

AND NOW
COMPLETELY
DIFFERENT



Development of an Inclusive Design Tool based on Psychological, Biomechanical & Functional Performance.

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What is Inclusive/Universal Design?

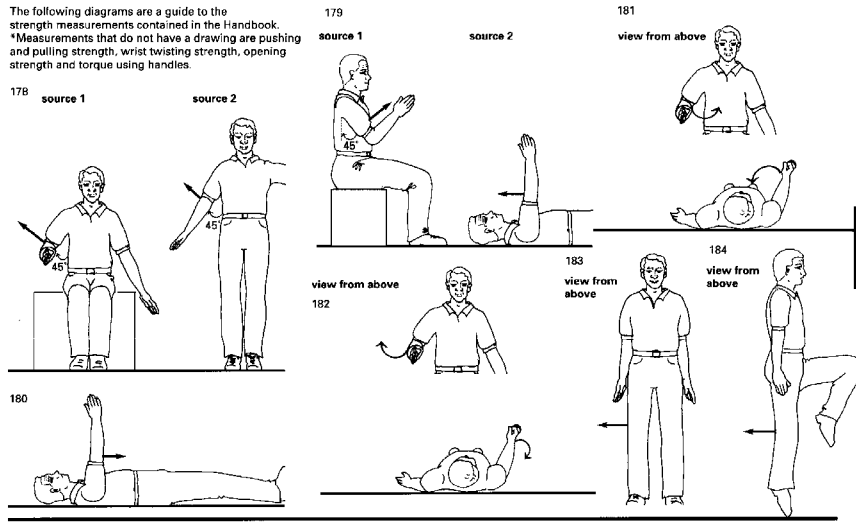
- Inclusive design is a process whereby designers, manufacturers and service providers ensure that their products and environments address the widest possible audience, irrespective of age or ability.
 - **Good design ENABLES**
 - **Bad design DISABLES**



Older Adultdata

STRENGTH MEASUREMENTS

The following diagrams are a guide to the strength measurements contained in the Handbook. *Measurements that do not have a drawing are pushing and pulling strength, wrist twisting strength, opening strength and torque using handles.



155 anthropometric measurements,
22 range of motion measurements,
30 strength measurements
10 measurements of performance

OLDER ADULTDATA (2000) is a comprehensive collection of anthropometric data on older adults (over 60 years of age) for use in the design of products.

ELBOW STRENGTH (N) 186

(extension)

Definition

Maximum static strength of the elbow extensor muscles. The maximum strength pushing downwards in the sagittal plane is measured. The measuring device is placed at the back of the arm just above the wrist (at the styloid processes).

Source

- Rice Person sitting. Shoulder in a neutral position, elbow flexed to 90 degrees, wrist semi-pronated
- Andrews Person lying down. Shoulder in a neutral position, elbow flexed to 90 degrees, wrist in a neutral position
- Sperling Person sitting. Shoulder in a neutral position, elbow flexed to 90 degrees, wrist in a neutral position
- Aniansson As Sperling

Country	Age Sample	Sex	Mean	SD	Source	Sample	Details
Canada	62-102	m	146	45	Rice et al. 1989	37	mixed
	62-102	f	110	32	Rice et al. 1989	81	mixed
Sweden	70	m	219	88	Sperling 1980	68	mixed
	70	f	104	46	Sperling 1980	83	mixed
	75	m	152	49	Aniansson et al. 1983	14	healthy
USA	50-59	f	82	22	Aniansson et al. 1983	19	healthy
	50-59	m	188	33	Andrews et al. 1996	25	healthy
	50-59	f	108	24	Andrews et al. 1996	25	healthy
	60-69	m	163	41	Andrews et al. 1996	26	healthy
	60-69	f	96	23	Andrews et al. 1996	29	healthy
	70-79	m	154	34	Andrews et al. 1996	26	healthy
70-79	f	92	18	Andrews et al. 1996	25	healthy	

