APPENDIX A: CH6 DELPHI TECHNIQUE

A.1 DELPHI ROUND 1 EMAIL QUESTIONAIRE

Dear XXXXXX,

Thank you for agreeing to partake in a survey exercise for this research project. Your participation will be completely confidential and
you will remain completely anonymous throughout this process. The data gathered within this survey will not be not be subject to any public disclosure and is for use only as part of a PhD research project.

The PhD project aims to identify the ethical issues relating to lower limb running prostheses and then to determine a strategy to assess them. The following survey is stage 1 of a Delphi questionnaire. This is designed to obtain your personal opinion relating to a key issue.

The Delphi process involves questioning you on three separate occasions:

- Round 1: Some general open ended questions will be submitted to you requiring your response. These are below for you to reply to now.

At a later date:

- Round 2: Your answers (and those from the other panellists) from round 1 will be summarised and formulated into a series of more specific questions that you will be asked to respond to.

- Round 3: Round 2's questions will be submitted to you again but this time you will also be able to see the average reply of the other panellists and you will then be asked if you would like to adjust your answer from the second round or not.

The identity of all panellists will remain confidential at all times.

The 3 questions listed below are designed to seek your personal opinion. Please reply to each one but please do not feel limited in the length or style of your answers. A reply to these by email is fine.

1) In your opinion, what is the role of a lower limb prostheses within Paralympic competition ?

2) If you can, please give examples which demonstrate that lower limb prostheses technology used for running could be regarded as fair or unfair.

3) In your opinion, what technological limits should or should not exist in the future for Paralympic running ?

Thanks for your assistance,

Bryce Dyer.

A.2 DELPHI ROUND 1 THEMES

Whilst only 3 open ended questions were asked within round one of the Delphi technique, 17 themes were created and are shown in the following table.

No.	Origin/ Theme No.	Theme
1	1:a	The role of the prostheses
2	1:b	Providing what means to a prostheses user ?
3	1:c	Is the prostheses part of the user ?
4	1:d	Restorative vs enhancement technology
5	1:e	Objective characteristics of a prostheses
6	1:f	User/endeavour classification
7	1:g	External effects of prostheses use
8	2:a	Equity of access to prostheses technology
9	2:b	Issue of the cost of prostheses technology
10	2:c	Mixed disability classification participation
11	2:d	Passive vs active prostheses design
12	2:e	Ethos of Paralympic competition
13	2:f	Limb length manipulation
14	2:g	Recognising a contribution by the prostheses
15	2:h	Physical effect of using a prostheses
16	3:a	The respondents opinion to a solution
17	3:b	The characteristics of stride length

A.3 DELPHI ROUND 2 QUESTIONNAIRE

No.	Statement		
1	The users of lower-limb running prosthesis within sports competition are *athletes*.		
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement		
2	The ongoing development of lower-limb running prostheses is part of the character of disability running competition.		
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement		
3	Financial cost of any lower-limb running prostheses technology should have no limits placed upon it if the health of the athlete with its use is improved. *(cost vs health)*		
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
4	Participation numbers within the lower-limb disability running event are more important than access to equal prostheses technology by the athletes. *(participation vs equipment equity)*

Strongly Disagree	Disagree	Agree	Strongly Agree

No.	Statement
5	Athlete participation numbers within the lower-limb disability running event are more important than the competitors having an identical disability type within the race *(participation vs classification).*

Strongly Disagree	Disagree	Agree	Strongly Agree

No.	Statement
6	The lower-limb running prosthesis is a piece of *sports equipment* (as a person would regard a pair of sports shoes or sports clothing).

Strongly Disagree	Disagree	Agree	Strongly Agree

No.	Statement
7	The lower-limb running prosthesis is not considered part of the users' human body (as they would regard their *natural* arms or legs).
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
8	The lower-limb running prostheses should not be able to perform better than the athlete's sound leg in a naturally trained state.
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
9	The lower-limb running prosthesis is for restoring the physical ability of the missing leg to the athlete.
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
10	The lower-limb running prosthesis is to restore the *function* ability of the missing leg to the athlete.
Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
11	**Any type of technology can be used in the lower-limb running prosthesis. Its performance output requires restricting <u>not</u> the method used to achieve it.**

Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
12	**The lower-limb running prosthesis performance needs to have some form of control.**

Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
13	**The lower-limb running prostheses maximum leg length should be restricted.**

Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
14	**The lower-limb running prostheses should not provide a stride length beyond that of the users' current naturally determined level.**

Strongly Disagree	**Disagree**	**Agree**	**Strongly Agree**

No.	Statement
15	Provided all athletes are **all** subjected to the **same** criteria and assessment, any testing may not consider all the characteristics of a lower-limb amputee running event.

