 deg. Back rounded. Hips flexed at 140 deg. Knees flexed at 100 deg. Heels off the surface.
8:	0:03	Top of head and hands take body weight, neck in line with spine. Elbows flexed at approximately 90 deg. Hips extend slightly. Left knee extends to neutral (straight). This knee extension provides propulsion along with a contribution from elbow extension. Right foot still in contact with surface. Right foot leaves surface with knee flexed at 90 deg.
9:	0:03	Subject rolls on top of head. Slight ventro-flexion of the neck. Shoulders contact surface. Hands leave surface when weight is taken on upper back and the spine is approx 60 deg. Wrists are

		hyper extended. Back (spine) slightly rounded. Head leaves surface when mid back is in contact with the surface. Hips flexed at approx 120 deg. Left knee flexes and is brought level with the flexed right knee.
10:	0:03	Head in line with spine after leaving surface. Arms assist in rotation and extend at the shoulders. Back slightly curved. Body in “C” position. Hips flexed at approximately 120 deg. Legs together. Knees flexed at approx 90 deg. Ankles in neutral position. Rotation continues until subject balancing on buttocks.
11:	0:03	Roll continues. Left hand is placed on the surface. Push from the left arm assists the subject to stand. Right arm remains horizontal. Hips flex. Knees flex slightly to approx 110 deg at same angle of flexion.
12:	0:03	Upper body and head move forward of knees. Head/eyes focused frontward (horizontal). Arms are brought the sides (neutral position). Hips and knees extend. Subject stands and walks forward starting with the right leg

The second trial for this subject was different in only two respects; there was no hesitation at the initial phase of the roll and during the latter part of the roll the subject did not place their hand on the surface. The subject parted their knees, which allowed the hips to continue to flex. However, when the subject attempted to stand balance was lost and the subject stepped backwards to regain balance.

When viewed from the dorsal aspect (trial 3) the extent of knee separation in the “stand up” phase was evident. Knees were approx 20 cm wider than shoulders. Trial 4 showed another attempt to “problem solve” the final stand-up phase. The subject crosses their legs at the ankles, which also led to loss of balance. This time laterally to the left.

The summarised descriptions of Debbie’s performance of the forward roll are shown in Table 2.

TABLE 2: GENERAL DESCRIPTION FOR DEBBIE

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • did not raise her arms • lacked muscular tension within her body • did align the body segments • contacted the surface with her head prior to commencement of rotation • used the top of her head was the pivot point around which the body weight was supported albeit momentarily • flexed the elbow to approximately 90° 	<ul style="list-style-type: none"> • The body was not rotated onto the upper back • The neck was flexed (head ducked forward) • The participant lowered the head to the surface with extensive elbow flexion, • The back was rounded and the participant adopted a tight ‘C’ body shape • Propulsion was achieved by using only one leg in conjunction with elbow 	<ul style="list-style-type: none"> • flexed her knees just after the forward-downward movement at the end of rotation • did not place her feet beneath the oncoming body • was unable to stand without downward force, provided by the left arm • walked forward (lost balance) on achieving a standing posture • demonstrated slightly different performance on

- | | | |
|--|--|-------------------------|
| <ul style="list-style-type: none"> • partially accepted the body weight on her arms and hands • flexed at the hips, and continued to flex throughout the descent • flexed her knees to approximately 45° when hip flexion reached 90° | <ul style="list-style-type: none"> extension • The trailing leg was observed to “catch up” rapidly, but did not extend • The right foot remained in contact with surface until the knee flexed to 90° | <p>different trials</p> |
|--|--|-------------------------|
-

Table 2 provides a description of the three hypothetical sequences of the forward roll, of a low quality performance from an individual from within the young adult cohort.

Perspective Analysis

As for the previous Case Studies, an analysis of the performance for each individual from the young adults cohort is presented from four perspectives. These are the, gymnastics (George, 1980), developmental phases Robertson and Halverson (1984), developmental sequences (Gallahue & Ozmun 2006) and levels of proficiency (Graham, Holt/Hale, & Parker, 1998) perspectives.

Gymnastics perspective

Debbie displayed movements, which deviated from the ideal in a number of aspects. These deviations included extensive hip and knee flexion, using the head as a pivot point and providing propulsion for rotation through the extension of only one leg. The performances varied from trial to trial, however, for the end sequence the assumption was made that the participant attempted to problem-solve, thereby variations in technique were evident. Thus, using this skill based instrument the participant was classified as *low to medium* quality.

Developmental Phases perspective

Analysis from the Developmental Phases perspective showed that for both *head* and *arm action component* of the initial phase, the participant was at *Step 2*, and for the leg component at *Step 1*. For the completion phase, both components were *Step 3*. The full developmental spectrum of movement was evident for this participant across the range of components.

Developmental Sequences perspective

The participant displayed movement characteristics from two different stages, the *initial* and *mature*. The body maintained a tight ‘C’, characteristic of the *mature* stage, but used the head as a pivot point, characteristic of the *initial* stage.

Debbie’s performance showed some developmental characteristics of each of the three stages of development; *initial*, *elementary* and *mature*. Thus, this participant exhibited a range of developmental stages for different elements of the roll.

Levels of Proficiency perspective

Debbie achieved all the movements necessary to be placed in the category of the *control* level of proficiency. However, some of the cues for a classification within the *utilization* level of proficiency were evident. A ‘C’ shaped body was evident, but the chin was not tucked sufficiently, and the hips were high. It was unclear whether this participant was actually at the *utilization* level and “no longer has to focus on rolling

as an isolated skill or whether the participant could use, rolling to transfer weight onto, from, and over large apparatus” (Graham, Holt/Hale, & Parker, 1998, p. 429).

TABLE 3: SUMMARY OF ALL PERSPECTIVES FOR DEBBIE

Case No. “Debbie”	Gymnastic Skill	Developmental Phases	Developmental Sequences	Levels of Proficiency
1B	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)

The data in Table 3 indicate that this person also fits between two categories for Developmental sequences. Debbie could not be classified above the control level in the Levels of Proficiency perspective.

Fiona (3B)

Fiona is an eighteen-year-old female who had previously trained in gymnastics as a child. At the time of data collection she was enrolled in a teaching degree at Hilltop University and data collection took place at the same session as for the previous participant. All performances of the roll appeared to be identical.

Movement Transcript

The following description, shown in Table 4 is based upon temporal sequencing and was filmed at Location C. This subject was viewed from an anterior (front) aspect.

TABLE 4: TIME BASED MOVEMENTS

Observation number	Elapsed time (seconds)	Description
1:	0:00	Start. Eyes focused on surface 1 meter in front, then at the furthest point of the safety mat area. Forward flexes the arms at shoulders to approx 70 degrees. Arms straight (Raised arms to below shoulder height). As arms reach this degree of flexion the hips flex and gymnast looks down approximately 1 metre in front of feet. When hip flexion reaches approximately 30 degrees the knees start to flex. Heels of the feet leave the surface.
2:	0:01	Descent to floor. Eyes focused 1 metre in front, approx where hands eventually make contact with the surface. Arms are straight and shoulder flexion approx 100 degrees. Back is slightly curved. Hip flexion is 90 degrees. Knees flex to approximately 60 degrees during descent then knee extension occurs such that when the subject’s hands reach the surface the knees are fully extended (legs are straight) and together. The subject’s toes are in contact with the surface. Body weight is on the hands and the head is approx 45 cm from the surface.
3;	0:02	Starting to roll. Subject’s neck is slightly flexed. The elbows commence to flex. The fingers of both hands are spread evenly apart. Back is slightly curved. Hip flexion is approx 90 degrees forming an “L” shape. Knees fully extended (slight hyperextension) to neutral position (0 degrees). Ankles plantar flex.

4:	0:02	Continuing to roll. The neck is slightly flexed and the subject's back contacts the surface at the shoulder line. The arms are flexed at the shoulders to 90 degrees forward flexion. The elbows are flexed to 90 deg. The wrists are hyperextended at 90 degrees (Hands still flat on the surface). Back relatively straight at an angle of approximately 80 degrees. Hip flexion is still 90 degrees. Legs straight (no knee flexion). Ankles in neutral position (toes not pointed).
5:	0:02	Continuing to roll. The head leaves the surface just prior to the middle of the curved back makes surface contact. The hands leave the surface at this point. The lower back is approx 30 deg from the surface. Hip flexion is approximately 120 degrees. The knees commence to flex. The feet are in a neutral position.
6:	0:02	Roll continues along a slightly curved back. Head in neutral position. Arms assist with maintaining momentum (arms brought forward through shoulder extension of the arms). Hip flexion maintained. Knees continue to flex and at the moment the feet contact the surface the knees are flexed to approximately 110 degrees.
7:	0:02	Starting to stand. The head is neutral, eyes focused forward. Arms horizontal and straight. (90 degrees forward flexion). The back is vertical as the buttocks leave the surface. Body weight is on the feet.
8:	0:03	Standing. Head neutral. Eyes looking ahead. The straight arms start to abduct to a position of 130 degrees of horizontal flexion. Hips and knees extend and the subject is standing.

The following descriptions of Fiona's performance of the forward roll, is shown in Table 5.

TABLE 5: GENERAL DESCRIPTION FOR FIONA

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • forward flexed the arms to a position above shoulder height • flexed her hips which was followed by knee flexion • tucked her chin • pushed off evenly with both legs • had straight legs at the moment hand contact was made with the surface • accepted her body weight on the arms and hands 	<ul style="list-style-type: none"> • used her arms to aid rotational movement • flexed her hips very late in the rotation • Did not display head or trunk lag 	<ul style="list-style-type: none"> • had her body weight over the base provided • rose to a standing position smoothly • used some hip flexion to aid standing

This description is of high quality performance, from an individual from the young adult cohort, which shows few deviations from what is considered to be efficient, hence, less information was required to explain deviations from the ideal movements.

Perspective Analysis

A description of the analysis of Fiona's performance is presented following the same perspective subdivisions as for previous Cases Studies.

Gymnastics perspective

Fiona showed few variations from the ideal format, when viewed from the gymnastic (skill) based perspective. The only discernable deviations included some knee flexion during the initial take off. However, this action would add propulsive force, especially from a stationary start. Her skill level is classified as *high*.

It is noteworthy that George's (1980) model does not include knee flexion followed by extension in the ideal performance of the roll even though this action provides a propulsive force and aids the performer when the roll is commenced from a stationary position. In competitive gymnastics "the fewer body segments that are out of a straight alignment the more aesthetically pleasing the performance is regarded" (Maunder, 2000).

At the conclusion of the beginning sequence, at the moment when the hands contacted the surface the legs were extended, exemplifying the ideal curved hollow shape described by George (1980). The arms were used to aid rotational movement, and at the end of rotation the hips were flexed. The whole performance was well coordinated and smooth. The desired slight momentary backward lean (extended torso) was absent from the end sequence of this performance as the participant used additional hip flexion to aid standing. Fiona displayed all the qualities of a highly skilled performer as described in George's (1980) model. Using this data the participant was classified as *high* quality.

Developmental Phases perspective

The arms and hands accepted the body weight. Both legs pushed off 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 over the base provided by the feet. There was no head or trunk lag. The knees began to flex just after the hips began the forward-downward movement. This participant was considered to be in the same stages as the previous participant, namely, CS6. The analysis placed the participant at the *highest* stage for each component.

Developmental Sequences perspective

Analysis of Fiona's performance pointed to the notion that the participant was beyond the capabilities of the system's categorisation. The movements observed placed her well beyond the fundamental movement stage of Gallahue and Ozmun's (2006) Developmental model.

Levels of Proficiency perspective

This participant displayed the features described in the *control* level category, such as having the chin tucked, hips high and the shoulders carrying all of the body weight during the trials. However, she was observed in an informal setting achieving at the *proficiency** level.

TABLE 6: SUMMARY OF ALL PERSPECTIVES FOR FIONA

Case No. “Fiona”	Gymnastic Skill	Developmental Phases	Developmental Sequences	Levels of Proficiency
3B	High	Beyond the scope of this perspective	Beyond the scope of this perspective	Control (No data re; Proficiency level)

Data in Table 6 provides a comparison between the four types of analysis. For this individual only the gymnastic perspective was relevant, the other perspective outlines did not cater for her performance capability. Fiona’s performance was beyond the scope of these perspectives.

APPENDIX K
Two Additional Young Adult Cohort Case Studies

Harry (3B)

Harry is a thirty eight year old male. He was enrolled in a teaching degree the University as an external student. Trial 1 was used for comparison purposes providing a lateral view of the participant. However, the participant always performed two rolls in succession, the rising to standing position was analysed from the second roll.