source 1,3 and 4



source 2



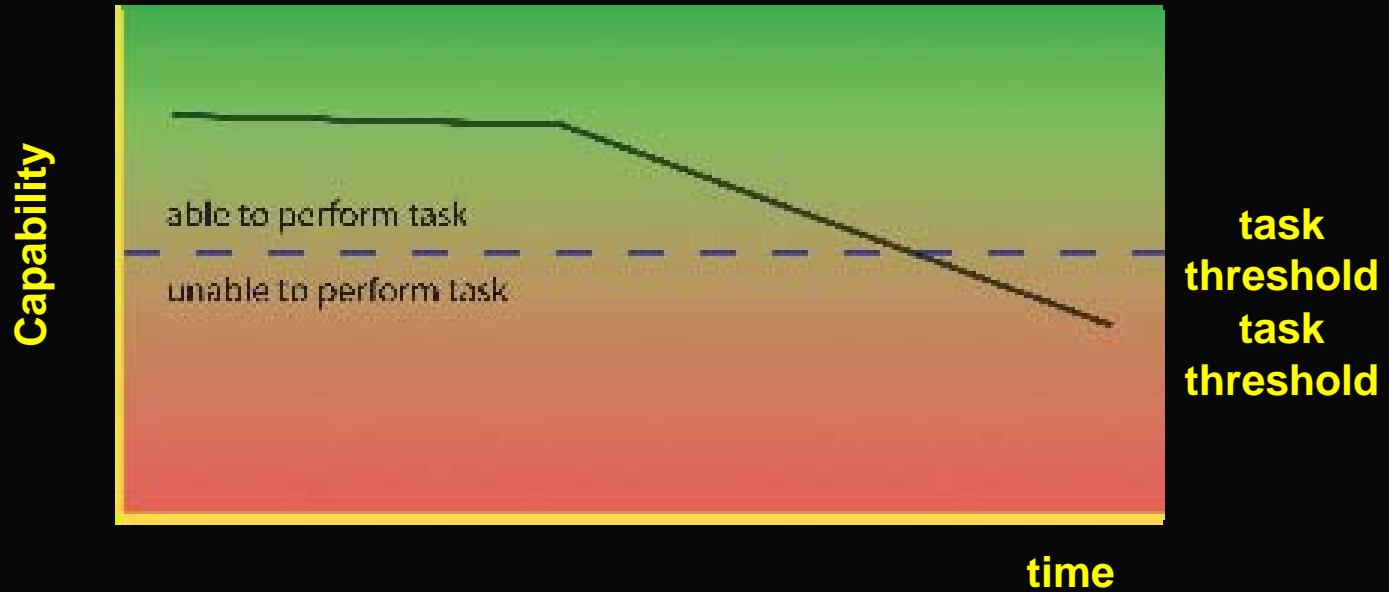
Aims

- To enable designers to assess the functional demands which their product/concept would place on older users
- To inform design without the need for in-depth knowledge of physiology, biomechanics and psychology of ageing.
- To present the information visually



Image courtesy of Helen Hamlyn Inst.





Capability

- physiological/biomechanical
- psychological



Functional capability

$$\text{Functional capacity (\%)} = \frac{\text{Strength required during the task}}{\text{Maximum muscle strength available}} \times 100$$



Maximal Performance

Estimate MVC strength

- Hip and knee strength over range of movement
- Grip strength
- Range of motion of upper and lower limb joints



Biomechanical Assessment

Full body biomechanics

Stairs

Chair

Door opening/closing

Lifting/reaching/placing
ng

Walking



Hand biomechanics

Remote control

Turning key

Opening jar



Biomechanics Laboratory Testing

- 84 healthy older adults
- 3 age groups
 - 60+ (15 ♀ 15 ♂)
 - 70+ (15 ♀ 15 ♂)
 - 80+ (11 ♀ 13 ♂)
- +900 hours of lab testing



Psychological input:

What issues might designers need to consider?

(1) Capability beliefs of older adults

Do older adults acknowledge changing abilities?