Strongly Disagree	Disagree	Agree	Strongly Agree

16. **In your opinion**, please move the following fairness criteria into the table below and rank them in their order of importance (by cutting and pasting within the table below).

Number 1 is the most important to you down to 7 which is less so.

1	
2	
3	
4	
5	
6	
7	

Criteria (to be moved into the table)

The cost of lower-limb prosthesis to athletes.

Athlete participation levels within disability running sport.

Athletes access to lower-limb prostheses technology.

Athletes competing with the same level of disability within a classification.

A sports history/tradition (the way things have been in the past).

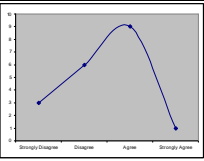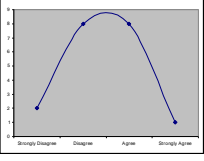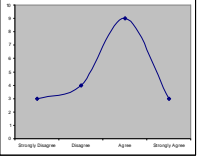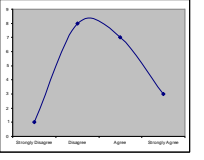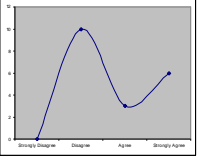**The quality of the performance by the athlete caused by the prostheses' use.**
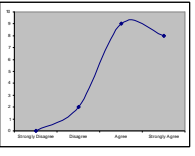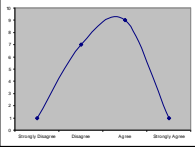
The athletes physical wellbeing.
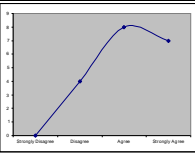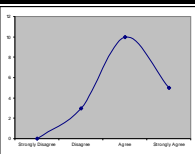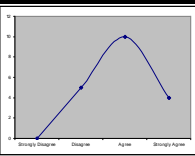
Notes (this is for any comments you may wish (but are not expected) to add.
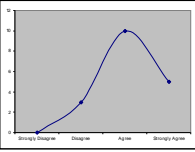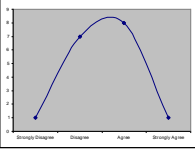
A.4 DELPHI ROUND 2 RESULTS

	Question / Statement	Mode of Consensus	Intensity Consensus	General Positive / Negative Consensus	Opinion Skew	Thoughts	Pursue to Round 3?
1	The users of lower-limb running prosthesis within sports competition are classified as athletes.	Strongly Agree	68.4%	89.5%		Consensus achieved.	No
2	The ongoing development of lower-limb running prostheses is part of the character of disability running competition.	Strongly Agree	42%	79%		Consensus achieved.	No
3	Financial cost of any lower-limb running prostheses technology should have no limits placed as long as it does not impair the athletes' physical wellbeing.	Agree	63%	68%		Consensus feasible at Round 3.	Undecided

4	Participation numbers within the lower-limb disability running event are more important than access to equal prostheses technology by the athletes.	Agree (but split opinion)	47%	*Consensus not established*		Unable to consistently prioritise one value over another.	No
5	Athlete participation numbers within the lower-limb disability running event are more important than the competitors having an identical disability type within the race.	Even Split Opinion	42%	*Consensus not established*		Unable to consistently prioritise one value over another.	No
6	The lower-limb running prosthesis is a piece of sports equipment (as a person would regard a pair of sports shoes or sports clothing).	Agree	47%	63%		Consensus uncertain at Round 3.	Yes
7	The lower-limb running prosthesis is not considered part of the users' human body (as they would regard their natural arms or legs).	Disagree (but split opinion)	47%	*Consensus not established*		Due to contradiction with Q8 - could the negative 'not' in the question be confusing respondents ? Pursue to round 3	Yes
8	The lower-limb running prostheses should not be able to perform better than the athlete's sound leg in a naturally trained state.	Disagree (but split opinion)	53%	*Consensus not established*		Due to contradiction with other questions, pursue to round 3	Yes