Movement Transcript

The following description, shown in Table 1 is based upon temporal sequencing and was filmed at Location C. This subject was viewed from an anterior (front) aspect.

TABLE 1: TIME BASED MOVEMENTS

Observation number	Elapsed time (seconds)	Description
1:	0:00	Start. Neck is ventro-flexed. Eyes focused directly down at the surface. Arms by each side, slightly flexed at elbows. Trunk in neutral position. Subject steps back with right leg (hyperextension). Both feet flat on the surface.
2:	0:01.	Neck remains flexed, eyes down. Arms are straight and forward flex at the shoulder to approximately 60 degrees. Forearms pronate (palms face downward) Trunk still upright. Right leg remains hyperextended. Both feet flat on the surface.
3:	0:01.	Subject starts to descend to surface. Head/eyes down - same position as for '1/' and '2/'. Hips commence flexion.
4:	0:01	Continued descent. Head/eyes down - same position as for '1/', '2/' and '3/'. Arms now almost vertical (100 degree forward flexion), slightly flexed at the elbow. Wrists hyperextended 90 degrees. Hands approximately 15 cm from surface. Hips continue to flex. At point when hips are higher than shoulders the right foot leaves the surface. The subject is balanced on a slightly flexed left leg. The subject loses balance. Hands contact the surface.
5/-	0:01	Rotation commences. Neck is ventro-flexed. Arms flex at the elbow to lower head to surface. Trunk is vertical. Hips in highest position. Right leg is flexed at 90 degrees at the hip and 100 degrees at the knee. Left foot leaves surface just prior to the head contacting the surface.
6:	0:01	Continued roll. Back of head contacts surface. Subject rolls onto upper back. Hands maintain position on surface. Right hip flexed approximately 100 degrees, and knee 100 degrees. Left hip flexed at 90 degrees, knee 70 degrees.
7:	0:02	Continuation of roll. Subject starts to roll along slightly curved back. Hands leave surface when body weight is on upper back. Upper arms are abducted, elbows flexed. Right hip flexed

approximately 100 degrees, and knee 100 degrees. Left hip flexed at 90 degrees, knee 90 degrees

8:	0:02	Continuation of the roll. Head leaves surface when mid back is in contact with the surface (fractionally after the hands). Arms assist with rotation and are flexed at the elbow. Back is very slightly curved. Left hip flexed more than right. Right knee flexed more than left. Right leg leads the rotation. Feet in neutral position.
9:	0:02	Continuation of roll. Head in neutral position. Arms adducted and rotate at elbow (Inward rotation). Lower back and buttocks in contact with the surface. Left hip and knee flexed at 90 degrees. Left knee flexed at 90 degrees and knee 100 degrees. Right heel of foot makes contact with surface. Feet neutral.
10:	0:02	Starting to stand. Neck slightly flexed. Head is in front of hip position. Arms are straight and forward flexed to 90 degrees. Back is curved. Buttocks leave surface. Left hip flexed at 110 degrees, Left knee flexed at 90 degrees. Left heel contacts surface with foot neutral. Right hip and knee flexed to a greater extent than left. Right foot flat on surface. A distance of approximately 40 cm between right and left feet (Left in front of right).
11:	0:03	Continuing to stand. Neck ventro-flexed. Eyes focus down approximately 2 metres in front. Head in front of hips. Arms slightly flexed at elbow extend down towards surface. Back slight "C" shape. Buttocks approximately 50 cm above the surface. Hips flexed 90 degrees. Right knee flexed to 90 degrees. Left knee flexed approximately 120 degrees. The distance of approximately 40 cms between right and left feet is maintained. Right heel leaves the surface.
12:	0:04	Continuing to stand. Neck ventro-flexed. Eyes focus down approximately 2 metres in front. Arms slightly flexed at elbow return to neutral position (arms by sides). Hips and knees extend. Right leg is brought to neutral position beside left but is outwardly rotated. The subject is standing and turns to the right

The following descriptions of Harry's performance of the forward roll, shown in Table 2, were derived from observation strategies that were the same as those used for the previous case studies.

TABLE 2: GENERAL DESCRIPTION FOR HARRY

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • did not raise his arms or stand with body tension at the commencement of the roll • flexed at the hips • "tucked" his head forward • contacted the surface with the head in front of the line of the hands 	<ul style="list-style-type: none"> • formed a curved 'C' shape with his body • synchronized his arms were for the entire forward roll • used his arms to assist with the maintenance of the roll through force production • flexed the legs and hips 	<ul style="list-style-type: none"> • finished with his hands held anterior to the body • lost balance and stepped forwards at the conclusion

- pivoted the back of his head but the arms and shoulders carried most of the body weight
- which remained flexed remained throughout rotation
- generated sufficient momentum through the action of the arms

Perspective Analysis

The final Case Studies are analysed for each individual from the older adult cohort. Once again they are presented from four perspectives the, gymnastics (George, 1980), developmental phases (Robertson and Halverson, 1984), developmental sequences (Gallahue & Ozmun 2006) and levels of proficiency (Graham, Holt/Hale, & Parker, 1998) perspectives.

Gymnastic perspective

Harry displayed movements, which deviated from the ideal in a number of aspects. These included lack of body tension, no flight phase, no ‘C’ shaped body configuration and the knees and hips remaining flexed throughout the roll. Some “style” was evident. This participant demonstrated a *medium* quality performance.

Developmental Phases perspective

Analysis of the two components comprising the initial phase of this participant’s trial indicated that the head and arm action component for the participant was at *Step 2*, as the head, arms and hands accepted the body weight. Also, the participant’s leg action component was *Step 2*. Observation and analysis of the completion phase found that this participant had achieved *Step 3* of the phase for the arm action, head and trunk and leg action components.

Developmental Sequences perspective

Harry was at the *mature* stage of this perspective. Supporting evidence included the fact that the back of the head contacted the surface in front of the hands, characteristic of the mature stage. In addition, the arms were synchronized for the entire forward roll and assisted with the maintenance of the rolling action, through force production. In addition, the body maintained a tight ‘C’ position and the participant had sufficient momentum to reach a standing position at the conclusion. However, the loss of balance at this point of the roll makes it unclear whether the participant’s classification could be affected.

Levels of Proficiency perspective

As for most other participants, the proficiency perspective indicated a performance judged to be at *control* level.

TABLE 3: SUMMARY OF ALL PERSPECTIVES FOR HARRY

Case No.	Gymnastic Skill	Developmental Phases	Developmental Sequences	Levels of Proficiency
Harry 3B	Medium	I (i) Step2 (ii) Step 2 C (i) Step 3 (ii) Step 3	Mature	Control (No data re; Proficiency level)

Data in Table 3 provides a comparison between the four types of analysis. Harry could not be classified in the Levels of Proficiency category because of a lack of specific data.

Ingrid (3C)

Ingrid is a 40-year-old female. She was enrolled in a teaching degree at University, as a student studying by distance education.

TABLE 4: TIME BASED MOVEMENTS

Observation number	Elapsed time (seconds)	Description
0:		Prior to start the subject stands at the edge of the safety surface and moves her hands to the head. She looks down at the surface.
1:	0:00	Start. Neck ventro-flexed. Eyes focused down at surface approximately one metre in front. Trunk is straight. Left arm flexed 100 degrees at elbow and left wrist flexed at 90 degrees. Right arm abducted slightly/ Legs straight. Feet apart approximately 30 cm.
2:	0:02	Neck remains ventro-flexed, and eyes still focused down at surface approximately one metre in front. Arms forward extend at the shoulders so they are forward extended approximately 100 degrees (10 degrees below horizontal), and extension occurs at the elbow. Wrists are hypertextend. Hip flexion commences. Legs straight.
3:	0:02.	Subject descending to surface. Head in anatomical neutral position. Eyes focused at point where hands will contact the surface. Arms are straight and forward extended at shoulders 90 degrees. When the hips reach 60 degrees flexion the knees commence to flex.
4:	0:02	Continued descent. Neck slightly dorsally flexed. Eyes still focused at point where hands will contact the surface. Hands contact surface. Wrists hyperextended to 90 degrees. Elbows start to flex. Back is curved "C" Shape. Hips are flexed at 90 degrees. Knee flexion 45 degrees. Legs slightly apart. Heels are off the surface.
5:	0:02	Rotation commences. Head in neutral position approximately 15 cm from surface. Arms flexed at elbow take body weight Back is curved "C" shape. Hips flexed at 90 degrees. Knees extend to neutral position. (providing force for rotation). Ankles plantar flex and feet are off the surface.
6:	0:03	Rotation continues. Upper back at the line of the shoulders contacts the surface. Upper arms forward flexed 100 degrees at the shoulder. Elbows flexed at 90 degrees. Wrists hyperextended 90 degrees (hands flat on the surface). Back is rounded. Hips flexed at 90 degrees making an "L" shape. Legs neutral (straight). Ankles plantar flexed (toes pointed).
7:	0:03	Rotation continues. Head in anatomical neutral position. Back of head just making contact with the surface. Arms leave surface and assist with rotation at a point when the middle of the back, which is rounded, contacts the surface. Hips are flexed to 100 degrees. Knees commencing to flex. Feet in neutral position. Head leaves surface as lower back makes contact.

8:	0:03	Rotation continues. Head in neutral position. Arms forward flexed at shoulders 90 degrees (parallel to floor, shoulder width apart). Back slightly curved at an angle of 45 degrees to vertical. Subject balanced on buttocks, Hips flexed at 90 degree. Knees 90 degrees. Heels contact the surface.
9:	0:03	Starting to stand. Neck slightly dorsi flexed. Arm are straight, forward flexed at the shoulders 100 degrees (hands slightly above shoulder height), but continue to rotate around the shoulder joint. Hip flexion increases to 160 degrees. Knees separate to allow this action and knees are flexed at 140 degrees. Buttocks leave the surface. Subject's weight is on feet, which are flat on the surface.
10:	0:04	On standing the subject is slightly off balance and takes a small step back.

The following Table 5 provides a general description of Ingrid's performance of the forward roll.

TABLE 5: GENERAL DESCRIPTION FOR INGRID

Beginning Sequence	Bridging Sequence	End Sequence
<ul style="list-style-type: none"> • forward flexed her arms to 90° then lowered them to approximately 100° of forward extension • demonstrated some body tension and a slightly dished body shape • flexed at the hips as she moved towards the surface, then flexed her knees • ventro-flexed the neck (chin tucked) and her body was lowered onto the upper back • avoided head contact with surface • flexed her elbows 	<ul style="list-style-type: none"> • moved her hips superior (above) and anterior (in front) to her shoulders • formed an open 'L' shape with her body • moved her arms simultaneously for the entire forward roll, • flexed her hips and knees simultaneously • did achieve a tight 'C' position during the middle part of the roll 	<ul style="list-style-type: none"> • positioned her feet correctly on the surface beneath the body's centre of gravity • had sufficient momentum to stand, but overbalanced slightly, which required a step back to regain balance

Table 4.15 provides a description of the forward roll for a high quality performance of an individual from the older adult cohort.

Perspective Analysis

A description of this analysis is presented under the appropriate subdivisions.

Gymnastics perspective

Ingrid showed few variations from the ideal form, when viewed from the gymnastic (skill) based perspective. Evidence of high-level quality included some "body tension" slightly dished body shape, hip flexion, a tucked head and the placement of the shoulders on the surface taking the body weight. Flexing of the knees allowed the

feet to be placed under the body. Deviations from the ideal included some knee flexion during the initial take off and a momentary loss of balance on standing. Performance of a sequence of rolls with little hesitation between rolls was achieved. From a gymnastic perspective Ingrid was regarded as being of *high* quality.

Developmental Phases perspective

Analysis of the two components comprising the initial phase of Ingrid’s trial indicated that for both the head and arm action and the leg action components were both at *Step 2*. Observation and analysis of the completion phase revealed Ingrid had achieved *Step 3* for all phases of arm action, head and trunk, and leg action components.

Developmental Sequences perspective

Ingrid displayed all the qualities of a *mature* performer, as described in this perspective. The movements were efficient and economical, and possibly “beyond” the *mature* stage of this perspective.

Levels of Proficiency perspective

Ingrid achieved all the actions necessary to be placed in the *control* level of proficiency with some style variations, which was alluded to in the gymnastic perspective.

