




## Does the Built Environment Influence Health?


**Challenging the influence of the built environment on sedentary living.**





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 Faculties of Kinesiology and Environmental Design  
 Physical Activity Forum 2010

## 'The Built Environment'





- Human-made surroundings - provide the setting for activity
  - Physical connections between the places where we live, work and play
- Interdisciplinary field of study


## One slide answer

- There is an influential role of the built environment on health.
- Multiplicity of factors that impinge on this.
- Range and diversity in the literature points to the complexity of knowledges that need to be integrated into planning.
- Multiplicity of actions will be required to *positively* impact public health.

Dempster B. (2008 Dec.). Report. *Environment*.






## Re-phrase



- What is the magnitude of the independent effect of built environment (BE) on physical activity?
- How do we measure this if there are many factors and actions that impact physical activity and then health?

Krizek KJ; Dempster, B.

## “Challenge is to not only think, but change the way we think.”



- Join together the seemingly unconnected.
- Frame of reference




## Take one step back – and then go forward.

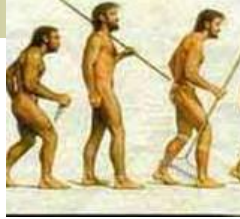
### Outline

- Evolution of 'sedentarism'
  - Genetics / Adaptation
- Travel Behaviour
  - Determinants and Lived experience
- Studies
  - Behaviour matched to observations
  - Walkability
  - Best and Child Friendly Neighbourhood Design
  - \$\$ retrofitting
- Frame of reference
  - Built Environment and Health




## Since the dawn of mankind

- We've been interacting with our natural environment
- Running down prey was a way of life that ensured hominid survival on the African savanna
- 10-20 km/day



## Sedentism is not new

- Occurred during the Palaeolithic era (tools)
- More common with the agricultural revolution-fixed habitat
- Cultural anthropologist



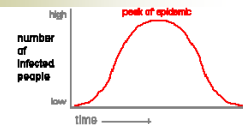
## Forced sedentism

- Dominant group restricts the movements of another
- Most cultures have absorbed into various versions of sedentary 'civilization'
- Even Nomadic populations have adopted fixed habitat.



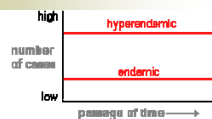
## Fixed habitat-health

- Major shifts in disease
- Plagues
- Epidemics shape human history
- High mortality rates during epidemics are result of social collapse (Neel, 1955)
- Helplessness, poor medical care, insufficient nutrition
- Ex. Spanish Flu- travel



## Fixed habitat-health

- Major shifts in disease
- Traditional agents of epidemics given away to chronic diseases-diseases of fixed habitats
- Travel-Technology
- Certain strains of  $H_1N_1$  are Endemic



## Frame of reference- PA

- Theoretical construct in which to develop research thinking and answer problems
- Population = the basic unit of study
- Genetic, environmental (built), socio-cultural, and behavioral components as major determinants
- Goal: health

# Natural Experiments

- Take advantage of a population or special circumstance that naturally isolates a particular problem
- Review three examples



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## 1) East African Turkana

- Fixed habitat**
- Group mobility
- Physical proximity during work and play
- Natural resistance
- Health problems cultural specific

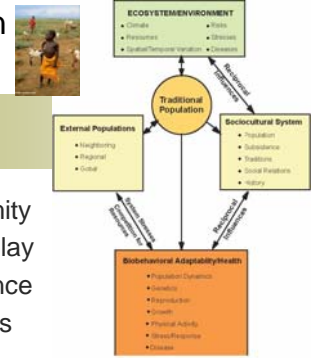


FIG. 1. Schematic representation of a natural experimental model in small remote anthropological populations. The relative genetic, ecological, and cultural homogeneity of the experimental population provide a natural laboratory for the study of health and disease, providing some of the confounding factors that exist in larger technologically complex societies.



## 2) Yakut people-Siberia

- Traditional-Cosmopolitan Communities**
- Gene pool increases or decreases
- Emerging and re-emerging pathogens
- Encephalomyelitis

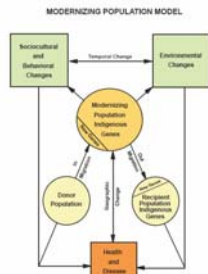


FIG. 3. Schematic of a natural experimental model in modernizing populations. The model is built on change and comparison of change across the same population temporally and/or across different populations. The major components of the model include sociocultural and behavioral changes, environmental modifications in a temporal context, migration and population movement, a redistribution of genes, and an exposure to novel events and conditions, all of which either could induce, ameliorate, or enhance specific risk factors for health and disease outcomes.