9	The lower-limb running prosthesis is for restoring the physical ability of the missing leg to the athlete.	Agree	42%	79%		Consensus potentially achieved if total favourability is included.	No
10	The lower-limb running prosthesis is to restore the function ability of the missing leg to the athlete.	Agree	47%	89%		Consensus potentially achieved if total favourability is included.	No
11	Any type of technology can be used in the lower-limb running prosthesis. Restrictions may be placed on the performance output of the prostheses, rather than on the actual methods used to achieve it.	Agree (but split opinion)	44%	*Consensus not established*		Consensus unlikely. Reformulate and pursue to Round 3 nonetheless.	Yes
12	The lower-limb running prosthesis performance needs to have some form of control.	Agree	53%	83%		Consensus potentially achieved if total favourability is included.	No
13	The lower-limb running prostheses maximum leg length should be restricted.	Agree	53%	74%		Consensus potentially achieved if total favourability is included.	No

1 4	The lower-limb running prostheses should not provide a stride length beyond that of the users' current naturally determined level.	Agree	55%	83%		Consensus potentially achieved if total favourability is included.	No
1 5	Provided all athletes are all subjected to the same criteria and assessment, any testing need not consider all the characteristics of a lower-limb amputee running event.	Agree (but split opinion)	47%	*Consensus not established*		Consensus unlikely. Reformulate and pursue to Round 3 nonetheless.	Yes
1 6	In your opinion, please move the following (7) fairness criteria into the table below and rank them in their order of importance (by cutting and pasting within the table below).	General disagreement	n/a	All values see consensus not achieved but wellbeing prioritised and tradition dismissed as a value.	n/a	58% agree that Physical wellbeing is the most important value. Ranked 1st and mean of 2.2.

76% agree that a sports history and tradition is generally an unimportant value. Ranked 7th and mean of 6.7. | Undecid ed |

A.5 DELPHI ROUND 3 QUESTIONNAIRE

Respondent Cover Note:

You recently assisted the second round of my research with your opinions to 16 questions on athletes with a disability who run competitively. This is the final round of the research and the X questions will take you no longer than 1 minute to complete.

Please read each statement and then delete 1 of the 2 boxed options below it leaving your option of 'agree' or 'disagree'.

A short note is provided with each question to let you know what the general opinion was in the previous round.

No.	Statement
1 (6)	The lower-limb running prosthesis is a piece of sports equipment.
Disagree	**Agree**

Note to respondent: In the last round of questions, 63% of respondents agreed with this.

No.	Statement
2 (8)	In the case of an athlete with a single leg amputation, it is acceptable for a lower-limb running prosthesis to outperform their natural leg.
Disagree	**Agree**

Note to respondent: In the last round of questions, overall consensus was split but favoured agreement.

No.	Statement
3 (16)	As long as it is within the rules of a sport, the athlete has the right to choose what technology they feel is appropriate to use.
Disagree	**Agree**

Note to respondent: In the last round of questions, 58% of respondents insinuated that health and wellbeing overruled all other concerns (such as cost, tradition, participation levels, and access to technology).

Rejected Lines of Questioning

No.	Statement
from (11)	In lower-limb sport prostheses, its performance needs regulation but new technology to improve this does not.
Disagree	**Agree**

Note: In the last round of questions, overall consensus was split but favoured agreement.

No.	Statement
from (15)	In light of the fact that all the known biomechanical specifics of lower-limb running performance may never be known, provided all athletes are tested equally, this is considered fair.
Disagree	**Agree**

Note: In the last round of questions, overall consensus was split but favoured agreement.

No.	Statement
from (16)	With regards to any new prosthesis technology, the health and wellbeing of the athlete is paramount over all other factors.
Disagree	**Agree**

Note: In the last round of questions, 58% of respondents insinuated that health and wellbeing overruled all other concerns (such as cost, tradition, participation levels, and access to technology).

APPENDIX B: CH8 JOST TEST DATA

B.1 JOST TEST KNEE MARKER DATA

Knee marker data when subjected to a 3Hz alternate leg jog/hop test for 10 seconds.

Overall Leg Frequency of Knee Marker (Hz)

Condition	1 Left	1 Right	1 Diff	2 Left	2 Right	2 Diff	3 Left	3 Right	3 Diff	4 Left	4 Right	4 Diff	5 Left	5 Right	5 Diff	6 Left	6 Right	6 Diff	Mean (Hz)	SD	CV (%)
1 Bi-lateral - Long	3.01	2.99	0.02	2.96	2.96	0	2.96	3.01	-0.05	3.02	2.96	0.06	2.94	3.01	-0.07	3.05	3.07	-0.02	3.00	0.04	1.3
2 Uni-lateral - Left Marker Long /Right Marker Short (more stiff)	2.99	2.98	0.01	2.98	2.99	-0.01	3.07	3.02	0.05	3.06	3.01	0.05	2.95	2.98	-0.03	2.96	3.01	-0.05	3.00	0.04	1.2
3 Bi-Lateral - Short	2.99	2.99	0	3.04	3.01	0.03	3.02	3	0.02	2.99	3.01	-0.02	2.96	2.98	-0.02				3.00	0.02	0.7
4 Uni-lateral - Left Marker Short (more stiff)/Right Marker Long	3	3.02	-0.02	2.98	3.14	-0.16	2.99	3	-0.01	3	3.02	-0.02	3.01	3.01	0	2.99	3	-0.01	3.01	0.04	1.4
5 Bi-Lateral - Long (rev)	2.96	3.19	-0.23	2.96	2.96	0	3.02	3.03	-0.01	3.03	3.04	-0.01	3	3.03	-0.03				3.01	0.03	1.1