TABLE 6: SUMMARY OF ALL PERSPECTIVES FOR INGRID

Case No.	Gymnastic Skill	Developmental Phases	Developmental Sequences	Levels of Proficiency
Ingrid 3C	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)

Data in Table 6 provides a comparison between the four types of analysis. Note that Ingrid’s performance could not be ascertained using the Developmental sequences model. In addition, she could not be classified in the Levels of Proficiency category because of a lack of data.

APPENDIX L

Coding for Beginning, Bridging & End Sequences: Children

No	BAH	BEA	BHT	BCP	5 Total	Rco	Rco	Rco	Rco	MHK	MSA	Totals	Rco	Rco	EFT	ELM	ERM	Totals	Rco	Rco	Rco
						BAH	BEA	BHT	BCP				MHK	MSA					MHK	MSA	EFT
1 w	sb	ba				0	0	1	1	bt	ar		2	1	ab	ka	sm		1	1	2
2 C	sb	cr			5 w=23	1	0	0	1	sbc	af		3	3	cb	lt	ru		2	2	4
3 w	sb	cr			5 c=14	0	0	0	1	sbc	av	ss=14	3	2	ab	ka	rs		1	1	0
4 C	sb	cr			5 sw=11	1	0	0	1	ss	as	bs=3	0	4	ab	ls	rs		1	0	0
5 w	sb	cr			5	0	0	0	1	BS	ar	bt=11	1	1	ab	la	uh	in=0	1	0	1
6 sw	st	nc			4	2	2	2	3	sbc	as	sbc=20	3	4	cb	lt	ru	ab=24	2	2	4
7 w	sb	cr			5 sb=27	0	0	0	1	ss	af		0	1	ab	lt	rs	cb=24	1	2	0
8 c	bb	cr			5 bb=13	1	1	0	1	ss	av		0	2	ab	fa	rs		1	1	0
9 C*	bb	ba			4 st=8	1	1	1	3	ss	af		0	3	ab	fa	sm		1	1	2
10 C	SB	cr			5	1	0	0	1	ss	av		0	2	ab	ka	sm	ls=12	1	1	2
11 w	sb	cr			5	0	0	0	1	BT	ae		2	0	ab	xl	uh	kfa=16	1	0	1
12 w	sb	ba			5 cr=21	0	0	1	1	bt	av	ae=4	2	2	ab	ka	uh	lt=20	1	1	1
13 c	bb	CR			5 ba=13	1	1	0	1	SBC	ar	ar=4	3	4	cb	lt	lb		2	2	3
14 c	bb	nc			5 nc=14	1	1	2	1	sbc	as	av=12	3	4	cb	lt	ru		2	2	4
15 c	bb	ba			5	1	1	1	1	bt	as	af=8	2	4	cb	lt	lb		2	2	3
16 sw	st	nc			2	2	2	2	4	sbc	as	as=20	3	4	cb	lt	ru		2	2	4
17 sw	bb	nc			4	2	1	2	3	sbc	as		3	4	cb	lt	ru	rs=12	2	2	4
18 sw	st	NC			4	2	2	2	3	sbc	as		3	4	cb	lt	ru	uh=8	2	2	4
19 sw	st	NC			4	2	2	2	3	sbc	AS		3	4	cb	lt	ru	sm=4	2	2	4
20 w	BB	NC			4	0	1	2	3	sbc	av		3	2	cb	XL	ru	lb=6	2	0	4
21 SW	sb	ba			4 6+=0	2	0	1	3	sbc	av		3	2	ab	ls	rs	ru=18	1	0	0
22 w	sb	BA			4 5=22	0	0	1	3	sbc	as		3	4	cb	lt	ru		2	2	4
23 w	sb	BA			4 3=3	0	0	1	3	bt	as		2	4	cb	lt	lb		2	2	3
24 w	sb	nc			4 4=19	0	0	2	3	bt	ar		2	1	ab	xl	uh		1	0	1
25 w	sb	cr			3 2=4	0	0	0	2	bt	av		2	2	ab	xl	uh		1	0	1
26 c	bb	BA			4	1	1	1	3	sbc	as		3	4	cb	lt	ru		2	2	4
27 w	sb	BA			4	0	0	1	3	sbc	as		3	4	ab	xl	rs		1	0	0
28 sw	bb	BA			4	2	1	1	3	sbc	AS		3	4	cb	lt	ru		2	2	4
29 c	BB	CR			4	1	1	0	3	SS	AF		0	3	ab	ka	uh		1	1	1
30 w	sb	cr			5	0	0	0	1	bt	av		2	2	cb	ka	rs		2	1	0
31 w	sb	CR			4	0	0	0	3	ss	av		0	2	ab	fa	ru		1	1	4
32 w	sb	BA			5	0	0	1	1	bs	AV		1	2	ab	ka	lb		1	1	3
33 w	SB	CR			4	0	0	0	3	SS	av		0	2	cb	ka	ru		2	1	4
34 w	sb	nc			4	0	0	2	3	ss	av		0	2	cb	xl	sm		2	0	2
35 sw	st	nc			2	2	2	2	4	sbc	as		3	4	cb	lt	ru		2	2	4
36 sw	st	nc			2	2	2	2	4	sbc	as		3	4	cb	lt	ru		2	2	4
37 C	st	nc			4	1	2	2	3	sbc	as		3	4	cb	lt	ru		2	2	4
38 c	BB	nc			4	1	1	2	3	sbc	as		3	4	AB	lt	ru		1	2	4
39 sw	st	nc			2	2	2	2	4	sbc	as		3	4	cb	lt	ru		2	2	4
40 w	sb	ba			5	0	0	1	1	bt	ar		2	1	CB	xl	lb		2	0	3
41 sw	bb	ba			3	2	1	1	2	bt	as		2	4	cb	fa	lb		2	1	3
42 C*	SB	cr			3	1	0	0	2	ss	ae		0	0	ab	ka	uh		1	1	1
43 C	bb	cr			5	1	1	0	1	ss	ae		0	0	ab	fa	rs		1	1	0
44 w	sb	cr			5	0	0	0	1	bs	ae		1	0	ab	ka	rs		1	1	0
45 w	sb	cr			5	0	0	0	1	ss	af		0	3	ab	la	uh		1	0	1
46 w	sb	cr			5	0	0	0	1	ss	ar		0	1	ab	ka	rs		1	1	0
47 w	sb	cr			5	0	0	0	1	bt	af		2	3	cb	lt	rs		2	2	0
48 w	sb	cr			5	0	0	0	1	ss	af		0	3	ab	lt	rs		1	2	0

Key:

- BAH: Beginning sequence, Arm/hand position
- BEA: Beginning sequence, Elbow/arm position
- BHT: Beginning Sequence, Head contact position
- BCP: Beginning Sequence, Number of body contact points
- MHK: Bridging Sequence, Hip/knee position
- HSA: Bridging Sequence, Shoulder/arm position
- EFP: End Sequence, Final leg movements
- ELM; End Sequence, Foot placements
- ERM: End Sequence, Final rotational movements
- Prefix 'Rco': Rasch Code

APPENDIX M

Coding for Beginning, Bridging & End Sequences: Young adults

No	BAH	BEA	BHT	BCP	Rco				MSA	T:Ya	Rco					T:Oa	Rco			
					BAH	BEA	BHT	BCP			MHK	MSA	MHK	MSA	EFT		ELM	ERM	EFT	ELM
1	c	bb	ba	3	T: C	1	1	1	2	bt	as	2	4	in	ka	ru	T:Oa	0	1	4
2	w	sb	ba	4	w=7	0	0	1	3	bt	as	2	4	cb	ka	ru	in=5	2	1	4
3	w	sb	ba	4	c=15	0	0	1	3	bt	as	2	4	cb	lt	ru	ab=11	2	2	4
4	c	bb	nc	4	sw=2	1	1	2	3	bt	ar	2	1	ab	ka	uh	cb=8	1	1	1
5	w	sb	cr	5	sb=5	0	0	0	1	bt	as	2	4	cb	fa	lb		2	1	1
6	w	sb	nc	4	bb=18	0	0	2	3	bs	ar	1	1	in	ka	uh		0	1	1
7	c	bb	nc	4	st=1	1	1	2	3	bt	af	2	3	in	xl	uh	ls=3	0	0	1
8	w	sb	cr	5		0	0	0	1	sbc	ar	3	1	in	xl	lb	kfa=14	0	0	3
9	c	bb	ba	4		1	1	1	3	bt	ar	2	1	ab	ka	sm	lt=7	1	1	2
10	sw	bb	nc	4	cr=6	2	1	2	3	bt	as	2	4	cb	ka	lb		2	1	3
11	w	bb	cr	5	ba=10	0	1	0	1	bt	AF	2	3	cb	ka	lb		2	1	3
12	c	bb	nc	4	nc=8	1	1	2	3	bt	af	2	3	ab	ka	lb	rs=1	1	1	3
13	c	bb	nc	4		1	1	2	3	bt	af	2	3	ab	ka	rs	uh=5	1	1	0
14	c	bb	cr	4		1	1	0	3	sbc	as	3	4	cb	lt	ru	sm=1	2	2	4
15	c	bb	ba	4	6+=0	1	1	1	3	bt	as	2	4	ab	lt	lb	lb=11	1	2	3
16	c	bb	ba	4	5=6	1	1	1	3	bt	AF	2	3	ab	lt	uh	ru=6	1	2	1
17	c	bb	ba	4	3=1	1	1	1	3	bt	as	2	4	ab	lt	lb		1	2	3
18	c	bb	nc	2	4=16	1	1	2	4	sbc	as	3	4	cb	lt	ru		2	2	4
19	c	bb	cr	5	2=1	1	1	0	1	bt	af	2	3	in	la	lb		0	0	3
20	c	bb	ba	4		1	1	1	3	bt	ar	2	1	ab	ka	lb		1	1	3
21	sw	st	nc	4		2	2	2	3	sbc	as	3	4	cb	lt	ru		2	2	4
22	c	bb	ba	4		1	1	1	3	bt	af	2	3	ab	ka	lb		1	1	3
23	c	bb	ba	5		1	1	1	1	bt	ar	2	1	ab	ka	lb		1	1	3
24	w	bb	cr	5		0	1	0	1	bt	af	2	3	ab	ka	uh		1	1	1

Key:

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- BHT: Beginning Sequence, Head contact position
- BCP: Beginning Sequence, Number of body contact points
- MHK: Bridging Sequence, Hip/knee position
- HSA: Bridging Sequence, Shoulder/arm position
- EFP: End Sequence, Final leg movements
- ELM; End Sequence, Foot placements
- ERM: End Sequence, Final rotational movements
- Prefix 'Rco': Rasch Code

