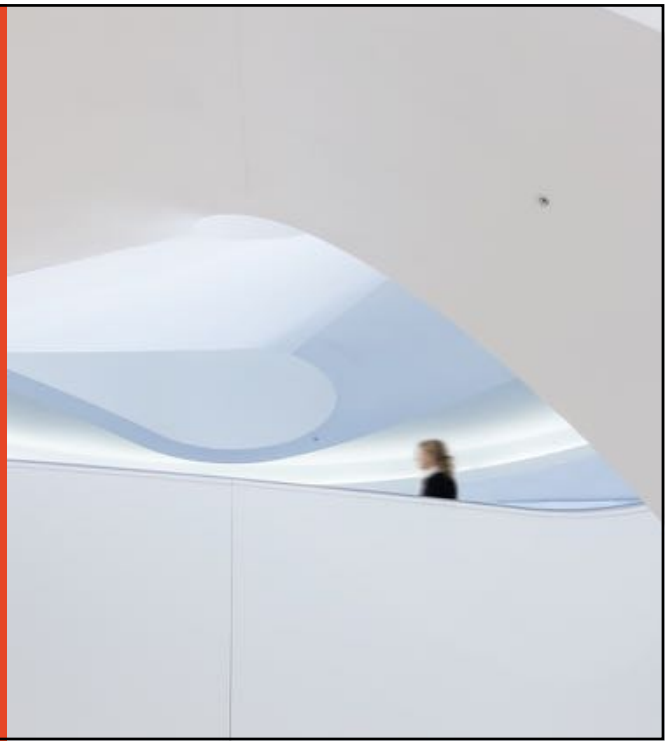
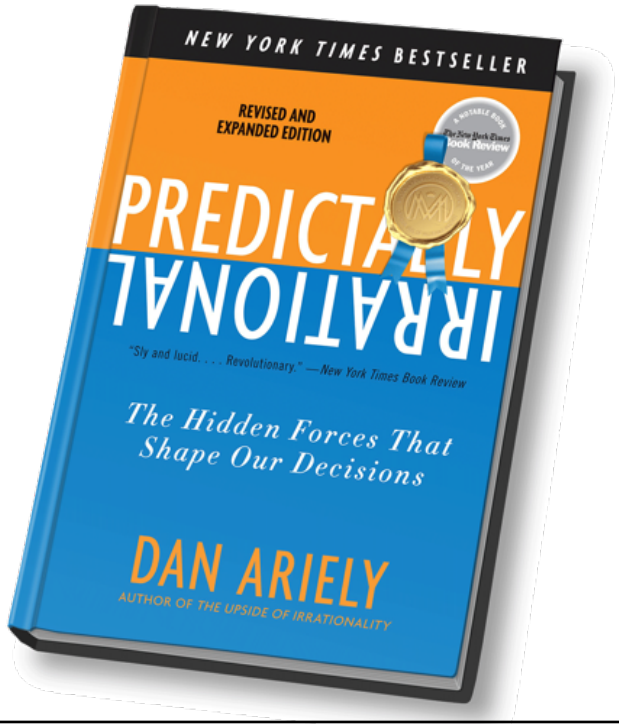
Active Spaces to Work

Brett Pollard
PhD Candidate
Faculty of Medicine & Health
Sydney School of Public Health