Average Stroke of marker* (Metres)

Condition	1 Left	1 Right	1 Mean	1 Diff	2 Left	2 Right	2 Mean	2 Diff	3 Left	3 Right	3 Mean	3 Diff	4 Left	4 Right	4 Mean	4 Diff	5 Left	5 Right	5 Mean	5 Diff	6 Left	6 Right	6 Mean	6 Diff	Mean Left & right	Mean Leg to leg diff (M)
1 Bi-lateral - Long	0.137	0.135	0.136	0.002	0.117	0.114	0.116	0.003	0.118	0.119	0.119	0.001	0.121	0.121	0.121	0.000	0.117	0.114	0.116	0.003	0.103	0.099	0.101	0.004	0.12	0.00
2 Uni-lateral - Left Marker Long /Right Marker Short (more stiff)	0.124	0.163	0.144	0.039	0.199	0.156	0.178	0.043	0.114	0.160	0.137	0.046	0.106	0.145	0.126	0.039	0.116	0.147	0.132	0.031	0.106	0.144	0.125	0.038	0.14	0.04
3 Bi-Lateral - Short	0.149	0.144	0.147	0.005	0.149	0.142	0.146	0.007	0.150	0.156	0.153	0.006	0.138	0.145	0.142	0.007	0.143	0.153	0.148	0.010			0.000		0.12	0.01
4 Uni-lateral - Left Marker Short (more stiff)/Right Marker Long	0.156	0.099	0.128	0.057	0.157	0.099	0.128	0.058	0.158	0.104	0.131	0.054	0.163	0.113	0.138	0.050	0.163	0.112	0.138	0.051	0.152	0.112	0.132	0.040	0.13	0.05
5 Bi-Lateral - Long (rev)					0.111	0.096	0.104	0.015	0.108	0.098	0.103	0.010	0.111	0.097	0.104	0.014	0.111	0.095	0.103	0.016			0.000		0.08	0.01

Max Vertical Velocity of Knee Marker (M/s)

Condition	1 Left	1 Right	1 Diff	2 Left	2 Right	2 Diff	3 Left	3 Right	3 Diff	4 Left	4 Right	4 Diff	5 Left	5 Right	5 Diff	6 Left	6 Right	6 Diff	Mean Left	Mean Right	Mean Diff
1 Bi-lateral - Long	.77	.82	0.055	.71	.83	0.119	.67	.79	0.122	.66	.72	0.062	.7	.71	0.012	.66	.73	0.071	.69	.77	.07
2 Uni-lateral - Left Marker Long /Right Marker Short (more stiff)	.61	.96	0.349	.68	.96	0.280	.66	.94	0.278	.69	.77	0.073	.65	.75	0.095	.63	.74	0.114	.65	.85	.2
3 Bi-Lateral - Short	.7	.79	0.088	.75	.67	0.083	.69	.81	0.121	.67	.68	0.007	.7	1.	0.297				.7	.79	.09
4 Uni-lateral - Left Marker Short (more stiff)/Right Marker Long	.8	.64	0.166	.84	.6	0.239	.83	.6	0.223	.98	.67	0.313	.87	.68	0.189	.77	.68	0.094	.85	.64	.2
5 Bi-Lateral - Long (rev)				.6	.67	0.072	.64	.63	0.013	.7	.6	0.099	.66	.6	0.059				.65	.62	-.02