APPENDIX N

Coding for Beginning, Bridging & End Sequences: Older Adults

No	BAH	BEA	BHT	BCP	T: C	Rco				MSA	T:Ya	Rco				T:Oa	Rco			
						BAH	BEA	BHT	BCP			MHK	MSA	EFT	ELM		ERM	EFT	ELM	ERM
1	sw	bb	nc	4		2	1	2	3	bt	as	2	4	cb	xl	uh	2	0	1	
2	c	bb	cr	3		1	1	0	2	bt	ar	2	1	in	la	uh	0	0	1	
3	sw	bb	ba	4	w=24	2	1	1	3	bt	af	2	3	ab	ka	sm	1	1	2	
4	c	sb	cr	5	c=18	1	0	0	1	bt	ar	2	1	ab	ka	uh	in=12	1	1	1
5	w	sb	cr	3	sw=3	0	0	0	2	bt	af	2	3	in	la	rs	ab=21	0	0	0
6	c	bb	ba	4		1	1	1	3	bt	af	2	3	in	xl	rs	cb=12	0	0	0
7	c	bb	ba	4		1	1	1	3	bt	af	2	3	ab	lt	uh		1	2	1
8	w	sb	cr	7	sb=15	0	0	0	0	bt	as	2	4	cb	xl	sm		2	0	2
9	w	sb	cr	3	bb=30	0	0	0	2	bt	as	2	4	ab	ka	sm	ls=21	1	1	2
10	c	bb	cr	5	st=0	1	1	0	1	bt	af	2	3	ab	ls	rs	Kfa=16	1	0	0
11	c	bb	cr	5		1	1	0	1	bt	af	2	3	ab	ka	uh	lt=8	1	1	1
12	w	bb	ba	3		0	1	1	2	bt	as	2	4	ab	la	uh		1	0	1
13	w	bb	cr	5	cr=18	0	1	0	1	bt	as	2	4	cb	ka	lb		2	1	3
14	c	bb	ba	5	ba=19	1	1	1	1	bt	ae	2	0	ab	ka	rs		1	1	0
15	c	bb	ba	5	nc=8	1	1	1	1	bt	af	2	3	cb	ka	lb		2	1	3
16	w	sb	ba	3		0	0	1	2	bt	af	2	3	in	xl	lb	rs=9	0	0	3
17	w	bb	ba	4		0	1	1	3	sbc	af	3	3	ab	la	rs	uh=29	1	0	0
18	c	sb	nc	4		1	0	2	3	sbc	as	3	4	cb	lt	lb	sm=1	2	2	3
19	w	sb	ba	5	6+=3	0	0	1	1	bt	af	2	1	ab	lt	rs	lb=5	1	2	0
20	w	bb	nc	4	5=15	0	1	2	3	bt	ae	2	0	in	la	rs	ru=1	0	0	0
21	w	sb	cr	7	3=5	0	0	0	0	bt	ae	2	0	ab	fa	rs		1	1	0
22	w	bb	cr	4	4=22	0	1	0	3	ss	ar	0	1	in	xl	rs		0	0	0
23	w	bb	ba	5	2=0	0	1	1	1	bt	ar	2	1	cb	xl	rs		2	0	0
24	w	sb	cr	5		0	0	0	1	bt	af	2	3	ab	lt	uh		1	2	1
25	c	bb	ba	3		1	1	1	2	bt	ae	2	0	in	la	sm		0	0	2
26	c	bb	ba	4		1	1	1	3	bt	ar	2	1	cb	lt	lb		2	2	3
27	sw	bb	nc	4		2	1	2	3	sbc	as	3	4	ab	ka	lb		1	1	3
28	c	bb	ba	3		1	1	1	2	bt	as	2	4	in	la	ru		0	0	4
29	c	bb	ba	4		1	1	1	3	sbc	as	3	4	cb	lt	lb		2	2	3
30	c	bb	ba	5		1	1	1	1	bt	AF	2	3	ab	lt	lb		1	2	3
31	c	bb	ba	5		1	1	1	1	bt	af	2	3	cb	ka	uh		2	1	1
32	w	bb	nc	4		0	1	2	3	bt	as	2	4	in	la	sm		0	0	2
33	w	sb	nc	4		0	0	2	3	bt	af	2	3	ab	lt	rs		1	2	0
34	w	sb	nc	3		0	0	2	2	bt	af	2	3	ab	ka	lb		1	1	3
35	w	bb	ba	3		0	1	1	2	bt	ae	2	0	ab	fa	lb		1	1	3
36	w	bb	ba	5		0	1	1	1	bt	ar	2	1	ab	ka	uh		1	1	1
37	w	bb	cr	4		0	1	0	3	bt	as	2	4	cb	lt	uh		2	2	1
38	c	bb	cr	5		1	1	0	1	bt	af	2	3	ab	ka	uh		1	1	1
39	w	sb	cr	5		0	0	0	1	bt	af	2	3	cb	xl	uh		2	0	1
40	w	sb	cr	5		0	0	0	1	sbc	af	3	3	ab	fa	uh		1	1	1
41	w	bb	cr	5		0	1	0	1	bt	af	2	3	cb	xl	rs		2	0	0
42	w	sb	cr	5		0	0	0	1	bt	af	2	3	in	la	uh		0	0	1
43	c	bb	nc	4		1	1	2	3	bt	af	2	3	in	la	uh		0	0	1
44	c	bb	cr	5		1	1	0	1	bt	ar	2	1	ab	ka	uh		1	1	1
45	w	sb	ba	5		0	0	1	1	bt	as	2	4	in	xl	lb		0	0	3

Key:

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- EFP: End Sequence, Final leg movements
- ELM; End Sequence, Foot placements
- ERM: End Sequence, Final rotational movements
- Prefix 'Rco': Rasch Code

APPENDIX O

Selected SOLO Sequence Descriptions for the Forward Roll

Sample of 10 CHILDREN.

Subject 1: Female.

Gym 1 CD ROM No 1. Time: 0:00

Beginning: Raises arms to horizontal, flexes knees, abducts arms, leans forward, extends legs from full knee flexion to partial flexion. Back of head contacts surface. *Comment:* These elements are taught with the exception of where this subject places her hands.

(Arms and knees. SOLO Focus: SOLO level/cycle: M1).

Bridging: Rolls along curved back. Legs remain flexed. Arms remain flexed but off surface. She leans forward. One arm is placed on surface anterior to her body the other touches surface beside hips.

(Arms action. SOLO Focus: SOLO level/cycle: U1).

End: Legs extend, and at the same time she raises arms above head and stretches up.

(Legs and arms. SOLO Focus: SOLO level/cycle: M1).

Comment: Raising the arms and stretching up is taught as part of gym “style”.

Subject 11: Female.

Gym 1. CD ROM Time 3:56

Beginning: From standing; flexes knees and leans forward places hands on surface then top of head. Leans further forward to over balance, legs are crossed and knees flexed. Little control.

(Focus Hand placement. . SOLO Focus: SOLO level/cycle: U1).

Bridging: Lands on flat back, legs remain flexed and crossed. Little control. Arms contact surface at elbow.

(Focus Rotating. SOLO Focus: SOLO level/cycle: U1).

End: Legs remain crossed and tucked under buttocks, leans forward and hands used to assist standing

(Focus Rising to stand. SOLO Focus: SOLO level/cycle: U1).

Subject 16: Female.

Gym 1. CD ROM Time 5:57

Beginning: 2 contact points. Hands take body weight.

(SOLO Focus: Multiple integrated. SOLO level/cycle: R2).

Bridging: Shoulder line contact. Open C shape. Legs extended, knees flex before feet contact.

(SOLO Focus: Multiple integrated. SOLO level/cycle: R2).

End: Feet close to buttocks, smooth rise to stand. *Comment:* Full control of roll.

(SOLO Focus: Multiple integrated. SOLO level/cycle: R2).

Subject 20: Female.

Gym 1 CD ROM Time 7:04

Beginning: Standing arms horizontal anterior then flexes knees and leans forward to place hands on surface then extends legs (push), body moves into rotation. Head is tucked as the arms flex and head approaches surface.

(SOLO Focus: Multiple independently. SOLO level/cycle: M1).

Bridging: Legs are extended and she lands slightly flat back. The arms rotate forward and the knees start to flex about half way through the rotation. Avoiding hand contact.

(SOLO level/cycle: U1).

End: She moves her body weight forward, arms forward in horizontal position. As knees extend hands are raised above head. (SOLO Focus: Hands and standing. SOLO level/cycle: M1).

Comment: Actions flow into each other and are co-joined.

Subject 30: Female

Gym 1 CD ROM Time 8:59

Beginning: Raises arms to horizontal anterior to the body, then controlled flex of knees and leans slightly forward into a crouched position. Arms are flexed slightly at the elbows, which extend to make contact with the floor. The arms flex allowing the head to be placed on the surface.

(SOLO Focus: Hands and legs. SOLO level/cycle: M1).

Bridging: Knees remain flexed throughout (tucked). Approximately half way through rotation the arms, which are wide move to a position anterior to the legs.

(SOLO Focus: Hands and legs. SOLO level/cycle: M1).

End: The rotation stops and the subject rocks forward and back forward and she leans forward so the trunk is between the legs. The legs extend at the same time the arms are raised above the head.

(SOLO Focus: Hands, legs, and stretch. SOLO level/cycle: M1).

Subject 38: Female.

Gym 1. CD ROM Time 11:04

Beginning: Arms wider than shoulders. Elbows flexed, but hands take weight immediately after feet leave surface (no glide).

(SOLO Focus: Multiple simultaneous. SOLO level/cycle: R2).

Bridging: Line of shoulders/upper back contact surface. Knees start to flex about mid way through rotation. Slight lack of rotation control*.

(SOLO level/cycle: R2).

End: Feet away from buttocks. Rises to stand unaided. Slight lack of control*.

(SOLO Focus: Multiple simultaneous. SOLO level/cycle: R2).

**Comment:* Rotation slightly too fast.

Subject 39: Female.

Gym 1. CD ROM Time 11:22

Beginning: 2 contact points (no glide). Hands/arms take body weight.

(SOLO Focus: Multiple simultaneous. SOLO level/cycle: R2).

Bridging: Line of shoulder/back contact surface. Closed C shape legs extended. Knees flex before foot contact.

(SOLO Focus: Multiple simultaneous. SOLO level/cycle: R2).

End: Rises to stand unaided and smoothly. (SOLO Focus: Multiple simultaneous. SOLO level/cycle: R2).

Comment: Full control throughout roll.

Following 5 Subjects: data collected at Location A

Subject 40: Female.

Gym 1. CD ROM Time 11:45

Beginning: Stands with arms by side, then leans forward and flexes knees to place hands the head on the surface. At this point subject loses balance and starts to rotate.

(SOLO Focus: hand placement. SOLO level/cycle: U1).

Bridging: Rotation on back of head and the legs are slightly flexed but flex more later in the rotation. The arms and legs rotate in unison with the body.

(SOLO Focus: Arms. SOLO level/cycle: U1).

End: Subject's extended arms are forward flexed at the shoulders and she leans forward between the knees. Knees extend and subject stands with arms horizontal.

(SOLO Focus: Arms. SOLO level/cycle: U1).

Subject 41: Male.

Gym 1. CD ROM Time 11:55

Beginning: 3 contact points. Weight taken on hands/arms. Back of head/shoulder line contacts surface after feet leave surface. Tucked position.

(SOLO Focus: Arms. SOLO level/cycle: U2).

Bridging: Remains in tucked, tight ball. Knees flexed.

(SOLO Focus: remaining tucked. SOLO level/cycle: U2).

End: Sufficient momentum to rise to stand unaided. Some loss of balance.

(SOLO Focus: remaining tucked. SOLO level/cycle: U2).

Subject 43: Male.

Gym 1. CD ROM Time 12:37

Beginning: Stands then flexes forward from waist to place hands on the surface, legs remain extended. Arms flex at the elbows then head contacts the surface, and the subject overbalances into the rotation.

(SOLO Focus: hand placement. SOLO level/cycle: U1).

Bridging: Legs remain extended or very slightly flexed throughout. Poor control. Hands move immediately to contact surface beside hips. Legs act as counterbalance to bring trunk off the surface.

(SOLO Focus: rotating. SOLO level/cycle: U1).

End: Subject has difficulty with action of standing.

(SOLO Focus: non-specific, standing. SOLO level/cycle: U1).

Sample of 10 YOUNG ADULTS

Subject 1: Male.

Gym 2 CD ROM Time: 0:01

Beginning: 4 contact points: not head. Places hands. Arms/hands take body weight. Line of shoulders the contact area. Legs uneven, pushes off one leg.

(SOLO Focus: Hand placement,. SOLO level/cycle: U2).

Bridging: Tight ball shape, legs remain flexed. Arms push forward. Controlled.

(SOLO Focus: Arms. SOLO level/cycle: U2).

End: Legs remain flexed. One heel against buttocks. Rises to stand unaided

(SOLO Focus: Rising. SOLO level/cycle: U2).

Comment: Subject was slightly unstable at conclusion.

Subject 5: Female.

Gym 4 CD ROM Time 0:00

Beginning: Standing with arms by side starts to flex forward at waist, then flexes knees to place hands on surface, head is anatomically neutral. Flexes arms and from tight tucked position leans forward to place head on surface.

(SOLO Focus: All descriptors. SOLO level/cycle: R1).

Bridging: Slightly extends legs to provide some push. Knees tucked to body and arms make an arc until they reach horizontal anterior to the body. Feet close to buttocks.

(SOLO Focus: All descriptors. SOLO level/cycle: R1).

End: Knees flexed stand without assist

(SOLO Focus: All descriptors. SOLO level/cycle: R1).

Subject 8: Female.

Gym 4 CD ROM Time 1:38

Beginning: Extended arms then flexes knees, the flexes arms and lowers head to surface. 5 points of contact including top of head. Push is with both legs.

(SOLO Focus: Hands, legs and push-off. SOLO level/cycle: M2).

Bridging: Rotates with extended legs, toes pointed, knees flex. Places hands on surface beside hips.

(SOLO Focus: Legs. SOLO level/cycle: U2).

End: Leans forward and pushes with hands. One leg crossed behind. Uncrosses legs to stand straight

(SOLO Focus: Legs. SOLO level/cycle: U2).