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## 3) Working Women

- Working outside the home
- New York city
- Normal response BP
- Typical conditions of life profoundly affect
- Systolic BP

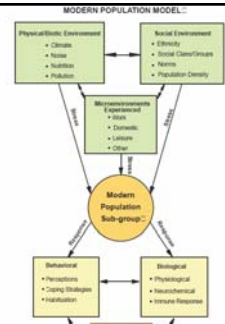


FIG. 5. Schematic of a natural experimental model in modern populations. The model is constructed on the premise that modern groups are affected by pervasive physical, biotic, and social stresses, but also must contend with situation-specific stresses as microenvironmental conditions vary. The combination of pervasive and situation-specific stresses alter biologic and behavior responses, which then influence



## 3) Continued

- Baseline changes in BP**
- Stress response**
- Adapt in short term
- But lead to mortality

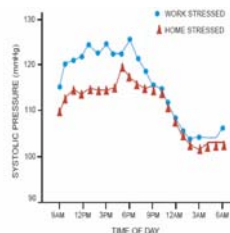


FIG. 6. Comparison of the pattern of systolic blood pressure variation among female secretaries and laboratory technicians, depending on whether work or home was performed in more stressful (20).



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## 'Genetics is always the 1st answer'



"Proposed that humans inherited genes that were evolved to support a physically active lifestyle."

Booth F. (2002). *J Appl Physiol*, 93: 3-30.





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## Adaptation is the result of natural selection




In biology, adaptive selection to different environments occurs.

- Novel traits, allows survival and reproduce more effectively in its environment.
- Produces 'entirely different animal.'

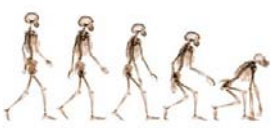



## Example of Adaptation




- Adaptation occurs in sense organs
- Sensitivity is altered in response to changes in environmental conditions.
- Pupil size increase to admit more light as night falls

- Are we living out of context, in an environment for which we have not adapted to?
- Or have we adapted?
  - Do we survive and reproduce more effectively in the environment?
  - Have we adapted to sedentism?
    - If so how do we measure this?
  - Or do we reverse it?



(Wade, 2006).

## What has the evolution of sedentism done for us?

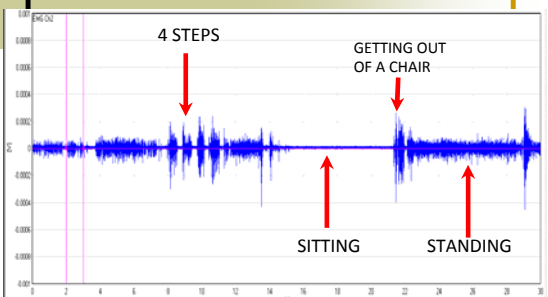

METs

Moderate	4	3.8: Brisk walking
Light	3	2.5: Slow walking
	2	2.0: Standing
Sedentary	1.8	1.8: Sitting (desk work)
	1.5	1.5: Sitting (talking)
	1.0	1.0: Sitting quietly (watching TV)
	0.9	0.9: Sleeping

Ainsworth et al., (2000). *Med Sci Sport Exer.*, 32:S498-S516

## Sitting induces muscular inactivity



Hamilton et al., (2007). Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. *Diabetes*, 56, 2655-2667.

## What has technologically done for us?

Awake 7 am	Breakfast 15 mins	Work on computer 3.5 hrs	Transport From work 45 mins	Watch TV 4 hrs	Sleep 11pm
Transport to work 45 mins	Lunch 30 mins	Work on computer 4 hrs	Evening meal 30 mins	Walk - 30 mins	

Sitting Opportunities 15.5 hrs (Owen, N. 2010)

## What has architecture done for us?

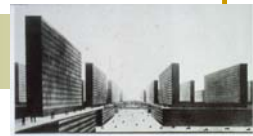
- Global cities
- Discussion of architecture design should include: the economic, equality, emotional, health, and environmental challenges.