THE UNIVERSITY OF SYDNEY

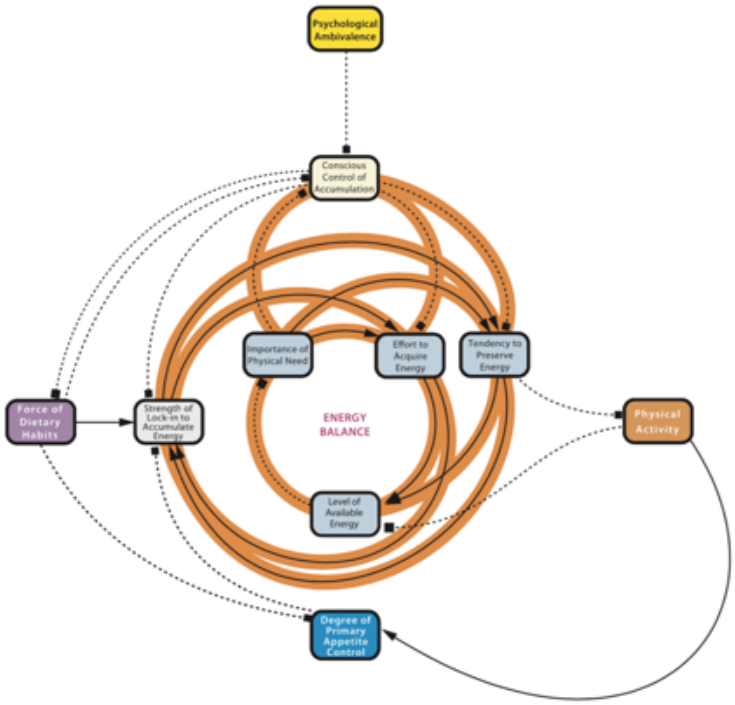


Predictably Immobile? Analysing the spatiotemporal movement behaviour of office workers.