- **Over-estimation: risk of physical injury**
- **Under-estimation: risk to independence**

(2) Ability of older adults to deal with novel situations



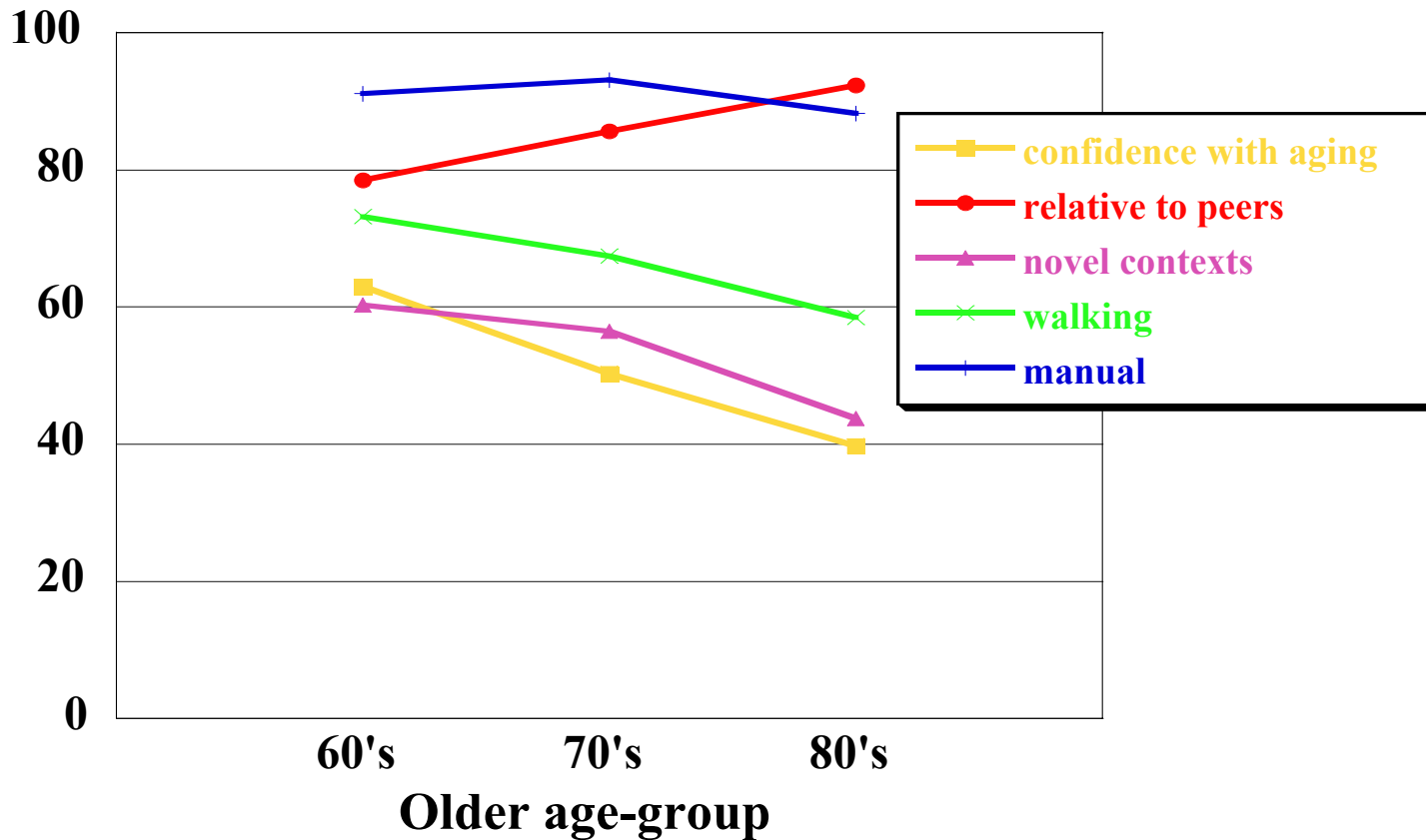
Capability beliefs questionnaire

- **Physical flexibility**
- **Physical endurance**
- **Walking ability**
- **Manual ability**
- **Co-ordinate precise movements**
- **Motor ability in demanding contexts**
- **Motor ability in novel contexts**
- **Confidence in motor ability in face of aging**
- **Motor ability relative to same-age peers**
- **Over-cautious and over-confident indicator**



capability beliefs

Confidence level (%)



(1) Level of Capability Belief

Over-confident:

- 56% of 60's
- 32% of 80's

Over-cautious:

- 30% of 60's
- 49% of 80's

(2) Over-riding inappropriate actions

- Greater failure to 'over-ride' in 70's and 80's compared to all younger age-groups
- Failure frequency and degree of error increase with extreme old age