(May 2010 Exhibit-Design Exchange, Bay Street, Toronto, Ontario)

## Live in built environment

- Replaced the natural environment
- BE most important element in the setting of our daily activities.
- Useful design



## Challenge the professional architect

- Architecture needs to be a vehicle for social change.
- Community needs to actively participate in the design process.



laurenarcher.wordpress.com

## Explored (2005) TRB.

1. Intuition
2. Theory and
3. Preliminary evidence

suggest that there is an association b/t



and



## Travel Behaviour

is the study of what people do over space, and how people use transport

Explore this with 4 points.

## 1. Travel behaviour is set in motion as a child



Walk to school



7<sup>th</sup> bday

1 mile (1.6 km) = 100 Cal  
250 X 2 = 500 Cal/d



Go Places –roaming  
Nomadic Behaviours

## Travel Behaviour



- Habits are important and are hard to change
- Learned
- Formed by practice
- Even though people might want to change their behaviour, it is not easy for them.



"My Mum told me stories...she biked to tennis practice as a child and when we went downtown together she walked furiously fast. We all walked or cycled to school, to local bakery etc..."

2. Other people's behaviour matters and people's self-expectations influence how they behave- reinforced

'The Stickness Factor' or Social Desirability



## Travel Behaviour



3. Created a sense of belonging for me and influenced where I wanted to live as an adult- community

Walkable neighbourhood

- Intentions
- Belief (new belief)
- Expressed and Nurtured



## Lived experiences of Travel Behaviour



4. Qualitative research- Ethnography

Ex.

- The Lived Experience of Transport Structure: An Exploration of Transport's Role in People's Lives
- Existing methodologies in transport and travel under-recorded and represented

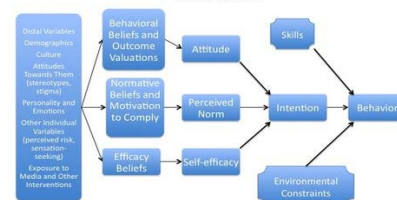
## Complexity in Urban Travel

- I walked school -*proximity*
- My children can not walk to school

If we build more urban and mixed communities will this change walking to school?

## Understanding Behaviour

An Integrative Model of Behavior Prediction



Fishbein, M. & Yzer, M.C. (2003). Using theory to design effective health behavior interventions. *Communication Theory*, 13:164-183.

## Future Research Practices BE

- Qualitative narrative style- understanding
- Lived experience people have is important
- Simple way of getting information is to get them to share their experience

Use of a mixed methods approach will enhance research into the built environment.

Amaratunga et al. (2002)



## Story leading to model of voluntary behaviour change

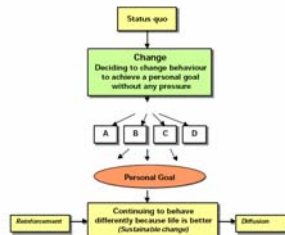
"I hope you remember me. I am the planning student from over in EVDS who was interested in urban / suburban form and its possible effects on health."

Jan 8<sup>th</sup> 2002



## EVDS student experience of walking

- Decision to change was impacted through the option of walking to work
- 'it was possible for her, to change'
- Experiencing a 'change moment'
- Feeling that a change is appropriate because it is fashionable



Ampt ES, (2003) Figure 1: The Conditions Surrounding Voluntary Behaviour Change)



Voluntary behaviour changes in travel always achieve a personal goal in terms of improvement of lifestyle, or behaviour that is more congruent with values, therefore they are sustainable.

Not all behaviour changes appeal to people.



## Unhealthy suburbs and the role of walkable neighbourhoods

(Arendt 2001, Ketcham 2001, Kreyling 2001a, and Kreyling 2001b)

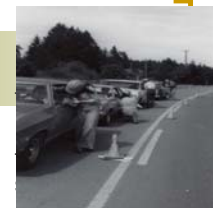
**Bridge municipal planning and health**

- "Our communities should be designed to incorporate safe walking routes, bike paths and bike lanes as real choices for transportation.
- Choosing to be active** is easier when neighbourhoods, workplaces, schools, commercial centres, and recreation facilities are geared towards active living." (CIP 1998, P?).



## Travel Forecasting

- Number?
- The destination?
- Who accompanies whom?
- When?
- The sequence?
- Route?
- Why?