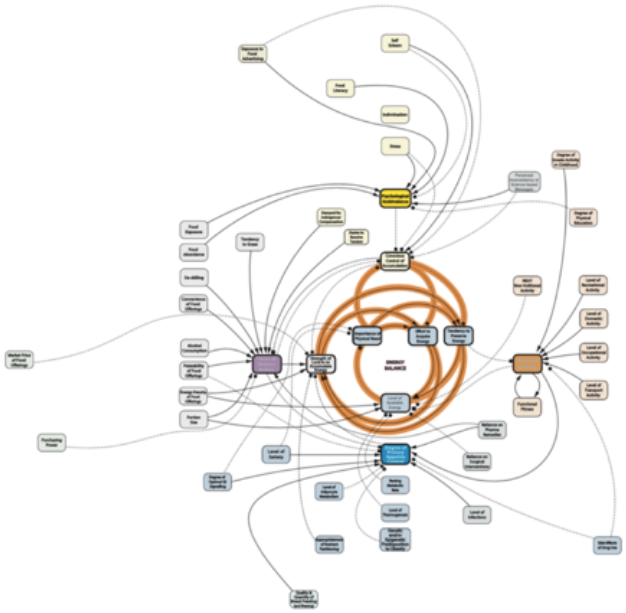


CENTER FOR ADVANCED HINDSIGHT

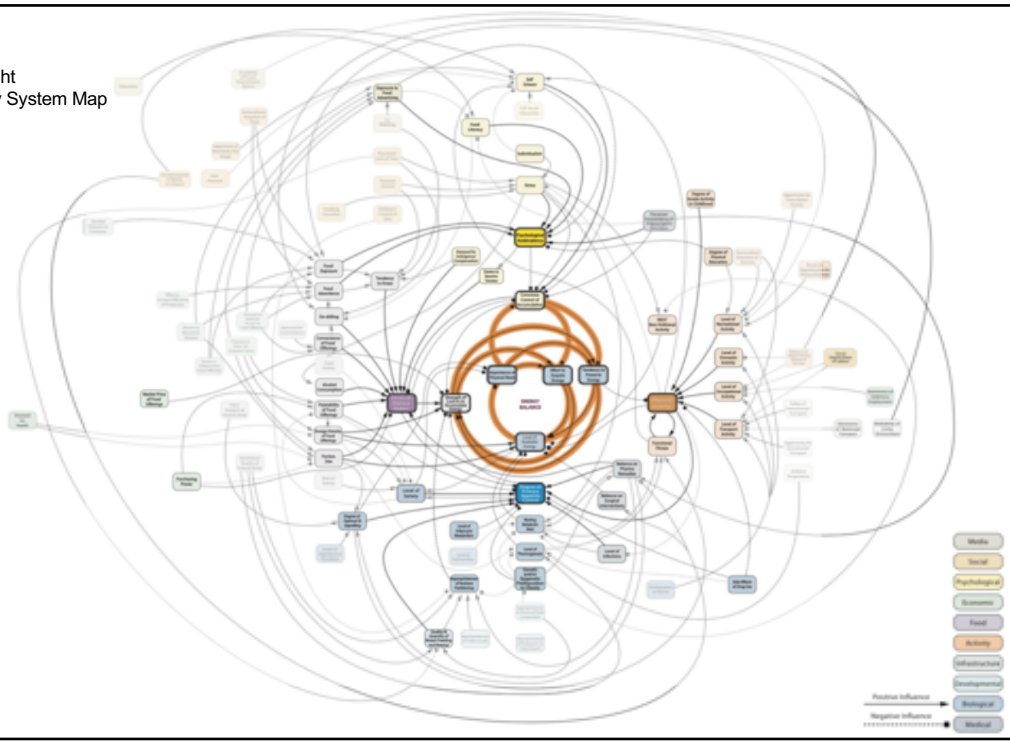
Foresight
Obesity System Map
2007



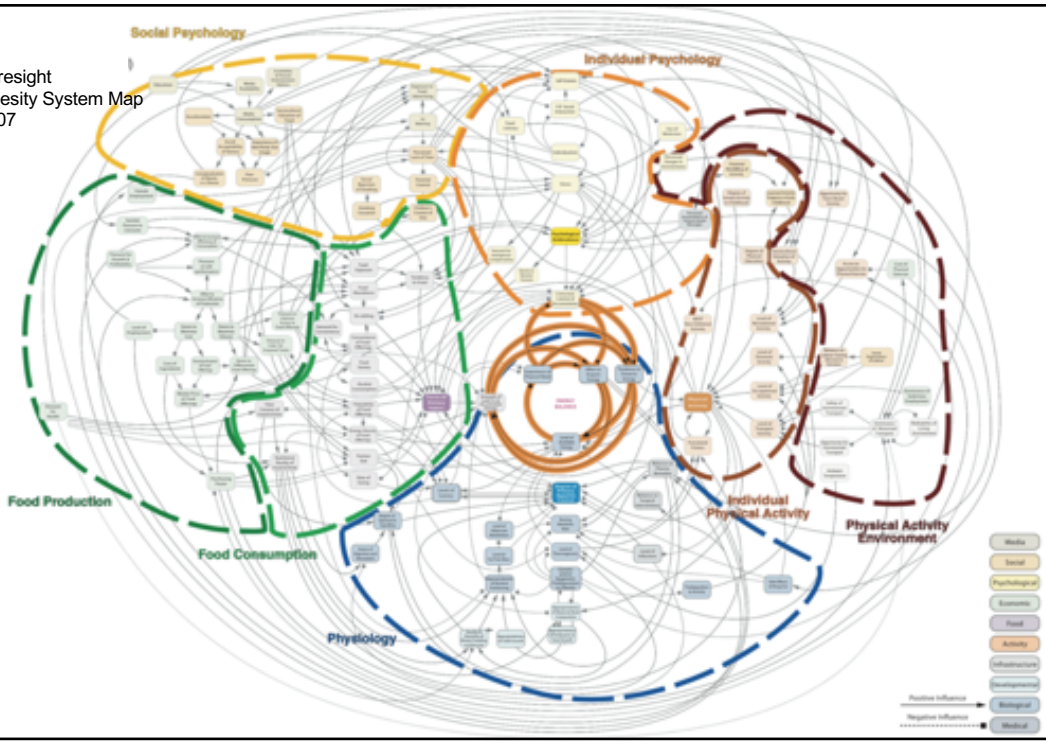
Foresight
Obesity System Map
2007



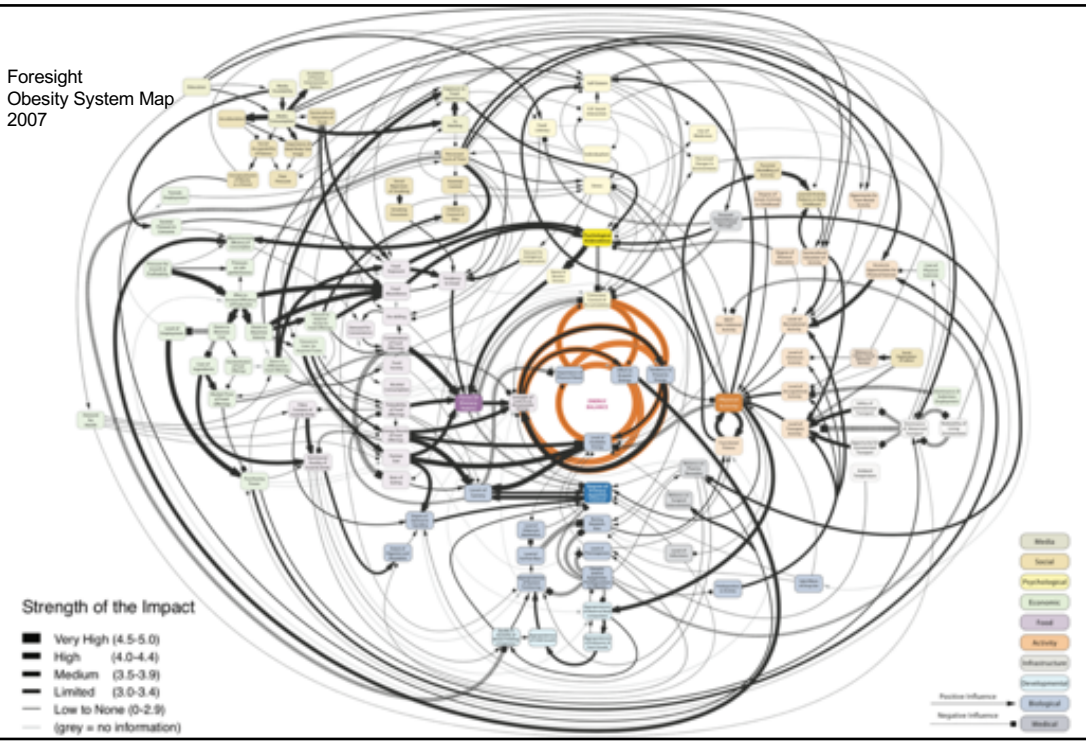
Foresight
Obesity System Map
2007



Foresight
Obesity System Map
2007



Foresight
Obesity System Map
2007



A 30-Year Follow-Up of the Dallas Bed Rest and Training Study

I. Effect of Age on the Cardiovascular Response to Exercise

Darren K. McGuire, MD, MHSc; Benjamin D. Levine, MD; Jon W. Williamson, PhD; Peter G. Snell, PhD; C. Gunnar Blomqvist, MD, PhD; Bengt Saltin, MD; Jere H. Mitchell, MD

Background—Cardiovascular capacity declines with aging, as evidenced by declining maximal oxygen uptake ($\dot{V}O_2$max), with little known about the specific mechanisms of this decline. Our study objective was to assess the effect of a 30-year interval on body composition and cardiovascular response to acute exercise in 5 healthy subjects originally evaluated in 1966.

Methods and Results—Anthropometric parameters and the cardiovascular response to acute maximal exercise were assessed with noninvasive techniques. On average, body weight increased 25% (77 versus 100 kg) and percent body fat increased 100% (14% versus 28%), with little change in fat-free mass (66 versus 72 kg). On average, $\dot{V}O_2$max decreased 11% (3.30 versus 2.90 L/min). Likewise, $\dot{V}O_2$max decreased when indexed to total body mass (43 versus 31 mL · kg^{-1} · min^{-1}) or fat-free mass (50 versus 43 mL/kg fat-free mass per minute). Maximal heart rate declined 