Reaching
Lifting
Placing

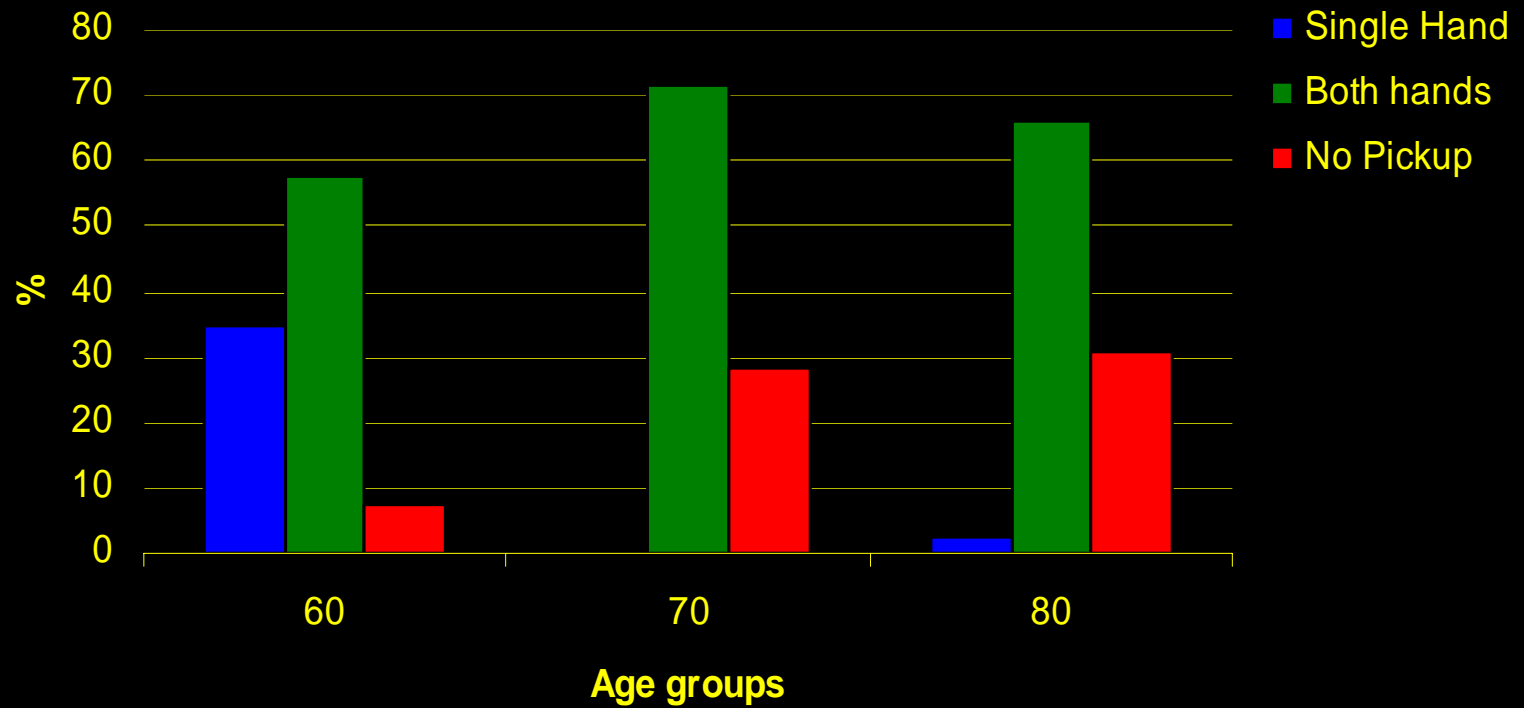


REMOTE CONTROL USAGE

*SINGLE
HANDED*



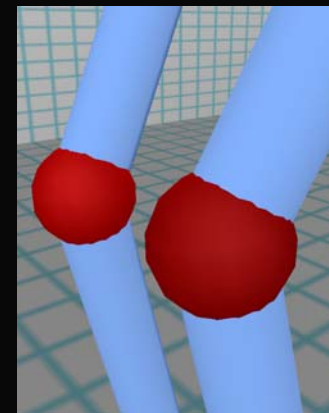
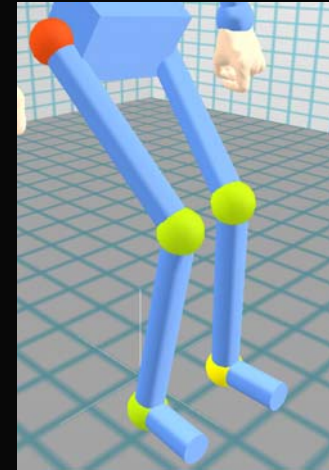
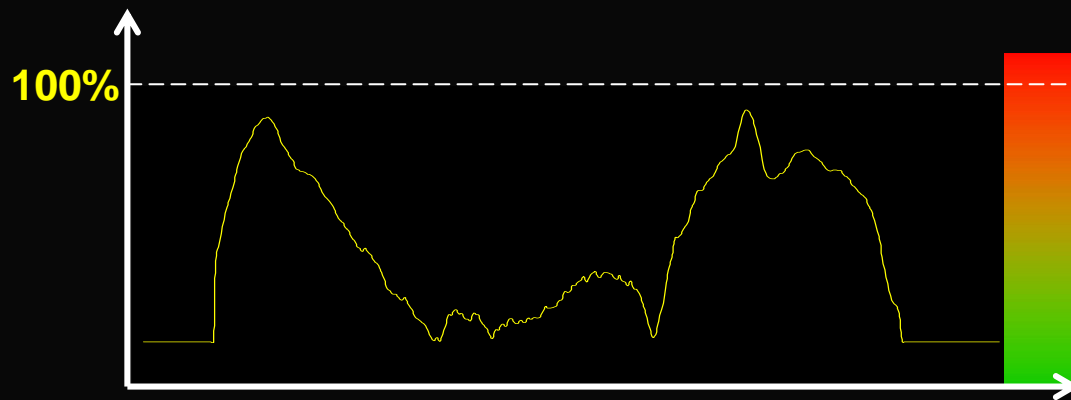
Remote Control: Style of Usage