## Review four studies –

## 1. Pedestrian Travel: Walkable Neighbourhoods



- Early urban form in Calgary accommodated pedestrian movement and contemporary suburban form does not.
- Do particular settings inhibit or encourage pedestrian travel and what elements contribute to this?

(Doyle-Baker, Kolody & Sandalack. 2004)

## Environmental Context

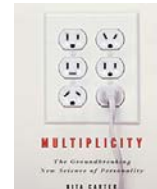
- Permeability –easy of foot travel
- Connectivity –linked up
- Legibility –find one's way around
- Comfort /Safety –walking
- Density /Variety /Interest – mix of buildings
- Amenities –stores

**The advantage of small blocks**  
A place with small blocks gives more choice of routes than one with large blocks. In the example below, the



## Multiplicities of human behaviour

- Environmental Contexts are difficult to pin down because they invoke behavioral decisions at variety of levels.



## Supportive Environment- they will exercise?

- Requirements:
- Recreational
  - Utilitarian
  - Safe
  - Provide cover
  - All seasons
  - Presence of life
  - Visual; sensory appeal



## Understanding Pedestrian Travel

- 40% of all day-to-day needs available neighborhood (Burden, 2001)
- 70% of individuals will walk 500 feet for daily errands
- 40% will walk 1/5 of a mile, and
- 10% will walk 1/2 mile (Southworth, 1997).

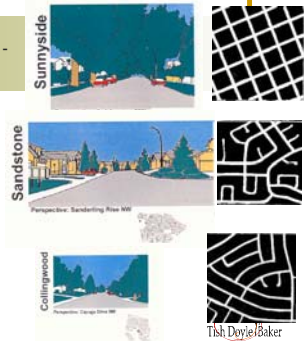
## An Urban Form Analysis in Calgary, Alberta

What/which environment was supportive for walking?

- Based on the precedent study of Southworth and Owens (1993)
- Three common neighbourhood types were analyzed

## Results: pedestrian supportive

- the 'gridiron' type (c.1912) - **best**
- the 'loops' and lollipops' type (c.1959) - **generally lacked in such features**
- 'warped parallel' type (c.1982). - **had a moderately successful pedestrian environment**



## Recommendations for Current Policy

- Fundamental change in how new communities are conceived and planned
- Plan for All People**
- All people walk but not all people drive
  - Driving is an exclusive activity
- If planners plan for pedestrians then they plan for everyone.
  - The reverse results in exclusionary planning

Kolody A. (2002). unpublished thesis

## 2. The NUDGE Project Neighbourhood Urban Design Gets Exercise

Neighbourhood Level:

- Differences in Physical Activity and
- Liveability

(Doyle-Baker, Petersen, Lambert & Sandalack 2007, MSSE).



## Self selection

- Do residents who prefer to walk choose to live in more walkable neighbourhoods?
- Is there an built environment impact on pedestrian travel?



## Door to Door Survey

- Residents of high-walkability neighbourhood (Case) reported higher residential density, land use mix, street connectivity, aesthetics, but not safety.
  - Walked more often to amenities than those in less-walkability (Control)
  - Proximity



## Walking vs Strolling?



- Walking implies a destination
- Strolling implies being with a person because you enjoy their company; destination is not as important

## Handy et al., 2006

- Account for self selection
  - Neighbourhood characteristics (perceptions) impact strolling frequency
  - Characteristics of local commercial are important for facilitating shopping trip



## 3. KIDS and Green, Places and Spaces (GPS) Project

- Did neighbourhood design change over time with respect to open, green spaces and parks?
- Did neighbourhood design impact children's ability to access these spaces?

(Nolan, Doyle-Baker & Sandalack, 2007)



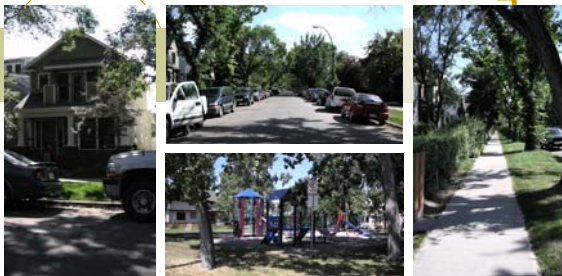
Meaghan Nolan

## Methods

- Four neighbourhoods
  - mapped, analyzed and compared designs
- Open space types were developed and applied to each neighbourhood
- Network Catchment Areas were used to indicate accessibility of spaces
- Quantitative work was not possible with tools available