6% (193 versus 181 bpm) and maximal stroke volume increased 16% (104 versus 121 mL), with no difference observed in maximal cardiac output (20.0 versus 21.4 L/min). Maximal AV oxygen difference declined 15% (16.2 versus 13.8 vol%) and accounted for the entire decrease in cardiovascular capacity.

Conclusions—Cardiovascular capacity declined over the 30-year study interval in these 5 middle-aged men primarily because of an impaired efficiency of maximal peripheral oxygen extraction. Maximal cardiac output was maintained with a decline in maximal heart rate compensated for by an increased maximal stroke volume. Most notably, 3 weeks of bedrest in these same men at 20 years of age (1966) had a more profound impact on physical work capacity than did 3 decades of aging. **(*Circulation*. 2001;104:1350-1357.)**

Key Words aging ■ oxygen ■ exercise ■ body composition

A 30-Year Follow-Up of the Dallas Bed Rest and Training Study

I. Effect of Age on the Cardiovascular Response to Exercise

Darren K. McGuire, MD, MHSc; Benjamin D. Levine, MD; Jon W. Williamson, PhD; Peter G. Snell, PhD; C. Gunnar Blomqvist, MD, PhD; Bengt Saltin, MD; Jere H. Mitchell, MD

3 weeks of bed rest had a greater reduction in physical work capacity than 30 years of aging

Background—Cardiovascular capacity declines with aging, as evidenced by declining maximal oxygen uptake ($\dot{V}O_2max$), with little known about the specific mechanisms of this decline. Our study objective was to assess the effect of a 30-year interval on body composition and cardiovascular response to acute exercise in 5 healthy subjects originally evaluated in 1966.