Visualisation of database

Software generated animation of motion

Joint moment mapping to simple visual scale

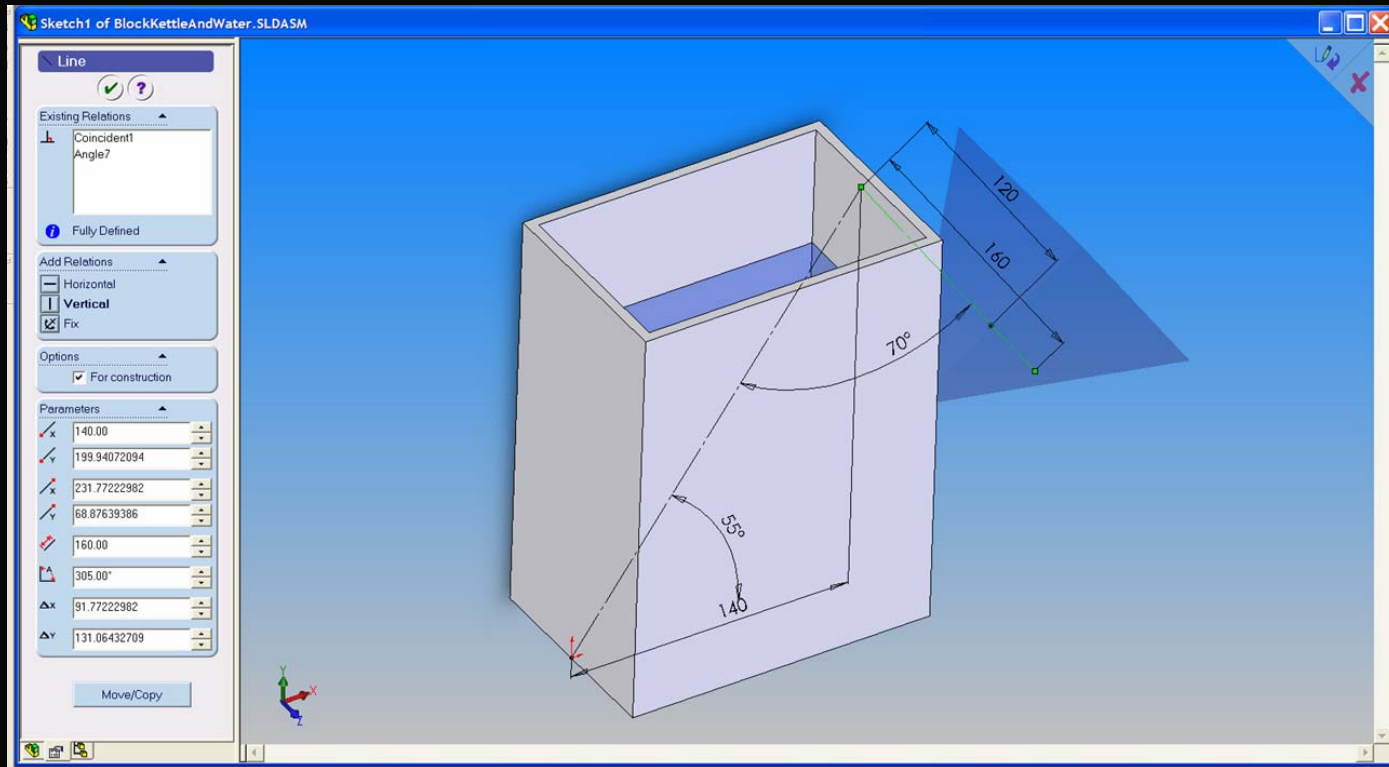