## 1914: Hillhurst



## 1958: Glamorgan



### 1977: Temple



### 1995: Somerset



### Results

- Older neighbourhoods
  - **sidewalks** acted as a buffer from the street
  - Roads were **narrower**, traffic was forced to travel more slowly, parallel parking
  - Several **windows facing the front** of the house; easily monitor the kids
  - Green space design was **simple**; accommodate a larger demographic



### Free Range Kids

- de Vries et al., (2007)
  - Parallel parking spaces and perception of active friendly
  - Green space,
  - Terraced housing,
  - Safe walking,
  - Water,
  - 30km zone



### 4. EcoUFORIA: Economic Evaluation of using Urban Form to Increase Activity



Francisco G. Alaniz Uribe  
BScArch, MPDU, MEdes  
Urban Design Lab



Gavin McCormack  
PhD  
Postdoctoral Fellow



Alan Shiehl, PhD; Bev Sandalack, PhD; Tish Doyle-Baker Dr. PH



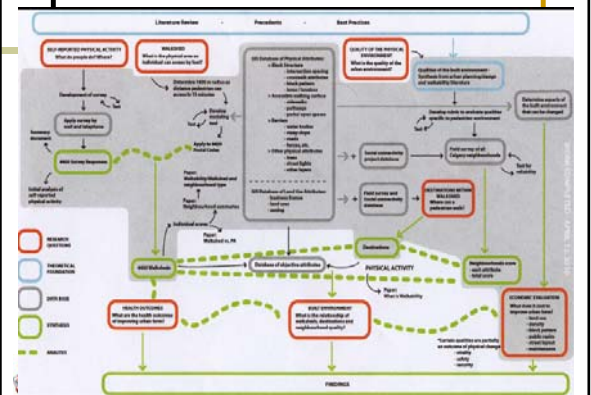
Pierre Guenette  
Master in Economics



Christine Friedenreich, PhD  
Cancer and PA epidemiologist



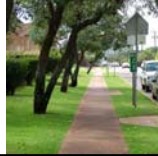
### Sandalack Group



## If only sidewalks were the answer to healthy lives!

- Contribute to the positive image of a neighbourhood but presently there is no research to identify a dollar value associated with increased walking and reduced chronic disease risk.

Pierre G. -economist



## Walkability Improvements Costs (last phase of the ECOUFORIA)

Communities	Neighbourhood Type	Walkability Improvement Cost	Residential to Commercial Ratio	Block Size and Connectivity Cost	Open Space	Total Cost
Acadia	Warped Grid Block Pattern	\$27,784,275.44	\$0.00	\$71,308,305.88	\$0.00	\$99,092,581.30
Algonquin	Warped Grid Block Pattern	\$12,002,885.03	12,383,572.61	\$29,025,191.91	\$0.00	\$43,440,448.56
Almonk	Warped Grid Block Pattern	\$17,395,163.97	12,500,728.61	\$35,248,011.10	\$0.00	\$55,233,903.74
<b>Average Warped Grid Block Pattern Cost</b>						
		<b>\$26,722,442.44</b>	<b>15,608,100.43</b>	<b>\$65,203,488.59</b>	<b>\$0.00</b>	<b>\$72,548,978.87</b>
Chaparral	Curvilinear Block Pattern	\$34,094,055.06	(6,878,177.61)	\$65,409,754.57	\$0.00	\$106,341,967.23
Highland	Curvilinear Block Pattern	\$34,248,835.60	(6,537,363.96)	\$103,941,443.96	\$0.00	\$144,722,647.52
Commerce	Curvilinear Block Pattern	\$26,165,865.71	5,465,123.39	\$41,954,527.47	\$0.00	\$75,460,466.58
Luscany	Curvilinear Block Pattern	\$70,362,505.61	\$8,087,507.83	\$87,304,404.50	\$0.00	\$175,654,418.95
<b>Average Curvilinear Block Pattern Cost</b>						
		<b>\$41,186,595.49</b>	<b>\$3,242,000.20</b>	<b>\$76,152,534.15</b>	<b>\$0.00</b>	<b>\$124,581,179.84</b>
Conestoga	Grid or Modified Grid Block Pattern	\$42,913,381.53	\$0.00	\$1,688,489.83	\$44,601,871.36	\$1,022,962.11
Downsview West	Grid or Modified Grid Block Pattern	\$3,023,901.11	\$0.00	\$0.00	\$0.00	\$3,023,901.11
Hillhurst	Grid or Modified Grid Block Pattern	\$11,852,316.14	\$0.00	\$5,963,564.31	\$0.00	\$19,815,880.45
Williamstown	Grid or Modified Grid Block Pattern	\$39,086,341.49	\$0.00	\$0.00	\$3,741,249.26	\$22,827,598.75
Madison	Grid or Modified Grid Block Pattern	\$44,713,624.66	\$0.00	\$12,495,388.74	\$0.00	\$57,209,013.40
<b>Average Grid or Modified Grid Block Pattern Cost</b>						
		<b>\$24,717,812.99</b>	<b>\$0.00</b>	<b>\$3,681,780.61</b>	<b>\$1,085,947.82</b>	<b>\$29,495,651.42</b>
Williamstown	Grid or Modified Grid Block Pattern	\$10,844,172.63	\$8,695,182.62	\$3,834,511.53	\$0.00	\$18,373,866.78
<b>Total Cost</b>						
		<b>\$176,187,243.00</b>	<b>\$46,617,684.78</b>	<b>\$68,523,932.03</b>	<b>\$5,429,739.00</b>	<b>\$296,748,599.81</b>