Left Knee Marker - Average Velocity**	1			2			3			4			5			6			Mean (M/Sec)		
Condition	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff
1 Bi-lateral - Long	.47	.4	0.07	.52	.28	-0.24	0.54	0.28	-0.26	0.52	0.29	-0.23	0.54	0.30	-0.24	.48	.27	0.21	.51	.3	-.21
2 Uni-lateral - Left Marker Long /Right Marker Short (more stiff)	.51	.3	0.21	.45	.3	0.15	0.49	0.27	0.22	0.48	0.25	0.23	.49	.27	0.22	.43	.25	0.18	.48	.27	-.2
3 Bi-Lateral - Short	.47	.41	0.06	.48	.43	0.05	.5	.42	0.08	.46	.38	0.08	.48	.38	0.10				.48	.4	-.07
4 Uni-lateral - Left Marker Short (more stiff)/Right Marker Long	.47	.45	0.02	.5	.44	0.06	.52	.44	0.08	.53	.45	0.08	.51	.46	0.05	.49	.43	0.06	.5	.45	-.06
5 Bi-Lateral - Long (rev)	.48	.25	0.23	0.50	0.25	0.25	0.48	0.25	0.23	0.49	0.27	0.22	0.46	0.28	0.18				.48	.26	-.22

Right Knee Marker - Average Velocity (M/s)**	1			2			3			4			5			6			Mean (M/Sec)		
Condition	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff	Low	High	Diff
1 Bi-lateral - Long	.4	.43	0.03	.35	.43	0.08	0.35	0.41	0.06	0.34	0.41	0.07	0.38	0.40	0.02	.37	.33	0.04	.37	.4	.04
2 Uni-lateral - Left Marker Long /Right Marker Short (more stiff)	.46	.5	0.04	.46	.46	0.00	0.47	0.50	0.03	0.45	0.42	0.03	.46	.42	0.04	.45	.41	0.04	.46	.45	-.01
3 Bi-Lateral - Short	.46	.41	0.05	.46	.4	0.06	.5	.44	0.06	.47	.4	0.07	.48	.43	0.05				.47	.42	-.06
4 Uni-lateral - Left Marker Short (more stiff)/Right Marker Long	.38	.28	0.10	.35	.26	0.09	.39	.26	0.13	.39	.32	0.07	.35	.34	0.01	.33	.37	0.04	.37	.31	-.06
5 Bi-Lateral - Long (rev)	.32	.28	0.04	0.41	0.26	0.15	0.41	0.28	0.13	0.45	0.23	0.22	0.44	0.24	0.20				.41	.26	-.15

Summary: Left vs Right - Knee Marker Average Velocity (M/s)	Left H-Low	Left L-High	Right H-Low	Right L-High	Net Mean Left	Right	Comments
Condition							
1 Bi-lateral - Long	.51	.3	.37	.4	0.41	0.39	Relatively symmetrical with slower limb raise
2 Uni-lateral - Left Marker Long /Right Marker Short (more stiff)	.48	.27	.46	.45	0.38	0.46	Right leg overall is faster
3 Bi-Lateral - Short	.48	.4	.47	.42	0.44	0.45	Near symmetrical on each side and on limb raise and lower
4 Uni-lateral - Left Marker Short (more stiff)/Right Marker Long	.5	.45	.37	.31	0.48	0.34	Left leg is faster overall
5 Bi-Lateral - Long (rev)	.48	.26	.41	.26	0.37	0.34	Relatively symmetrical with slower limb raise
General Mean	.49	.34	.42	.37			Left leg to right leg imbalance compensated on downstroke
Limb to limb velocity compensation of all trials	0.66		0.60				Net left leg to right leg imbalance

APPENDIX C: CH9 STATIC LOAD TEST DATA

C.1 PROSTHESES STIFFNESS COMPARISON DATA

Method	Prosthesis	Overall Average Stiffness		Upper segment (1500-2000N)		Stiffness at peak load (2000N)		Upper segment (1500-2000N)	
		Mean Stiffness (N/mm)	CV (%)	Mean Stiffness (N/mm)	CV (%)	Peak Stiffness (N/mm)	CV (%)	Peak Stiffness (N/mm)	CV (%)
FDE	1	51	1.6	58	0.7	60	0.6	82	1.5
PSF	1	30	0.9	43	0.5	58	0.5	85	0.8
FDE	2	39	1.7	46	1.1	48	1.1	69	0.7
PSF	2	26	0	36	0	42	0.2	76	0.2