Subject 11: Female.

Gym 4 CD ROM Time 2:57

Beginning: Hands by sides, leans forward and flexes knees, hesitates, then continues to flex knees and hands place on the surface, hip and knee flexion continues until cramped crouch achieved. Elbows continue to flex and the top of the head placed on the surface.

(SOLO Focus: Arms/hands. SOLO level/cycle: U1).

Bridging: One leg is raised and used for propulsion, then both legs flexed together so body is in a tight ball. Knees remain flexed.

(SOLO Focus: Leg for rotation. . SOLO level/cycle: U1).

End: Arms push through to horizontal anterior to the body and body weight is moved forward over feet. Left hand used to assist rise. Some loss of balance.

(Focus :Arms to assist rise. SOLO level/cycle: U1).

Comment: Inconsistent End strategies on different trials.

Subject 13: Male

Gym 4 CD ROM Time: 4:01

Beginning: Raises arms leans forward, extends arms and flexes knees, then extends knees places hands on surface 4 contact points: not head. Shoulder line contacts surface.

(SOLO Focus: Arms and legs. SOLO level/cycle: M2).

Bridging: Tight Ball shape knees flexed. Puts hands on head to hold his hat on.

(SOLO Focus: Remaining tucked and retaining hat. SOLO level/cycle: M2).

End: Attempts to rise, hand use to assist with push. Rocks back & forth, leans forward then stands (somatotype issue).

(SOLO Focus: Difficult to determine but several aspects receive attention. SOLO level/cycle: M1).

Subject 14: Female.

Gym 4 CD ROM Time: 4:38

Beginning: Standing, leans forward, extends arms and flexes knees, places hands on surface then extends knees. 4 contact points. Feet leave surface just a back of head touches surface (SOLO Focus: Multiple synchronised. SOLO level/cycle: R2).

Bridging: Legs remain extended then knees flex late. Arms move through to horizontal, but not in high arc.

(SOLO Focus: All aspects of rotation. SOLO level/cycle: R2).

End: Rises to stand. Body vertical, arms move to sides, legs extend. Slight overbalance

(SOLO focus: All aspects. SOLO level/cycle: R2).

Subject 16: Male.

Gym 6 CD ROM Time 0:00

Beginning: Walks up, raises arms to waist height, leans forward about 90deg extends arms and flexes knees, places hands on surface then extends knees slightly. 4 contact points **not** head. Feet leave surface before back of head contact.

(SOLO Focus: SOLO level/cycle: M2).

Bridging: Knees to chest (hip flex), but lower legs (knee flex) minimal. Trying to maintain a tight ball. Arms rotate with body and hands placed on surface beside hips.

(SOLO Focus: Rotation, hands to surface, keeping tucked position. level/cycle: M2).

End: Stands to rise, uses arms/hands to assist. Loss of balance

(SOLO Focus: Using hands to assist rise. SOLO level/cycle: U2).

Subject 18: Female.

Gym 6 CD ROM Time 1:27

Beginning: Feet leave surface immediately prior to hand contact. Arms extended.
(SOLO Focus: Multiple synchronised. SOLO level/cycle: R2).

Bridging: Open C shape.

(SOLO Focus: Multiple synchronised. SOLO level/cycle: R2).

End: Leg flex then total control rise to stand.

(SOLO Focus: Multiple synchronised. SOLO level/cycle: R2).

Subject 20: Male.

Gym 10 CD ROM Time 0:11 and 0:53 and 1. 30 (anterior view).

Beginning: Forward flex of hips and shoulders. Head tucked and body weight taken on arms.
4 contact points with almost a “flight” phase.. arms used as pivot.

(SOLO Focus: Multiple hand placement, head position, leg push. SOLO level/cycle: M2).

Bridging: Body in tight ball. Arms rotate with body and placed on surface.

(SOLO Focus: Rotation. SOLO level/cycle: U2).

End: Over rotates. Hands used minimally to assist balance.

(SOLO Focus: non-specific. SOLO level/cycle: U2).

Subject: 24: Female.

Gym 10 CD ROM Time 0:38 and 1:16

Beginning: Extreme hip flexion, then knee flexion. Hands close to feet. 5 contact points including back of head

(SOLO Focus: Head tuck. SOLO level/cycle: U2).

Bridging: Hip flexion but knee flexion not as great. Trying to achieve a tight ball.

(SOLO Focus: Maintaining body tucked position. SOLO level/cycle: U2).

End: Uses one hand and leans forward towards feet to assist rise.

(SOLO Focus: Rising through the use of the hand/arm push. SOLO level/cycle: U2).

Sample of 10 OLDER ADULTS

Subject 5: Female.

Gym 2 CD ROM Time: 3:46

Beginning: Stands flexes forward then remains crouched. Extends knees, hips remain flexed, but hands remain close to the surface. Flexes knees and places hands on the surface. Head contacts surface as one leg is raised to provide rotational force. 5 points of contact including top of head.

(SOLO Focus: Hand, head and leg push. SOLO level/cycle: M1).

Bridging: Tucked, but one leg extends more than the other. Arms remain flexed and are placed on the surface lateral to the hips.

(SOLO Focus: Hand, body tuck. SOLO level/cycle: M1).

End: Uses hands to move body weight over closest foot. Other foot away from buttocks.

(SOLO Focus: Hand placements, body position. SOLO level/cycle: M1).

Subject 6: Female.

Gym 2: CD ROM Time: 4:08

Beginning: Stands. Hip flexion then as extended arms move towards surface knee flexion. Continued knee flexion, hands on surface. Knees extend until head contacts surface. Back of head contacts after feet leave surface.

(SOLO Focus: Hand placement, body shape, head position and push. SOLO level/cycle: R1).

Bridging: Leg rotation uneven. Leg extends and remains extended. Some control.

(SOLO Focus: Arms action, body tuck SOLO level/cycle: M1).

End: Hand used to assist. Crosses legs, moves feet towards buttocks. Onto kneeling position before standing

(SOLO Focus: Solving rising to stand problem SOLO level/cycle: M1)*

**Comment:* Endomorphic somatotype and lack of hip flexion contributing factors to End sequence result.

Subject 8: Female.

Gym 2: CD ROM Time: 4:54

Beginning: forward hip flexion, then knee flexion and shoulder flexion as hands placed on the surface. Continued hip and knee flexion and knees contact the surface and then top of head. . 7 points of contact: Feet, knees, hands, and top of head. Second and subsequent trials knees were off the surface.

(SOLO Focus: Placing head on surface and leg kick. SOLO level/cycle: U1).

Bridging: With knees on surface the lower leg is extended raising the hips. Then kicking upward with one leg provides propulsion. Tucked position, during rotation but legs apart longitudinally. Arms move in high arc to horizontal plane until hands are well anterior to the knees.

(SOLO Focus: Arm action and maintaining momentum SOLO level/cycle: M1).

End: Hip flexion allows her to lean forward. Legs cross half way through rotation but then uncross at the end. Arms are well forward of the body and thus assist standing. On trials 3 & 4 hands are used to assist the rise to standing. Arms abducted on reaching standing position.

(SOLO Focus: Arms action and hip flexion. SOLO level/cycle: M1).

Subject 14: Male

Gym 2 CD ROM Time 7:00

Beginning: Arms raised to just below shoulders: horizontal. Hip flexion occurs to a position where waist is horizontal, some knee flexion follows. Only right hand is place “flat” on the surface, the “back” (wrist pronated) of the left hand is placed on the surface and the left forearm and left shoulder takes the body weight. “Almost a shoulder roll.” Feet leave surface as top head contacts surface.

(SOLO Focus: Achieving tucked position, leg push and head on surface. SOLO level/cycle: M1).

Bridging: Minimal leg push. Knees remain half flexed. Arms rotate and hands placed on surface beside hips.

(SOLO Focus: Arm movement. SOLO level/cycle: U1).

End: One hand is on the surface and is to move body weight over feet and assist rise, the other hand is moved forward of the body in a horizontal plane as a counter balance.

(SOLO Focus: Moving body past COG. SOLO level/cycle: U1).

Subject 25: Female.

Gym 2 CD ROM Time: 12:06

Beginning: Leans forward until hands are close to surface before flexing one knee and raising the other leg posteriorly. Hands contact surface and the elbows flex. The raised leg continues to move to vertical at which point the knees are flexed at about 90°. The head is now in contact with the surface

(SOLO Focus: SOLO level/cycle: U1).

Bridging: Rotation commences, subject balanced on top of head. Other leg leaves surface, and this leg continues to flex at the knee throughout the rotation. The leg used to aid rotation extends during rotation to an extended position at the end. The arms rotate around the elbow and the hands are placed on the surface lateral to the hips.

(SOLO Focus: SOLO level/cycle: U1).

End: One leg is fully flexed other extended, the subject leans forward and with push from the arms moves the centre of gravity over the flexed leg. The legs are separated, one anterior and one posterior the subjects extends the knees and whilst doing so the arms swing forward to horizontal then return to the sides of the body

(SOLO Focus: SOLO level/cycle: U1).

Subject 26: Male.

Gym 7 CD ROM Time: 0:01 and 1:07

Beginning: Arms flexed at elbows. Hip, knee and arm extension. Hands placed on surface, head ventro flexes. 4 contact points including top/back of head.

(SOLO Focus: Hand placement, body tuck, neck flexion. SOLO level/cycle: M2).

Bridging: Little push as momentum from hip and knee flexion is employed. Tight ball. Arms make high arc and move anterior to the body to horizontal position.

(SOLO Focus: Arms action and body tuck. SOLO level/cycle: M2).

End: Rises to stand with the aid of hip flexion and conservation of momentum. Loses balance forward on standing.

(SOLO Focus: Maintaining arm position and moving body past COG. SOLO level/cycle: M2).

Subject 31: Male.

Gym 7 CD ROM Time:0:36 and 2:01.

Beginning: Standing slightly flexed arms by sides, looking down, leans forward then flexes knees then extends arms towards surface. Continues to flex knees and places hands on the surface. Forward flexes head and neck and simultaneously raises one leg posteriorly off the surface. Back of head makes contact. Arms support body weight. 4 contact points, including back of head.

(SOLO Focus: Head and providing rotational force. SOLO level/cycle: M1).

Bridging: Rotation continues and subject rolls along curved back. When trunk is vertical the other leg leaves the surface and “catches-up” with the take off leg. Both knees are flexed at about 90° and remain so for the remainder of the rotation. Arms, which are flexed at the elbow rotate to a point where the hands contact the surface lateral to the hips.

(SOLO Focus: Remaining tucked and arm action SOLO level/cycle: M1).

End: Leans forward, uses hands to push. Hips and legs extend, rise to stand.

(SOLO Focus: Moving body past COG. SOLO level/cycle: U1).

Subject 36: Female.

Gym 8 CD ROM Time: 0:34 and 1:42

Beginning: Moves towards mat with slight forward flexion and hands beside body. Continues to forward flex hips and knees, tucks chin. As hands contact surface the elbows flex. And knee flexion continues. She is in a very tight tucked position as she places her head on the surface. 5 contact points including back of head. Little weight taken on hands.

(SOLO Focus: Head contact. SOLO level/cycle: U1).

Bridging: Some knee flexion and knees remain flexed throughout. Extreme hip flexion is maintained. Arms remain slightly flexed and are placed on the surface beside the hip.

(SOLO Focus: Knee flexion. SOLO level/cycle: U1).

End: Uses hands to move hips towards the feet and thus to assist rise as does the upward motion of both arms.

(SOLO Focus: Arm action. SOLO level/cycle: U1).

Subject 41: Female.

Gym 8 CD ROM Time: 2:18 and 3:06

Beginning: Hip forward flexion and some knee flexion, then she places hands on surface, then top of head. One leg raised to the posterior.

(SOLO Focus: Head placement. SOLO level/cycle: U1).

Bridging: Balanced on head and hands. One leg leaves surface when trunk is almost vertical. Rolls along curved back. The other leg “catches up” just prior to the feet making contact with the surface at the end of rotation. Arms rotate and are placed on surface beside hips.

(SOLO Focus: Tucked body shape. SOLO level/cycle: U1).

End: Leans forward, hands used to assist, extends knees then hips.

(SOLO Focus: Moving body weight past COG. SOLO level/cycle: U1).

Subject 45: Female.

Gym 6: CD ROM Time: 0:28

Beginning: Forwards flexion of the hips then straight arms forward flex to vertical. Knees commence to flex slightly. Arm flexion occurs and head touches the surface. Chin tucked.
(SOLO Focus: Head placement. SOLO level/cycle: R1).