## Acadia Walkability Improvement Costs- EcoUFORIA

Items	Unit Cost	Units	Total Cost
<b>Walkability Improvements</b>			
Sidewalks	\$323.00	29321	\$1,140,836.00
Street Lights	\$4,500.00	821	\$3,894,500.00
Trees	\$2,523.45	6770	\$17,083,740.30
Crosswalk	\$11.48	488.9	\$5,809.52
Crosswalk Signs	\$107.30	32	\$3,232.00
Crosswalk Lights	\$138,400.00	8	\$1,107,200.00
Curb Extensions	\$36,050.00	234	\$8,525,900.00
Totals			<b>\$29,540,918.82</b>
<b>Residential to Commercial Ratio</b>			
Acadia Mean House Price	\$483,426.96	0	\$0.00
Residential Demolition	\$10,400.00	0	\$0.00
Totals			<b>\$0.00</b>
<b>Block Size and Connectivity</b>			
Acadia Mean House Price	\$483,426.96	96	\$46,964,938.56
Residential Demolition	\$10,400.00	17	\$102,800.00
Concrete	\$173.19	4662.8	\$81,123,071.46
Reinforcement	\$15.00	9669.8	\$145,053.00
Trees	\$2,523.45	2813	\$4,968,451.70
Street Lights	\$4,500.00	138,223	\$621,845.73
Residential Streets	\$1,033.00	4894.4	\$7,524,116.00
Totals			<b>\$142,897,976.20</b>
<b>Open Space</b>			
Acadia Mean House Price	\$483,426.96	0	\$0.00
Residential Demolition	\$10,400.00	0	\$0.00
Totals			<b>\$0.00</b>
<b>Total</b>			
			<b>\$88,660,877.81</b>



## Summarize

- Good urban design is critically important
- Intuitively* we know that people have a hard time being active if opportunities don't exist.
- Evidence* supports making changes.



## Necessary but not sufficient

- Improved conditions may be *necessary* but they are not *sufficient* for adoption of healthy lifestyles.



## Healthy inquiry into complex causal links of BE can not be answered to day!

Recall how interaction with the BE relates to basic preferences, learned behaviour and lifestyles (SES).



# Review



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# Sedentism is a response to a particular environment



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# If there is a story to tell it means that change has happened.

## Lived experiences



(Owen, N. 2010)


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# Observation

## Natural Experiments

- Anthropological, epidemiological, and evolutionary problems; difficult to solve because experimental research design is limited.



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# BE and Health

Determinant      Behaviour      Health

Beliefs  
Values

Environment → Physical Activity → Health Outcome

Frame of reference

Sugiyama T. (2010 May). Identifying Built Environment Attributes Associated with Sedentary Behaviours. ICPAPH.


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# Intention a key determinant of action

What are the Travel Behaviour intentions of young people?