Conclusions—Cardiovascular capacity declined over the 30-year study interval in these 5 middle-aged men primarily because of an impaired efficiency of maximal peripheral oxygen extraction. Maximal cardiac output was maintained with a decline in maximal heart rate compensated for by an increased maximal stroke volume. Most notably, 3 weeks of bedrest in these same men at 20 years of age (1966) had a more profound impact on physical work capacity than did 3 decades of aging. (*Circulation*. 2001;104:1350-1357.)

Key Words aging ■ oxygen ■ exercise ■ body composition

JAMA Network

From: **Effect of a Workplace Wellness Program on Employee Health and Economic Outcomes: A Randomized Clinical Trial**

JAMA. 2019;321(15):1491-1501. doi:10.1001/jama.2019.3307

Workplace wellness programs have become increasingly popular as employers have aimed to lower health care costs and improve employee health and productivity. In 2018, 82% of large firms and 53% of small employers in the United States offered a wellness program, amounting to an $8 billion industry.[1,2] This growth has been aided by public investments such as the Affordable Care Act, which included funds to promote the development of workplace wellness programs.

Workplace wellness programs tend to focus on modifiable risk factors of disease, such as nutrition, physical activity, and smoking cessation. Despite widespread adoption, causal evidence of such programs' effects on health and economic outcomes has been limited. Meta-analyses have produced varying estimates of benefits relative to costs.[3-5] Observational studies have often been limited by a lack of valid control groups, selection bias, and small samples.[6-8] Experimental studies of comprehensive wellness programs have been scarce and have produced mixed results, with most of the more rigorous studies now dated.[9,10] Other

Key Points

Question What is the effect of a multicomponent workplace wellness program on health and economic outcomes?

Findings In this cluster randomized trial involving 32 974 employees at a large US warehouse retail company, worksites with the wellness program had an 8.3-percentage point higher rate of employees who reported engaging in regular exercise and a 13.6-percentage point higher rate of employees who reported actively managing their weight, but there were no significant differences in other self-reported health and behaviors; clinical markers of health; health care spending or utilization; or absenteeism, tenure, or job performance after 18 months.

Meaning Employees exposed to a workplace wellness program reported significantly greater rates of some positive health behaviors compared with those who were not exposed, but there were no significant effects on clinical measures of health, health care spending and utilization, or employment outcomes after 18 months.

JAMA Network

From: **Effect of a Workplace Wellness Program on Employee Health and Economic Outcomes: A Randomized Clinical Trial**

JAMA. 2019;321(15):1491-1501. doi:10.1001/jama.2019.3307

8.3% more staff reported engaging in regular exercise
13.6 % more staff reported managing their weight

JAMA Network

From: **Effect of a Workplace Wellness Program on Employee Health and Economic Outcomes: A Randomized Clinical Trial**

JAMA. 2019;321(15):1491-1501. doi:10.1001/jama.2019.3307

8.3% more staff reported engaging in regular exercise
13.6 % more staff reported managing their weight

but no significant differences in clinical markers of health, health care spending, absenteeism & job performance after 18 months.

ARTICLE | PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B, BIOLOGICAL SCIENCES

The Impact of the 'Open' Workspace on Human Collaboration

by **Ethan Bernstein** and Stephen Turban

PRINT SHARE EMAIL

Abstract

Organizations' pursuit of increased workplace collaboration has led managers to transform traditional office spaces into "open," transparency-enhancing architectures with fewer walls, doors, and other spatial boundaries, yet there is scant direct empirical research on how human interaction patterns change as a result of these architectural changes. In two intervention-based field studies of corporate headquarters transitioning to more open office spaces, we empirically examined—using digital data from advanced wearable devices and from electronic communication servers—the effect of open office architectures on employees' face-to-face, email, and instant messaging (IM) interaction patterns. Contrary to common belief, the volume of face-to-face interaction decreased significantly (approx. 70%) in both cases, with an associated increase in electronic interaction. In short, rather than prompting increasingly vibrant face-to-face collaboration, open architecture appeared to trigger a natural human response to socially withdraw from officemates and interact instead over email and IM. This is the first study to empirically measure both face-to-face and electronic interaction before and after the adoption of open office architecture. The results inform our understanding of the impact on human behavior of workspaces that trend toward fewer spatial boundaries.