Bridging: From a position of extreme hip flexion (i.e. legs almost fully extended). The body passes the COG and rotation is initiated with a slight leg extension. Arms make a high arc and finish in the horizontal plane. Legs remain flexed until the second half of rotation then knee flexion occurs in one leg.

(SOLO Focus: Arm action SOLO level/cycle: R1).

End: The flexed leg touches the surface approximately 20 cm from the buttocks and the other is placed in front of the first leg (heel to toe) On subsequent passes she crosses her legs. She forward flexes and rises to standing.

(SOLO Focus: Arm and leg action. SOLO level/cycle: M1).

APPENDIX P

SOLO Levels and Cycles for all Children, Young Adults and Older Adults

Children: SOLO codes from a sequences perspective

Subject Number	Compact Disk Number	Elapsed Time Min/sec	Beginning Sequence SOLO Code	Bridging Sequence SOLO Code	End Sequence SOLO Code
1	1	0:00	M1	U1	M1
2	1	0:06	R1	U2	R1
3	1	0:01	U1	U1	U1
4	1	0:49	M1	U1	U1
5	1	1:43	U1	U1	U1
6	1	1:59	M2	M2	M2
7	1	2:05	M1	U1	U1
8	1	2:19	U1	U1	M1
9	1	2:36	M1	M1	M1
10	1	3:13	M1	M1	M1
11	1	3:56	U1	U1	U1
12	1	4:56	M1	M1	U1
13	1	5:38	U2	M2	M2
14	1	5:43	U2	U2	M2
15	1	5:47	M1	M1	M1
16	1	5:57	R2	R2	R2
17	1	6:14	R2	R2	R2
18	1	6:27	R2	R2	R2
19	1	6:43	R2	M2	R2
20	1	7:04	M1	U1	M1
21	1	7:16	U1	U1	U1
22	1	7:29	M2	M2	M2
23	1	7:41	U2	U2	U2
24	1	7:55 & 8:46	U1	U1	U1
25	1	8:06	U1	U1	U1
26	1	8:15	M2	M2	M2
27	1	8:23	M2	M2	M2
28	1	8:34	U2	U2	U2
29	1	8:01 & 8:42	M1	U1	M1
30	1	8:59	M1	M1	M1
31	1	9:05	R1	M1	R1
32	1	9:08	M1	U1	M1
33	1	9:15	M1	U1	M1
34	1	9:19	U1	U1	U1
35	1	9:59	R2	R2	R2
36	1	10:26	R2	R2	R2
37	1	10:45	R2	R2	R2
38	1	11:04	R2	R2	R2
39	1	11:22	R2	R2	R2
40	1	11:45	U1	U1	U1
41	1	11:55	U2	U2	U2
42	1	12:15	U1	U1	U1
43	1	12:37	U1	U1	U1
44	1	13:29	U1	U1	U1
45	5	0:29	M1	U1	U1
46	5	0:48	M1	U1	M1
47	5	1:12	U1	U1	U1
48	5	1:21	U1	U1	U1

Young Adults: SOLO codes from a sequences perspective

Subject Number	Compact Disk Number	Elapsed Time Min/sec	Beginning Sequence SOLO Code	Bridging Sequence SOLO Code	End Sequence SOLO Code
1	2	0:01	U2	U2	U2
2	2	0:41	U2	U2	U2
3	2	1:15	R2	R2	M2
4	2	1:52	M2	M2	U2
5	4	0:00	R1	R1	R1
6	4	0:03	M1	U1	U1
7	4	0:58	M1	U1	U1
8	4	1:38	M2	U2	U2
9	4	2:08	M2	U2	U2
10	4	2:03	M2	U2	M2
11	4	2:57	U1	U1	U1
12	4	3:28	M2	U2	M2
13	4	4:01	M2	M2	M1
14	4	4:38	R2	R2	R2
15	4	5:13	R2	M2	R2
16	6	0:00	M2	M2	U2
17	6	0:58	M2	U2	U2
18	6	1:27	R2	R2	R2
19	10	0:02&0:46&1:22	R1	R1	R1
20	10	0:11&0:53&1:30	M2	U2	U2
21	10	0:19&0:58&1:51	R2	R2	R2
22	10	0:26&1:03&1:37	U2	U2	U2
23	10	0:32&1:09&1:44	M2	U2	U2
24	10	0:38 & 1:16	U2	U2	U2

Older Adults: SOLO codes from a sequences perspective

Subject Number	Compact Disk Number	Elapsed Time Min/sec	Beginning Sequence SOLO Code	Bridging Sequence SOLO Code	End Sequence SOLO Code
1	2	2:31	U2	U2	U2
2	2	3:01	M1	U1	M1
3	2	3:15	M2	M2	M2
4	2	3:31	M1	M1	M1
5	2	3:46	M1	M1	M1
6	2	4:08	R1	M1	M1
7	2	4:34	M2	M2	U2
8	2	4:54	M1	M1	M1
9	2	5:11	U2	U2	U2
10	2	5:25	M1	U1	U1
11	2	5:45	U1	M1	U1
12	2	6:12	U2	U2	U2
13	2	6:26	U2	U2	U2
14	2	7:00	M1	U1	U1
15	2	7:28	U2	U2	U2
16	2	7:51	M1	M1	M1
17	2	8:23	M2	M2	U1
18	2	8:48	R2	R2	R2
19	2	9:13	M1	M1	U1
20	2	9:33	R1	M1	M1
21	2	9:57	U1	U1	U1
22	2	10:35	U1	U1	U1
23	2	11:06	U1	U1	U1
24	2	11:33	U1	U1	U1
25	2	12:06	U1	U1	U1
26	7	0:01 & 1:07	M2	M2	U2
27	7	0:11 & 1:19	R2	R2	M2
28	7	0:18 & 1:56	U2	U2	U2
29	7	0:24 & 1:48	M2	M2	M2
30	7	0:30 & 1:32	M1	R1	M1
31	7	0:36 & 2:01	M1	M1	U1
32	8	1:06	R1	M1	M1
33	8	0:10 & 1:13	M1	M1	U1
34	8	1:28	M2	M2	U2
35	8	1:35	M1	M1	U1
36	8	0:34 & 1:42	U1	U1	U1
37	8	0:48	U2	U2	U2
38	8	0:57	M1	U1	U1
39	8	2:00 & 2:50	U1	U1	U1
40	8	2:09 & 2:58	U1	M1	U1
41	8	2:18 & 3:06	U1	U1	U1
42	8	2:28 & 3:15	U1	U1	U1
43	8	2:36 & 3:23	R1	R1	U2
44	8	3:29	M1	M1	M1
45	6	0:28	R1	R1	M1

APPENDIX Q

Samples of SOLO Observation Checklists (Three from each Cohort)

Children:

Children Subject Number 2. Recording: Gym 1. Time: 0:06
Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1)	Medium quality (Cycle transition)	High Quality (Cycle 2)
<i>Start</i>			
Hand position	>20cm wide Or elbows bend out <input type="checkbox"/>	< 20cm wide of shoulders <input checked="" type="checkbox"/>	Shoulder width <input type="checkbox"/>
Head contact	Superior surface touching <input type="checkbox"/>	Dorsal surface touching <input checked="" type="checkbox"/>	Off the surface <input type="checkbox"/>
Contacts	Five or more <input checked="" type="checkbox"/>	Three <input type="checkbox"/> Four <input type="checkbox"/>	Two <input type="checkbox"/>
Leg push	None or weak <input type="checkbox"/>	Uneven <input type="checkbox"/>	Even <input checked="" type="checkbox"/>
<i>Rotation</i>			
Control	Lacking control <input type="checkbox"/>	Some control <input type="checkbox"/>	Total control <input checked="" type="checkbox"/>
Arm action	Elbows remain flexed <input checked="" type="checkbox"/>	Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input type="checkbox"/>
Legs	Remain extended <input type="checkbox"/>	Remain flexed <input type="checkbox"/> Extended then flex in second half of rotation <input checked="" type="checkbox"/>	
<i>Finish</i>			
Rising	Lacking control <input type="checkbox"/>	Some loss of balance <input type="checkbox"/>	Totally smooth <input checked="" type="checkbox"/>
Feet	Anterior to buttocks >30cm <input type="checkbox"/>	Slightly anterior to buttocks <input checked="" type="checkbox"/>	Inferior to buttocks <input type="checkbox"/>
Legs	Abducted > 20cm <input type="checkbox"/>	Abducted < 20cm <input checked="" type="checkbox"/>	Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator <input type="checkbox"/>	or Two or more <input type="checkbox"/>	or Multiple <input checked="" type="checkbox"/>

Demonstrated aspects of learning: Hand placement, back of head placement, late flexion of legs. Able to adjust action at end to avoid hand contact.
Other comments:
Appears to be working on:
SOLO: R1

Children Subject Number 10. Recording: Gym 1 Time: 3:13
Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1)	Medium quality (Cycle transition)	High Quality (Cycle 2)
<i>Start</i>			
Hand position	>20cm wide Or elbows bend out <input type="checkbox"/>	< 20cm wide of shoulders <input checked="" type="checkbox"/>	Shoulder width <input type="checkbox"/>
Head contact	Superior surface touching <input checked="" type="checkbox"/>	Dorsal surface touching <input type="checkbox"/>	Off the surface <input type="checkbox"/>
Contacts	Five or more <input checked="" type="checkbox"/>	Three <input type="checkbox"/> Four <input type="checkbox"/>	Two <input type="checkbox"/>
Leg push	None or weak <input type="checkbox"/>	Uneven <input type="checkbox"/>	Even <input checked="" type="checkbox"/>
<i>Rotation</i>			
Control	Lacking control <input checked="" type="checkbox"/>	Some control <input type="checkbox"/>	Total control <input type="checkbox"/>
Arm action	Elbows remain flexed <input type="checkbox"/>	Abducted <input checked="" type="checkbox"/>	Arms extended (shoulder width) <input type="checkbox"/>
Legs	Remain extended <input checked="" type="checkbox"/>	Remain flexed <input type="checkbox"/> Extended then flex in second half of rotation <input type="checkbox"/>	
<i>Finish</i>			
Rising	Lacking control <input type="checkbox"/>	Some loss of balance <input checked="" type="checkbox"/>	Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm <input checked="" type="checkbox"/>	Slightly anterior to buttocks <input type="checkbox"/>	Inferior to buttocks <input type="checkbox"/>
Legs	Abducted > 20cm <input checked="" type="checkbox"/>	Abducted < 20cm <input type="checkbox"/>	Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator <input type="checkbox"/>	or Two or more <input checked="" type="checkbox"/>	or Multiple <input type="checkbox"/>

Demonstrated aspects of learning: arms "presentation", leg bend, hand position and moving her feet to a position under her buttocks at the end.
Other Comments:
SOLO: M1

Children Subject Number 42. Recording: Gym 1 Time: 12:15
Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1)	Medium quality (Cycle transition)	High Quality (Cycle 2)
<i>Start</i>			
Hand position	>20cm wide Or elbows bend out <input type="checkbox"/>	< 20cm wide of shoulders <input type="checkbox"/>	Shoulder width <input checked="" type="checkbox"/>
Head contact	Superior surface contact <input checked="" type="checkbox"/>	Dorsal surface touches <input type="checkbox"/>	Off the surface <input type="checkbox"/>
Contacts	Five or more <input checked="" type="checkbox"/>	Three <input type="checkbox"/> Four <input type="checkbox"/>	Two <input type="checkbox"/>
Leg push	None or weak <input type="checkbox"/>	Uneven <input checked="" type="checkbox"/>	Even <input type="checkbox"/>
<i>Rotation</i>			
Control	Lacking control <input checked="" type="checkbox"/>	Some control <input type="checkbox"/>	Total control <input type="checkbox"/>
Arm action	Elbows remain flexed <input checked="" type="checkbox"/>	Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input type="checkbox"/>
Legs	Remain extended <input checked="" type="checkbox"/>	Remain flexed <input type="checkbox"/> Extended then flex in second half of rotation <input type="checkbox"/>	
<i>Finish</i>			
Rising	Lacking control <input checked="" type="checkbox"/>	Some loss of balance <input type="checkbox"/>	Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm <input checked="" type="checkbox"/>	Slightly anterior to buttocks <input type="checkbox"/>	Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm <input checked="" type="checkbox"/>	Abducted < 20cm <input type="checkbox"/>	Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator <input checked="" type="checkbox"/>	or Two or more <input type="checkbox"/>	or Multiple <input type="checkbox"/>