Walking



CAD Integration

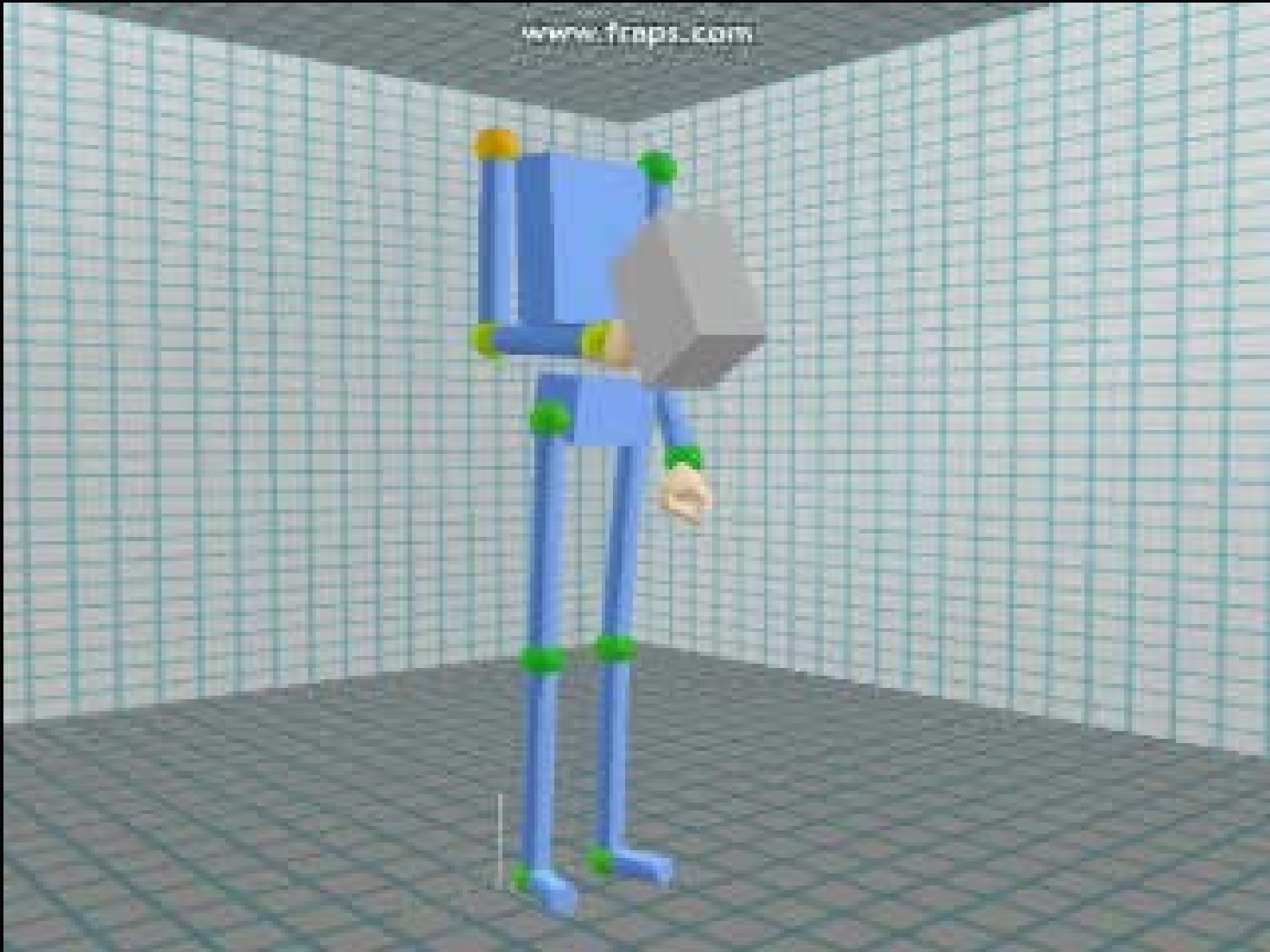
Integration with designer's CAD software