APPENDIX D: CH9 RUN TEST DATA

D.1 RUN TEST DATA

Clip No	Imbalance Type	Setting Left Foot	Setting Right Foot	Stride Pattern	Percieved Speed	Time to complete	Speed over 4m (m	1-2	2-3	Mean	Freq (Hz	1-2	2-3			Outcome	Limb Diff	Left/right
7227	Bi-lateral	Long	Long	L-R-L	Fast	0.952	4.2	0.362	0.334	0.35	2.87	1.52	1.40	2.92	0.12	Left to right stride is greatest	0.12	-0.12
7228	Bi-lateral	Long	Long	L-R-L	Fast	0.876	4.6	0.347	0.338	0.34	2.92	1.58	1.54	3.13	0.04	Left to right stride is greatest	0.04	-0.04
7229	Bi-lateral	Long	Long	R-L-R	Fast	0.876	4.6	0.319	0.338	0.33	3.04	1.46	1.54	3.00	-0.09	Left to right stride is greatest	0.09	-0.09
7230	Bi-lateral	Long	Long	R-L-R	Fast	0.876	4.6	0.304	0.334	0.32	3.13	1.39	1.53	2.91	-0.14	Left to right stride is greatest	0.14	-0.14
7231	Bi-lateral	Long	Long	R-L-R	Fast	0.862	4.6	0.309	0.338	0.32	3.09	1.43	1.57	3.00	-0.13	Left to right stride is greatest	0.13	-0.13
7232	Bi-lateral	Long	Long	R-L-R	Fast	0.819	4.9	0.309	0.324	0.32	3.16	1.51	1.58	3.09	-0.07	Left to right stride is greatest	0.07	-0.07
7233	Bi-lateral	Long	Long	R-L-R	Fast	0.786	5.1	0.309	0.314	0.31	3.21	1.57	1.60	3.17	-0.03	Left to right stride is greatest	0.03	-0.03
7234	Bi-lateral	Long	Long	R-L-R	Fast	0.933	4.3	0.386	0.39	0.39	2.58	1.65	1.67	3.33	-0.02	Left to right stride is greatest	0.02	-0.03
7235	Bi-lateral	Long	Long	R-L-R	Fast	0.881	4.5	0.343	0.376	0.36	2.78	1.56	1.71	3.26	-0.15	Left to right stride is greatest	0.15	-0.15
	Mean					0.84	4.6	0.33	0.34		2.98	1.52	1.57	3.09	-0.05			
7236	Bi-lateral	Long	Long	R-L-R	Slow	1.09	3.7	0.353	0.347	0.35	2.86	1.30	1.27	2.57	0.02	Right to left stride is greatest	0.02	0.02
7237	Bi-lateral	Long	Long	L-R-L	Slow	1.043	3.8	0.333	0.338	0.34	2.98	1.28	1.30	2.57	-0.02	Right to left stride is greatest	0.02	0.02
7238	Bi-lateral	Long	Long	L-R-L	Slow	1.014	3.9	0.343	0.357	0.35	2.86	1.35	1.41	2.76	-0.06	Right to left stride is greatest	0.06	0.06
7240	Bi-lateral	Long	Long	L-R-L	Slow	0.971	4.1	0.319	0.333	0.33	3.07	1.31	1.37	2.69	-0.06	Right to left stride is greatest	0.06	0.06
7241	Bi-lateral	Long	Long	L-R-L	Slow	0.9	4.4	0.328	0.319	0.32	3.09	1.46	1.42	2.88	0.04	Left to right stride is greatest	0.04	-0.04