Demonstrated aspects of learning: just roll and trying to be neat
Other comments: ⊗1 hands inside shoulder width not weight bearing ⊗ This action stems from learning to roll down hill on wedge mat 2 hands remain in toe-touch position until half way through rotation then elbows and hands to floor 3 roll stops used hands to rise
SOLO: U1

Young Adults

Young Adults Subject Number 3 . Recording: Gym 2 Time: 1:15

Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1) →	Medium quality (Cycle transition)	→ High Quality (Cycle 2)
<u>Start</u>			
Hand position	>20cm wide Or elbows bend out	<input type="checkbox"/> <20cm wide of shoulders <input checked="" type="checkbox"/>	Shoulder width <input type="checkbox"/>
Head contact	Superior surface contact	<input type="checkbox"/> Dorsal surface touches <input checked="" type="checkbox"/>	Off the surface <input type="checkbox"/>
Contacts	Five or more	<input type="checkbox"/> Three <input type="checkbox"/> Four <input checked="" type="checkbox"/>	Two <input type="checkbox"/>
Leg push	None or Weak	<input type="checkbox"/> Uneven <input type="checkbox"/>	Even <input checked="" type="checkbox"/>
<u>Rotation</u>			
Control	Lacking control	<input type="checkbox"/> Some control <input type="checkbox"/>	Total control <input checked="" type="checkbox"/>
Arm action	Elbows remain flexed	<input type="checkbox"/> Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input checked="" type="checkbox"/>
Legs	Remain extended	<input type="checkbox"/> Remain flexed <input checked="" type="checkbox"/> Extended then flex in second half of rotation	<input type="checkbox"/>
<u>Finish</u>			
Rising	Lacking control	<input type="checkbox"/> Some loss of balance <input type="checkbox"/>	Totally smooth <input checked="" type="checkbox"/>
Feet	Anterior to buttocks >30cm	<input type="checkbox"/> Slightly anterior to buttocks <input checked="" type="checkbox"/>	Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm	<input type="checkbox"/> Abducted < 20cm <input type="checkbox"/>	Anatomically neutral <input checked="" type="checkbox"/>
Overall Focus:	Single Indicator	<input type="checkbox"/> or Two or more <input type="checkbox"/>	or Multiple <input checked="" type="checkbox"/>
Demonstrated aspects of learning: Most learned descriptors are demonstrated			
Other comments: Demonstrated limits of what she has been exposed to in her learning environment			
SOLO: R2			

Young Adults Subject Number 10. Recording: Gym 4 Time: 2:30

Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1) →	Medium quality (Cycle transition)	→ High Quality (Cycle 2)
<u>Start</u>			
Hand position	>20cm wide Or elbows bend out	<input type="checkbox"/> <20cm wide of shoulders <input type="checkbox"/>	Shoulder width <input checked="" type="checkbox"/>
Head contact	Superior surface contact	<input type="checkbox"/> Dorsal surface touches <input type="checkbox"/>	Off the surface <input checked="" type="checkbox"/>
Contacts	Five or more	<input type="checkbox"/> Three <input type="checkbox"/> Four <input checked="" type="checkbox"/>	Two <input type="checkbox"/>
Leg push	None or Weak	<input type="checkbox"/> Uneven <input type="checkbox"/>	Even <input checked="" type="checkbox"/>
<u>Rotation</u>			
Control	Lacking control	<input type="checkbox"/> Some control <input type="checkbox"/>	Total control <input checked="" type="checkbox"/>
Arm action	Elbows remain flexed	<input type="checkbox"/> Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input checked="" type="checkbox"/>
Legs	Remain extended	<input type="checkbox"/> Remain flexed <input checked="" type="checkbox"/> Extended then flex in second half of rotation	<input type="checkbox"/>
<u>Finish</u>			
Rising	Lacking control	<input type="checkbox"/> Some loss of balance <input checked="" type="checkbox"/>	Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm	<input checked="" type="checkbox"/> Slightly anterior to buttocks <input type="checkbox"/>	Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm	<input checked="" type="checkbox"/> Abducted < 20cm <input type="checkbox"/>	Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator	<input type="checkbox"/> or Two or more <input checked="" type="checkbox"/>	or Multiple <input type="checkbox"/>
Demonstrated aspects of learning:			
Other comments:			
SOLO: M2			

Young Adults Subject Number 23. Recording: Gym 10 Time: 0.32/1.09/1.4

Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1) →	Medium quality (Cycle transition)	→ High Quality (Cycle 2)
<u>Start</u>			
Hand position	>20cm wide Or elbows bend out	<input checked="" type="checkbox"/> <20cm wide of shoulders <input type="checkbox"/>	Shoulder width <input type="checkbox"/>
Head contact	Superior surface contact	<input type="checkbox"/> Dorsal surface touches <input checked="" type="checkbox"/>	Off the surface <input type="checkbox"/>
Contacts	Five or more	<input checked="" type="checkbox"/> Three <input type="checkbox"/> Four <input type="checkbox"/>	Two <input type="checkbox"/>
Leg push	None or Weak	<input type="checkbox"/> Uneven <input type="checkbox"/>	Even <input checked="" type="checkbox"/>
<u>Rotation</u>			
Control	Lacking control	<input type="checkbox"/> Some control <input checked="" type="checkbox"/>	Total control <input type="checkbox"/>
Arm action	Elbows remain flexed	<input type="checkbox"/> Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input checked="" type="checkbox"/>
Legs	Remain extended	<input type="checkbox"/> Remain flexed <input checked="" type="checkbox"/> Extended then flex in second half of rotation	<input type="checkbox"/>
<u>Finish</u>			
Rising	Lacking control	<input checked="" type="checkbox"/> Some loss of balance <input type="checkbox"/>	Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm	<input type="checkbox"/> Slightly anterior to buttocks <input checked="" type="checkbox"/>	Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm	<input checked="" type="checkbox"/> Abducted < 20cm <input type="checkbox"/>	Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator	<input type="checkbox"/> or Two or more <input type="checkbox"/>	or Multiple <input type="checkbox"/>
Demonstrated aspects of learning: Head contact avoidance, maintaining tight ball during rotation.			
Other comments: 1. Arms extend but one placed on surface			
SOLO: U2			

Older Adults

Older Adults Subject Number 23. Recording: Gym 2 Time: 11:07

Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1) →	Medium quality (Cycle transition)	→ High Quality (Cycle 2)
<i>Start</i>			
Hand position	>20cm wide Or elbows bend out	<input checked="" type="checkbox"/> <20cm wide of shoulders	<input type="checkbox"/> Shoulder width <input type="checkbox"/>
Head contact	Superior surface contact	<input checked="" type="checkbox"/> Dorsal surface touches	<input type="checkbox"/> Off the surface <input type="checkbox"/>
Contacts	Five or more	<input checked="" type="checkbox"/> Three <input type="checkbox"/> Four	<input type="checkbox"/> Two <input type="checkbox"/>
Leg push	None or Weak	<input checked="" type="checkbox"/> Uneven	<input type="checkbox"/> Even <input type="checkbox"/>
<i>Rotation</i>			
Control	Lacking control	<input type="checkbox"/> Some control <input checked="" type="checkbox"/>	Total control <input type="checkbox"/>
Arm action	Elbows remain flexed	<input checked="" type="checkbox"/> Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input type="checkbox"/>
Legs	Remain extended	<input type="checkbox"/> Remain flexed <input checked="" type="checkbox"/> Extended then flex in second half of rotation	<input type="checkbox"/>
<i>Finish</i>			
Rising	Lacking control	<input checked="" type="checkbox"/> Some loss of balance	<input type="checkbox"/> Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm	<input checked="" type="checkbox"/> Slightly anterior to buttocks	<input type="checkbox"/> Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm	<input checked="" type="checkbox"/> Abducted < 20cm	<input type="checkbox"/> Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator	<input checked="" type="checkbox"/> or Two or more	<input type="checkbox"/> or Multiple <input type="checkbox"/>
Demonstrated aspects of learning: 1. Legs crossed and uneven distance apart 2. One foot in front of other			
Other comments:			
SOLO: U1			

Older Adults Subject Number 26. Recording: Gym 7 Time: 0:01 & 1:07

Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1) →	Medium quality (Cycle transition)	→ High Quality (Cycle 2)
<i>Start</i>			
Hand position	>20cm wide Or elbows bend out	<input type="checkbox"/> <20cm wide of shoulders	<input checked="" type="checkbox"/> Shoulder width <input type="checkbox"/>
Head contact	Superior surface contact	<input checked="" type="checkbox"/> Dorsal surface touches	<input type="checkbox"/> Off the surface <input type="checkbox"/>
Contacts	Five or more	<input type="checkbox"/> Three <input type="checkbox"/> Four	<input checked="" type="checkbox"/> Two <input type="checkbox"/>
Leg push	None or Weak	<input type="checkbox"/> Uneven	<input type="checkbox"/> Even <input checked="" type="checkbox"/>
<i>Rotation</i>			
Control	Lacking control	<input type="checkbox"/> Some control <input type="checkbox"/>	Total control <input checked="" type="checkbox"/>
Arm action	Elbows remain flexed	<input type="checkbox"/> Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input type="checkbox"/>
Legs	Remain extended	<input type="checkbox"/> Remain flexed <input type="checkbox"/> Extended then flex in second half of rotation	<input checked="" type="checkbox"/>
<i>Finish</i>			
Rising	Lacking control	<input type="checkbox"/> Some loss of balance	<input checked="" type="checkbox"/> Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm	<input type="checkbox"/> Slightly anterior to buttocks	<input checked="" type="checkbox"/> Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm	<input type="checkbox"/> Abducted < 20cm	<input type="checkbox"/> Anatomically neutral <input checked="" type="checkbox"/>
Overall Focus:	Single Indicator	<input type="checkbox"/> or Two or more	<input checked="" type="checkbox"/> or Multiple <input type="checkbox"/>
Demonstrated aspects of learning:			
Other comments:			
SOLO: M2			

Older Adults Subject Number 45 .Recording: Gym 6 Time: 0:28

Indicators Measure of Quality Continuum (Modified descriptors)

(Temporal order)	Low Quality (Cycle 1) →	Medium quality (Cycle transition)	→ High Quality (Cycle 2)
<i>Start</i>			
Hand position	>20cm wide Or elbows bend out	<input checked="" type="checkbox"/> <20cm wide of shoulders	<input type="checkbox"/> Shoulder width <input type="checkbox"/>
Head contact	Superior surface contact	<input type="checkbox"/> Dorsal surface touches	<input checked="" type="checkbox"/> Off the surface <input type="checkbox"/>
Contacts	Five or more	<input checked="" type="checkbox"/> Three <input type="checkbox"/> Four	<input type="checkbox"/> Two <input type="checkbox"/>
Leg push	None or Weak	<input type="checkbox"/> Uneven	<input type="checkbox"/> Even <input checked="" type="checkbox"/>
<i>Rotation</i>			
Control	Lacking control	<input type="checkbox"/> Some control <input type="checkbox"/>	Total control <input checked="" type="checkbox"/>
Arm action	Elbows remain flexed	<input type="checkbox"/> Abducted <input type="checkbox"/>	Arms extended (shoulder width) <input checked="" type="checkbox"/>
Legs	Remain extended	<input type="checkbox"/> Remain flexed <input checked="" type="checkbox"/> Extended then flex in second half of rotation	<input type="checkbox"/>
<i>Finish</i>			
Rising	Lacking control	<input type="checkbox"/> Some loss of balance	<input checked="" type="checkbox"/> Totally smooth <input type="checkbox"/>
Feet	Anterior to buttocks >30cm	<input checked="" type="checkbox"/> Slightly anterior to buttocks	<input type="checkbox"/> Almost inferior to buttocks <input type="checkbox"/>
Any part of Legs	Abducted > 20cm	<input type="checkbox"/> Abducted < 20cm	<input checked="" type="checkbox"/> Anatomically neutral <input type="checkbox"/>
Overall Focus:	Single Indicator	<input type="checkbox"/> or Two or more	<input type="checkbox"/> or Multiple <input type="checkbox"/>
Demonstrated aspects of learning:			
Other comments:			
SOLO: R1			

APPENDIX R
SOC Codes For All Cohorts

Child No	SOC code	Young Adult No	SOC code	Older Adult No	SOC code
1	M1	1	U2	1	U2
2	R1	2	U2	2	M1
3	U1	3	R2	3	M2
4	U1	4	M2	4	M1
5	U1	5	R1	5	M1
6	M2	6	U1	6	M1
7	M1	7	U1	7	M2
8	U1	8	U2	8	M1
9	M1	9	U2	9	U2
10	M1	10	M2	10	M1
11	U1	11	U1	11	M1
12	M1	12	M2	12	U2
13	U2	13	M2	13	U2
14	U2	14	R2	14	U1
15	M1	15	R2	15	U2
16	R2	16	M2	16	M1
17	R2	17	U2	17	M2
18	R2	18	R2	18	R2
19	R2	19	R1	19	M1
20	M1	20	M2	20	M1
21	U1	21	R2	21	U1
22	M2	22	U2	22	U1
23	U2	23	U2	23	U1
24	U1			24	U1
25	U1			25	U1
26	M2			26	M2
27	M2			27	R2
28	U2			28	U2
29	M1			29	M2
30	M1			30	M1
31	R1			31	M1
32	M1			32	M1
33	U2			33	M1
34	U1			34	M2
35	R2			35	M1
36	R2			36	U1
37	R2			37	U2
38	R2			38	U1
39	M2			39	U1
40	U1			40	U1
41	U2			41	U1
42	U1			42	U1
43	U1			43	R1
44	U1			44	M1
45	M1			45	R1
46	M1				
47	U1				
48	U1				

APPENDIX S

The Performers: Notes related to the findings

Three factors influence the participants' performances. These are – Biomechanical and Physical Capacities of participants, Psychological, and Experiential.