Simple massing model of container

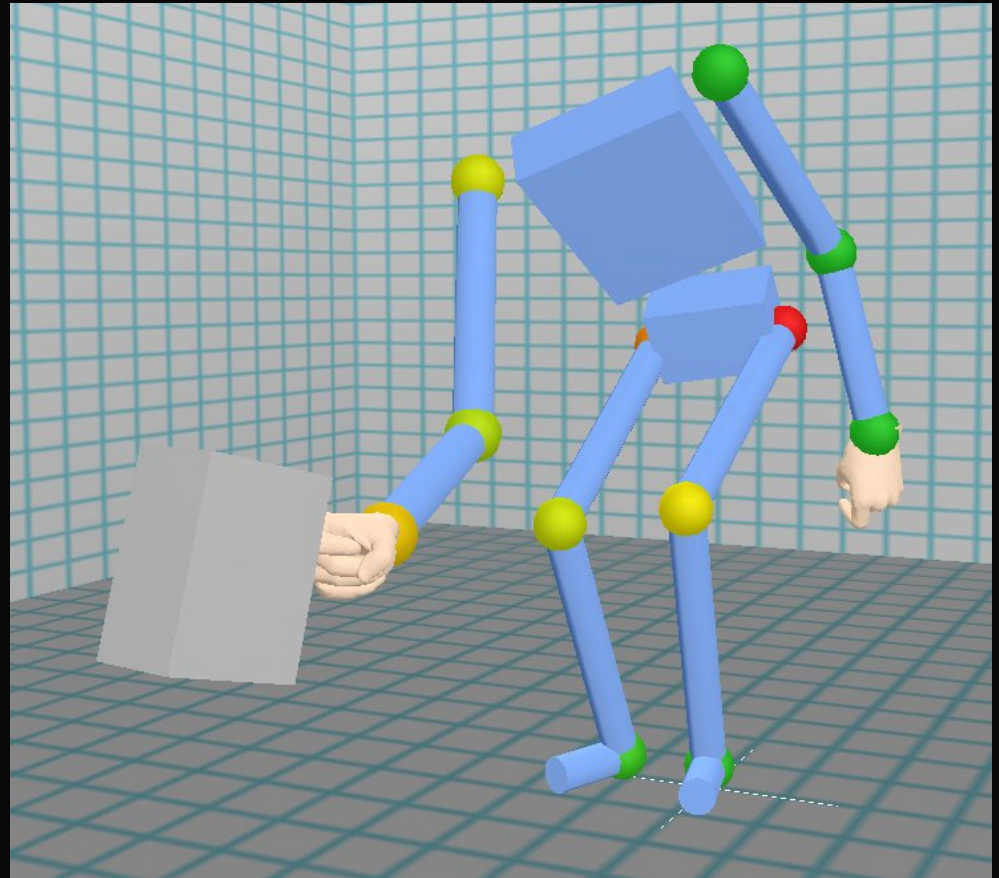


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Next steps

- Integrate psychological findings
- Expand richness of information
- Add design guidelines and strategies
- Investigation of ways to enable the designer to empathise with the situation of the user



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