ARTICLE | PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B, BIOLOGICAL SCIENCES

The Impact of the 'Open' Workspace on Human Collaboration

by Ethan Bernstein and Stephen Turban

PRINT SHARE EMAIL

face to face interactions decreased by 70%
email and IM increased significantly

Abstract

Organizations' pursuit of increased workplace collaboration has led managers to transform traditional office spaces into "open," transparency-enhancing architectures with fewer walls, doors, and other spatial boundaries, yet there is scant direct empirical research on how human interaction patterns change as a result of these architectural changes. In two intervention-based field studies of corporate headquarters transitioning to more open office spaces, we empirically examined—using digital data from advanced wearable devices and from electronic communication servers—the effect of open office architectures on employees' face-to-face, email, and instant messaging (IM) interaction patterns. Contrary to common belief, the volume of face-to-face interaction decreased significantly (approx. 70%) in both cases, with an associated increase in electronic interaction. In short, rather than prompting increasingly vibrant face-to-face collaboration, open architecture appeared to trigger a natural human response to socially withdraw from officemates and interact instead over email and IM. This is the first study to empirically measure both face-to-face and electronic interaction before and after the adoption of open office architecture. The results inform our understanding of the impact on human behavior of workspaces that trend toward fewer spatial boundaries.

JCRE
18,1

48

Received 31 October 2015
Revised 11 February 2016
Accepted 19 February 2016

Flexibility in use

Switching behaviour and satisfaction in activity-based work environments

Jan Gerard Hoendervanger
Knowledge Centre NoorderRuimte, Hanze University of Applied Sciences, Groningen, The Netherlands
Iris De Been
Center for People and Buildings, Delft, The Netherlands
Nico W. Van Yperen
Department of Psychology, University of Groningen, Groningen, The Netherlands
Mark P. Mobach
Knowledge Centre NoorderRuimte, Hanze University of Applied Sciences, Groningen, The Netherlands, and
Casper J. Albers
Department of Psychometrics and Statistics, University of Groningen, Groningen, The Netherlands

Abstract
Purpose – Despite their growing popularity among organisations, satisfaction with activity-based work (ABW) environments is found to be below expectations. Research also suggests that workers typically do not switch frequently, or not at all, between different activity settings. Hence, the purpose of this study is to answer two main questions: Is switching behaviour related to satisfaction with ABW environments? Which factors may explain switching behaviour?
Design/methodology/approach – Questionnaire data provided by users of ABW environments (n = 3,189) were used to carry out ANOVA and logistic regression analyses.

JCRE
18,1

Flexibility in use

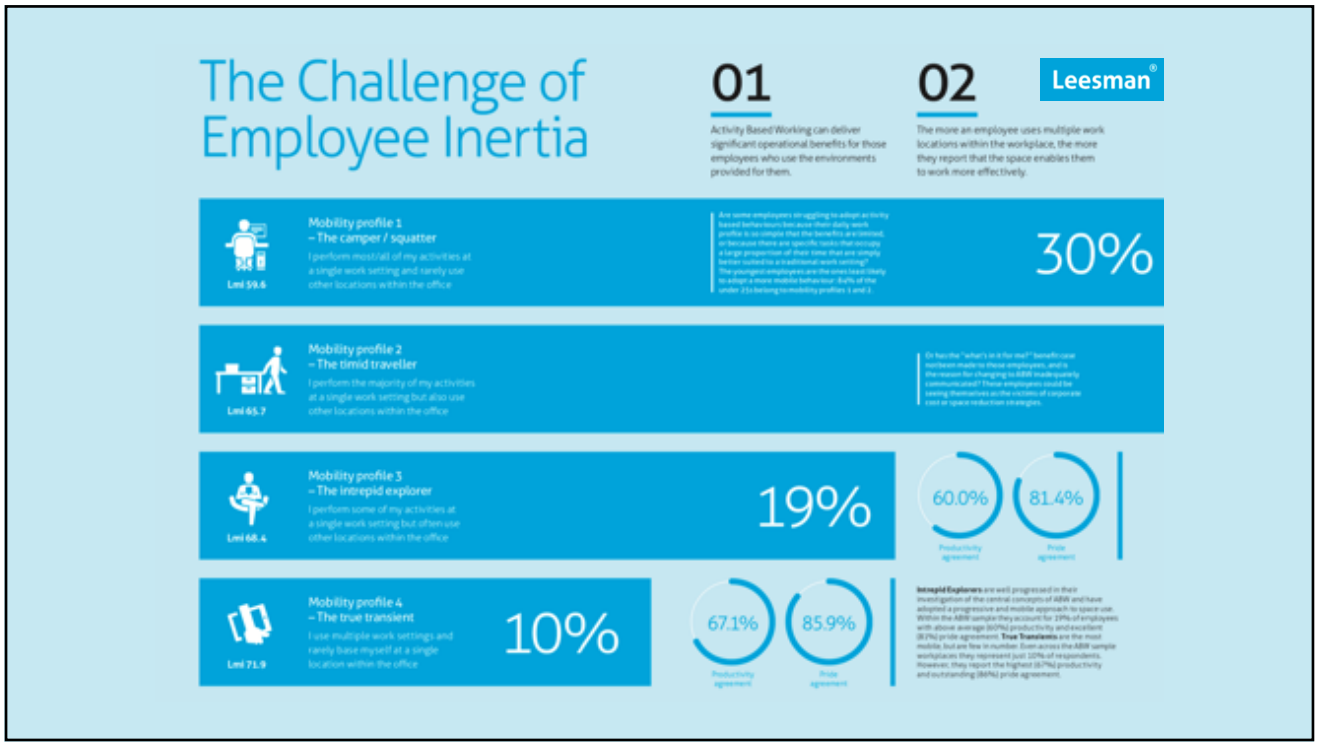
Switching behaviour and satisfaction in activity-based work environments