Biomechanical and Physical Capacities of Participants

Performance can be affected by biomechanical factors, for example, joint mobility, bone size and proportionality as well as physical capacities such as, agility, speed, muscular strength, endurance, flexibility, co-ordination, and the like. The following paragraphs contain descriptions, using examples from each sequence of the forward roll, related to how these factors can affect performances. Commencing with an example from the beginning, followed by the bridging sequence and then the end sequence, each cohorts' characteristics are examined.

For the beginning sequence the data indicated that for Hand position most children placed them “wide of the shoulders” thereby permitting the head to be closer to the surface, compared with when the arms were extended. One explanation for a “close to the surface” head position is that children's heads are large in proportion to their body making them “top heavy” (Gallahue & Ozmun, 2002, p. 113) and thus prone to loss of balance, as situation that is created when the centre of gravity is beyond their base of support.

However, from a biomechanical and physiological perspective, when the arms are flexed wide at more than 90° at the elbows, and/or the elbow joints are not locked into an extended position a problem arises because muscular strength becomes an input factor. Conversely, muscular strength is not required when the extended elbow joints align the upper and lower segments of the arm and “locks the elbow,” thereby stabilising the arm (Schembri, 1983 , p. 15). A flexed elbow requires considerably more input from muscles of the arm, such as the brachialis, brachioradialis, triceps and the biceps brachii, as well as the muscles of the shoulder girdle, such as the deltoids and pectoralis major and minor, to support body weight. Skilled gymnasts who position the hands on the surface, shoulder width apart with an extended arm can easily support their body weight, as a result of biomechanical principles based upon the strength of bone alignment over muscle strength.

For young adults the most common Hand position was described as “slightly wide of shoulder width apart.” Anecdotally the majority of young adult participants within the sample tended to be actively engaged in various vigorous physical activities, and had maintained a range of motor fitness components, such as coordination, strength, and flexibility. Older adults demonstrated some of the characteristics of both children and younger adults. However, the apparent difference in strength, joint flexibility, weight, and body proportionality between participants is offered as an explanation for the differences in performance.

The Arm/elbow position adopted by children, specifically, the elbows flexed at an angle greater than 90° and abducted at the shoulder (i.e., pointing away from the midline of the body) is also explicable in terms of body proportionality. Flexing the elbows allows the weight of the head to remain closer to the body’s centre of gravity, providing greater stability. In contrast, the younger adult cohort flexed the elbows posteriorly, that is, there was no rotation of the arm at the shoulder, but there was elbow flexion, which means the head was forward beyond the centre of gravity, anterior to the line of the hands, a position that requires neuromuscular control and balance.

It was noted that the Head position for children was that top of the head (i.e., superior aspect or crown) was placed on the surface more often than either of the other two cohorts, providing a pivot point about which the body was rotated. With a “relatively high centre of gravity and the ratio of the head in relation to the body is large” (Pangrazi, 2004, p. 27) control of the head, in a situation involving loss of balance, appears problematic. It is likely that children would rather place the head on the surface, than rotate around the hands with a relatively weak arm position with the probability of collapsing “face down” onto the surface.

Throughout the bridging sequence of the roll, children tended to display either knee extension (straight leg position) or the higher order of “knee extension – knee flexion – knee extension.” To explain the extended knee position consideration needs to be given to the concept that “cephalocaudal (head to toe) and proximodistal (mid line of the body to outer extremities) development is occurring” (Peterson, 2004, p. 118). For children this means that the extremities are more difficult to control than body components that are closer to the mid-line. In addition, the hip flexor muscles, such as the psoas major and the iliacus are unable, due to lack of strength, to maintain or initiate hip flexion. Previous studies, notably those by Robertson (1978) found that

children tended to straighten the legs at the conclusion of a forward roll. The fact that a number of children display a more advanced “straight-bent” leg action is attributable to the nature of this cohort. Some of these children have been sub-elite and elite gymnasts for some time and have developed strength and “good form” as a result of constant training, practice and issues related to their mesomorphic (muscular) somatotype (Caine, Cochrane, Caine, & Zemper, 1989).

Furthermore, the Shoulder/arm positions demonstrated both the ideal as well as poorer quality attributes, which can be explained in physiological terms. The children who displayed the ideal Shoulder/arm position were both chronologically older and more experienced than the beginners who showed a general trend of having the arms abducted at the shoulders and an open “V” position; a ploy used to attempt to maintain balance. Age differences generally lead to greater muscular and neuromuscular development and hence greater relative strength and coordination. Elite female gymnasts tend to possess somatotypes (body types) that are mesomorphic (muscular) with a typical somatotype ranking of 2.0–4.0–3.0 (Bloomfield, Ackland, & Elliott, 1998 p. 56). The first number represents a measure of ectomorphy (linearity), the second mesomorphy (muscularity), and the third endomorphy (adiposity). Each dimension is based on a maximum score of 7.0 (Sheldon, 1954). Increased strength leads to a greater control as was evidenced in the Shoulder/arm positions for young and older adults.

During the end sequence the children further reflected the somewhat dichotomous nature of the cohort with regard to their Feet position. The beginners placed their feet “away from” the buttocks, whilst the older and stronger members of this cohort placed their feet closer to the ideal position. The young adults and older adults presented an “away from” the buttocks position, indicating less general flexibility and a larger hip to waist ratio than children. Even though both the adult cohorts maintained a flexed knee during the rotation, an increase in weight, particularly for middle age, that is, 35–45 years (Shephard, 1998) and older adults (Nieman, 1995) results in larger thighs and waist girth. These factors coupled with “deterioration of ligaments and tendons in older people” (Gordon et al., 1992, p. 545) leads to a lack of flexibility (Shephard, 1998). For a typical individual from the young adult and the older adult cohorts, attempting to place the feet close to the buttocks becomes problematic.

Psychological

Although not addressed directly in this study, psychological factors can include individual attributes such as, self-confidence, anxiety, motivation, level of arousal and other personality traits. Psychological factors explain a number of influences affecting results.

For children the head being nearer to the surface can lead to the perception of “greater confidence” over the descent from a standing position to the surface, and thus less anxiety or fear exists over the prospect of losing control. For example, if a child’s arms are extended, the head is still at standing height from the surface, and the greater the possibly that some anxiety is present. Furthermore, placing the head on the surface means there is contact during the roll giving better “feel” as a result of kinaesthetic feedback at the beginning of the roll. The head placed on the surface gives the participant the ability to more easily control the rate of rotation, which lessens (erroneously) a perceived risk of injury.

A number of researchers, including Duda (1995), and Weiss, Weise, and Klint (1989) found that fear of injury is a common source of worry amongst young people engaged in gymnastics. Magyar and Chase (1996) indicated that the perception of risk, can lead to a gymnast’s fear of being injured, while learning a new skill. Both Packard (2004) and Wickstrom (1983) commented that children were afraid of losing balance. Wickstrom (1983 p. 240) indicated “two complications that must be kept in mind when interpreting data on the development of the skill (forward roll) are the child’s fear of losing balance and his disadvantageous body segment proportion.” In addition, Gill, Taylor, and Pengelly (2004) reported that children highlighted fear of injury as a barrier to sport participation. Booth, Owen, and Gore (1997) found that parents were also concerned about the prospect of their child being injured. Developmentally, children have much larger heads in comparison to the rest of their bodies than adults. This creates a larger “target” when falls occur. Children’s centre of balance is high due to this relatively large head, their rapid growth and “bowed” position of the spine.

Better skilled children matched the young adults in the ability to achieve a satisfactory head position. However, older adults used the crown of the head as a point of rotation in similar percentages to the children. The older adults showed a similar frequency of hand position to the children, namely, wide of the shoulders. The older adult cohort

also indicated, in follow-up interviews, a reluctance to perform the roll due to fear of injury, in addition to lacking the technique that ensures a “safe” performance. Gill, Taylor and Pengelly (2005) found that fear of falling was a concern with regard to older people. This finding was ratified by the results obtained from the application of the instrument “Leximancer” to the interview data.

The results for the Arm/elbow position for children reveal some similarity to those of older adults, that these two cohorts have a greater percentage of “wide arms” than younger adults. There is a number of possible psychological reasons why older adults exhibit similar characteristics, which include being cautious and anxious about possible injury, loss of strength with increasing age, lack of recent practice.

Even though some young adults and older adults expressed some concern about “looking silly”, as revealed in the interviews, adults appear to “know their own ability”. This observation was based on the fact that they had performed a roll on previous occasions.

Experiential

Experiential factors can explain a number of influences affecting the results. These include length of time in practicing, number of exposures to the activity, the opportunity to perform under different circumstances, access to expertise, knowledge about conditions affecting the outcome of a roll and so on.

Inexperienced children (beginners) demonstrated the characteristics of poor quality performances whereas more experienced individuals, who had participated in gymnastics skill practices over a period of time, showed higher quality movements. This scenario was evident despite that fact that most “newly commencing” individuals had been exposed to the gymnastic routines of other gymnasts through the observation of them performing forward rolls at their Club. Furthermore, poorer quality performances were observed for the beginners even though were under constant supervision and the instruction of nationally accredited coaches who insisted on the maintenance of good gymnastic posture.

For many young and older adults the time factor between previous attempts to perform a roll varied, as evidenced in the responses elicited in interview data (see Appendix #). Individuals from both cohorts indicated they had performed a forward roll at some time in the past. The retention of learning from these previous

experiences was evident as they were aware that rolling was a continuous movement. In addition they had a practical working knowledge of the conservation of angular momentum and were aware of the necessity to attempt to maintain movement, because “rotation around a smaller radius of rotation (tucked position) decreases the moment of inertia and increases the angular velocity” (Luttgens, Deutsch, & Hamilton, 1992, p. 403).

Furthermore, many individuals from both the younger and older adults had been taught using “dated” teaching practices and equipment. For example, maintaining a tucked position during rotation, which in the past was mandated for safety reasons. This is evidenced in the gymnastics teaching manual *Physical Education for Primary Schools: Gymnastics*, issued by the Department of Education in Queensland (1971) and the *Natural Science, Health and Physical Education Curriculum* issued by the Department of Education in NSW (1975).

Some other “teaching practices” such as crossing the legs at the end of the rotation, because it is easier to rise to stand using this strategy, can explain why this practice was observed for some participants. In explaining these phenomena recognition needs to be given to the notion that they were common teaching strategies used by physical educationalists, but not necessarily gymnastic coaches. By way of further example, of how teaching practices can influence “incorrect” movements; by placing one-foot forward at the beginning of the roll, the teacher is able to “spot” (support) the performer by using one hand behind the knee on the upper leg to assist rotation (Pangrazi, 2001). This particular strategy has been somewhat superseded with the advent of wedge shaped gymnastic mats, which facilitate the ability to roll (down a slope) without the coach having to assist by physically turning the individual (Maunder, personal communication, 2006). Evidence of such teaching practices may also be found in the publications pertaining to *Physical Education for Primary Schools: Gymnastics* (Department of Education New South Wales, 1975 p. 104; Department of Education Queensland, 1971, p. 19).