- Young people do not want to give up automobiles but they **value** climate change!
- Motivations are age specific



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## Weight gain is a slow creep

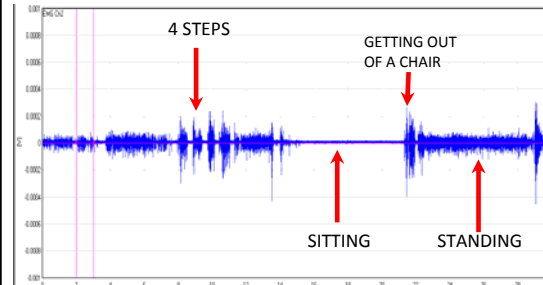
- 30 C/d extra = 3lb yr.
  - a mouthful of banana, a few potato chips
- More time on your feet today and tomorrow may make the difference between remaining lean and getting fat.
- Stand up!**



Tish Doyle Baker

## Sitting induces muscular inactivity—Stand up now!

Hamilton et al., (2007). Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. *Diabetes*, 56, 2655-2667.



## “Your chair is your enemy.”

Judson O. (Feb. 23, 2010)



- Inherited variation is species specific.
- Environment changes
- Individuals possessing genes that allow them to survive and reproduce more successfully pass their genes to their offspring more than those that do not.



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## Move beyond ‘prevention’ toward creative and proactive possibilities-



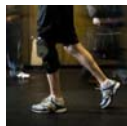
Moving stairs video



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## Capturing the problem and re-inventing it

- Energy of walking captured & stored
- Utilizing energy-Hybrid Human
- Translated into powers credits for the iPhone.



apps

- Physical activity movements captured, stored and translated into calories utilized.
- Quantifying energy use each day



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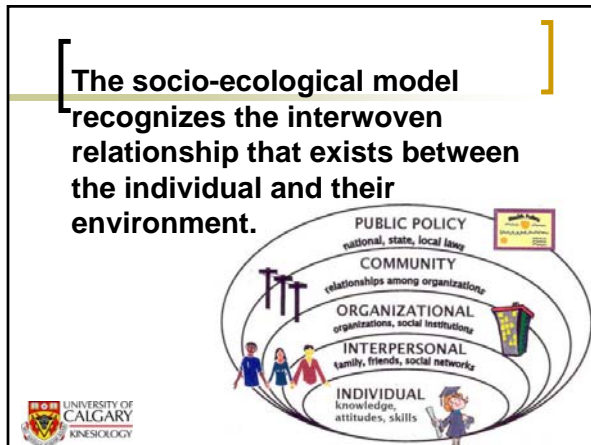
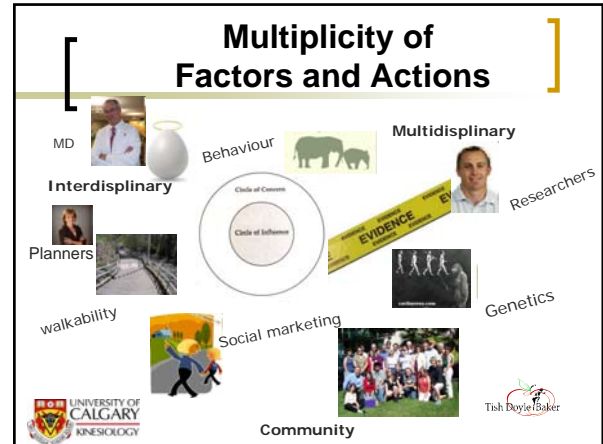
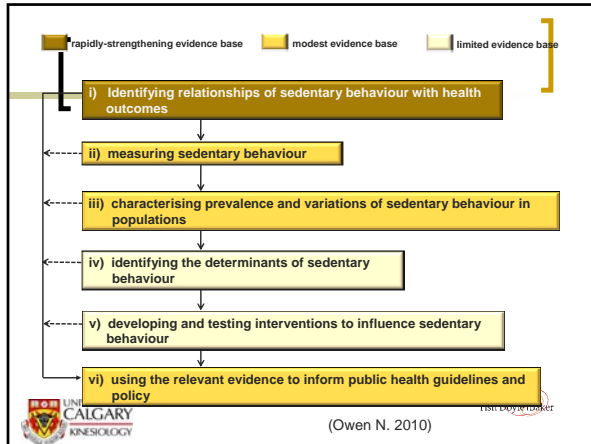
## Social Desirability

### Seniors raise a sweat at own playground



May 20, 2010, Calgary Herald

Tish Doyle Baker



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