7242	Bi-lateral	Long	Long	L-R-L	Slow	1.033	3.9	0.348	0.333	0.34	2.94	1.35	1.29	2.64	0.06	Left to right stride is greatest	0.06	-0.06
7243	Bi-lateral	Long	Long	L-R-L	Slow	0.995	4.0	0.343	0.319	0.33	3.02	1.38	1.28	2.66	0.10	Left to right stride is greatest	0.1	-0.1
	Mean					1.01	3.99	0.34	0.34		2.97	1.35	1.33	2.68	0.01			
7244	Uni-lateral	Short	Long	R-L-R	Fast	0.919	4.4	0.305	0.324	0.31	3.18	1.33	1.41	2.74	-0.08	Left to right stride is greatest	0.08	-0.08
7245	Uni-lateral	Short	Long	L-R-L	Fast	0.843	4.7	0.324	0.281	0.30	3.31	1.54	1.33	2.87	0.20	Left to right stride is greatest	0.2	-0.2
7246	Uni-lateral	Short	Long	L-R-L	Fast	0.829	4.8	0.314	0.286	0.30	3.33	1.52	1.38	2.90	0.14	Left to right stride is greatest	0.14	-0.14
7247	Uni-lateral	Short	Long	L-R-L	Fast	0.838	4.8	0.319	0.276	0.30	3.36	1.52	1.32	2.84	0.21	Left to right stride is greatest	0.21	-0.21
7248	Uni-lateral	Short	Long	L-R-L	Fast	0.833	4.8	0.306	0.3	0.30	3.30	1.47	1.44	2.91	0.03	Left to right stride is greatest	0.03	-0.03
7249	Uni-lateral	Short	Long	L-R-L	Fast	0.829	4.8	0.314	0.281	0.30	3.36	1.52	1.36	2.87	0.16	Left to right stride is greatest	0.16	-0.16
7250	Uni-lateral	Short	Long	L-R-L	Fast	0.843	4.7	0.314	0.271	0.29	3.42	1.49	1.29	2.78	0.20	Left to right stride is greatest	0.2	-0.2
	Mean					0.85	4.7	0.31	0.29		3.32	1.48	1.36	2.84	0.12			
7252	Uni-lateral	Short	Long	R-L-R	Slow	1.076	3.7	0.329	0.366	0.35	2.88	1.22	1.36	2.58	-0.14	Left to right stride is greatest	0.14	-0.14
7253	Uni-lateral	Short	Long	R-L-R	Slow	1.029	3.9	0.328	0.376	0.35	2.84	1.28	1.46	2.74	-0.19	Left to right stride is greatest	0.19	-0.19
7254	Uni-lateral	Short	Long	R-L-R	Slow	1.062	3.8	0.334	0.357	0.35	2.89	1.26	1.34	2.60	-0.09	Left to right stride is greatest	0.09	-0.09
7255	Uni-lateral	Short	Long	R-L-R	Slow	1.062	3.8	0.334	0.362	0.35	2.87	1.26	1.36	2.62	-0.11	Left to right stride is greatest	0.11	-0.11
7256	Uni-lateral	Short	Long	L-R-L	Slow	1.043	3.8	0.362	0.333	0.35	2.88	1.39	1.28	2.67	0.11	Left to right stride is greatest	0.11	-0.11
7257	Uni-lateral	Short	Long	L-R-L	Slow	1.024	3.9	0.347	0.324	0.34	2.98	1.36	1.27	2.62	0.09	Left to right stride is greatest	0.09	-0.09
	Mean					1.05	3.81	0.34	0.35		2.89	1.29	1.35	2.64	-0.05			

7259	Bi-lateral	Short	Short	L-R-L	Fast	0.91	4.4	0.286	0.319	0.30	3.31	1.26	1.40	2.66	-0.15	Right to left stride is greatest	0.15	0.15
7260	Bi-lateral	Short	Short	L-R-L	Fast	0.881	4.5	0.291	0.314	0.30	3.31	1.32	1.43	2.75	-0.10	Right to left stride is greatest	0.1	0.1
7261	Bi-lateral	Short	Short	L-R-L	Fast	0.881	4.5	0.295	0.305	0.30	3.33	1.34	1.38	2.72	-0.05	Right to left stride is greatest	0.05	0.005
7262	Bi-lateral	Short	Short	L-R-L	Fast	0.824	4.9	0.296	0.295	0.30	3.38	1.44	1.43	2.87	0.00	Left to right stride is greatest	0	0
7263	Bi-lateral	Short	Short	L-R-L	Fast	0.843	4.7	0.305	0.31	0.31	3.25	1.45	1.47	2.92	-0.02	Right to left stride is greatest	0.02	0.02
7264	Bi-lateral	Short	Short	R-L-R	Fast	0.795	5.0	0.3	0.291	0.30	3.38	1.51	1.46	2.97	0.05	Right to left stride is greatest	0.05	0.05
	Mean					0.86	4.68	0.30	0.31		3.33	1.39	1.43	2.82	-0.04			
7266	Bi-lateral	Short	Short	L-R-L	Slow	1.152	3.5	0.348	0.348	0.35	2.87	1.21	1.21	2.42	0.00	Balanced	0	0
7267	Bi-lateral	Short	Short	R-L-R	Slow	1.1	3.6	0.353	0.352	0.35	2.84	1.28	1.28	2.56	0.00	Balanced	0	0
7268	Bi-lateral	Short	Short	L-R-L	Slow	1.038	3.9	0.347	0.362	0.35	2.82	1.34	1.39	2.73	-0.06	Right to left stride is greatest	0.06	0.06
7269	Bi-lateral	Short	Short	R-L-R	Slow	1.057	3.8	0.338	0.352	0.35	2.90	1.28	1.33	2.61	-0.05	Left to right stride is greatest	0.05	-0.05
7270	Bi-lateral	Short	Short	L-R-L	Slow	0.99	4.0	0.348	0.352	0.35	2.86	1.41	1.42	2.83	-0.02	Right to left stride is greatest	0.02	0.02
	Mean					1.07	3.76	0.35	0.35		2.86	1.30	1.33	2.63	-0.02			
7272	Uni-lateral	Long	Short	R-L-R	Fast	0.862	4.6	0.319	0.291	0.31	3.28	1.48	1.35	2.83	0.13	Right to left stride is greatest	0.13	0.13
7273	Uni-lateral	Long	Short	R-L-R	Fast	0.871	4.6	0.32	0.304	0.31	3.21	1.47	1.40	2.87	0.07	Right to left stride is greatest	0.07	0.07
7274	Uni-lateral	Long	Short	R-L-R	Fast	0.862	4.6	0.315	0.29	0.30	3.31	1.46	1.35	2.81	0.12	Right to left stride is greatest	0.12	0.12
7275	Uni-lateral	Long	Short	R-L-R	Fast	0.848	4.7	0.324	0.271	0.30	3.36	1.53	1.28	2.81	0.25	Right to left stride is greatest	0.25	0.25
7276	Uni-lateral	Long	Short	R-L-R	Fast	0.852	4.7	0.305	0.286	0.30	3.38	1.43	1.34	2.77	0.09	Right to left stride is greatest	0.09	0.09
	Mean					0.86	4.66	0.32	0.29		3.31	1.47	1.34	2.82	0.13			
7278	Uni-lateral	Long	Short	L-R-L	Slow	1.1	3.6	0.333	0.376	0.35	2.82	1.21	1.37	2.58	-0.16	**Right to left stride is grea**	0.16	0.16
7279	Uni-lateral	Long	Short	L-R-L	Slow	1.119	3.6	0.333	0.391	0.36	2.76	1.19	1.40	2.59	-0.21	**Right to left stride is grea**	0.21	0.21
7280	Uni-lateral	Long	Short	L-R-L	Slow	1.119	3.6	0.343	0.376	0.36	2.78	1.23	1.34	2.57	-0.12	**Right to left stride is grea**	0.12	0.12
7281	Uni-lateral	Long	Short	L-R-L	Slow	1.048	3.8	0.338	0.376	0.36	2.80	1.29	1.44	2.73	-0.15	**Right to left stride is grea**	0.15	0.15
7282	Uni-lateral	Long	Short	L-R-L	Slow	1.114	3.6	0.357	0.376	0.37	2.73	1.28	1.35	2.63	-0.07	**Right to left stride is grea**	0.07	0.07
	Mean					1.10	3.64	0.34	0.38		2.78	1.24	1.38	2.62	-0.14			
7284	Bi-lateral	Long (reversed)	Long (reversed)	R-L-R	Slow	0.91	4.4	0.319	0.376	0.35	2.88	1.40	1.65	3.05	-0.25	Left to right stride is greatest	0.25	-0.25
7285	Bi-lateral	Long (reversed)	Long (reversed)	R-L-R	Slow	0.976	4.1	0.319	0.367	0.34	2.92	1.31	1.50	2.81	-0.20	Left to right stride is greatest	0.2	-0.2
7286	Bi-lateral	Long (reversed)	Long (reversed)	R-L-R	Slow	0.943	4.2	0.338	0.371	0.35	2.82	1.43	1.57	3.01	-0.14	Left to right stride is greatest	0.14	-0.14
7287	Bi-lateral	Long (reversed)	Long (reversed)	L-R-L	Slow	1	4.0	0.357	0.338	0.35	2.88	1.43	1.35	2.78	0.08	Left to right stride is greatest	0.08	-0.08
7288	Bi-lateral	Long (reversed)	Long (reversed)	R-L-R	Slow	0.876	4.6	0.329	0.333	0.33	3.02	1.50	1.52	3.02	-0.02	Left to right stride is greatest	0.02	-0.02
7289	Bi-lateral	Long (reversed)	Long (reversed)	L-R-L	Slow	1.067	3.7	0.366	0.338	0.35	2.84	1.37	1.27	2.64	0.10	Left to right stride is greatest	0.1	-0.1
	Mean					0.96	4.18	0.34	0.35		2.89	1.41	1.48	2.89	-0.07			

Notes

Time starts when torso intesects vertical wall markers

Time is taken from 1st vertical line to 5th (=4m)

Step time is taken from first observed impact onwards

Footage is at 210 FPS

APPENDIX E: CH10 DROP JUMP DATA

E.1 DROP JUMP TEST DATA

Drop JUMP Av. Force - Right Foot (Shod)

Drop JUMP Av. Force Left Foot (Bare)

APPENDIX F: PUBLISHED JOURNAL PAPERS