48

Jan Gerard Hoendervanger
Knowledge Centre NoorderRuimte, Hanze University of Applied Sciences, Groningen, The Netherlands
Iris De Been
Center for People and Buildings, Delft, The Netherlands
Nico W. Van Yperen
Knowledge Centre NoorderRuimte, Hanze University of Applied Sciences,
Casper J. Albers
Department of Psychometrics and Statistics, University of Groningen, Groningen, The Netherlands

Abstract

25% of people never changed location
24% of people changed location less than once a week
4% of people changed location multiple times per day



Åvitsland et al. Archives of Public Health (2017) 75:2
DOI 10.1186/s13690-016-0170-8

Archives of Public Health

RESEARCH Open Access

Promoting workplace stair climbing: sometimes, not interfering is the best

Andreas Åvitsland*, Ane Kristiansen Solbraa and Amund Riiser

Abstract

Background: Stair climbing is a vigorous activity and can lead to several health benefits. Studies seeking to increase stair climbing in various public locations have shown positive effects, while results from similar studies conducted in the workplace are inconclusive. This study examined stair climbing in the workplace, and monitored effects from a single- and a combined intervention. Interventions were inspired by nudging, the libertarian method of influencing behavior.

Methods: By quasi-experimental design, stair- and elevator traffic in two office buildings was monitored preceding-, during- and following interventions with stair leading footprints alone, and combined with stair-riser banners. Chi square tests were applied to determine differences between baseline and the subsequent periods. Web-based questionnaires were distributed after follow-up period.

Results: Elevators and stairs were used 45 237 times, of which 89.6% was stair use. Intervention site stair climbing at baseline (79.0%) was significantly reduced with footprints (-5.1%, $p < 0.001$), and footprints with stair-riser banners (-5.7%, $p < 0.001$) while baseline stair climbing at the control site (94.2%) remained stable ($p > 0.027$).

Conclusions: Stair climbing was significantly reduced during the intervention periods. Use of stair leading footprints alone, or combined with stair-riser banners in an attempt to influence stair climbing may be ineffective, or cause a negative reaction, when applied in a workplace with a pre-existing high amount of stair climbing.

Keywords: Physical activity, Public health, Active transport, Nudging, Quasi-experimental

Background

Physical inactivity is a major risk factor for non-communicable diseases (NCDs) [1]. Being physically active is associated with reduced risk of cardiovascular disease [2], type 2 diabetes [3], colon cancer [4] and obesity [5]. The recommended 150 min per week of moderate to vigorous physical activity [6] is only fulfilled by 32.0% of Norwegian adults [7] while inconclusive evidence suggests the equivalent portion in the USA to be somewhere between 8.2% [8] and 57.0% [9]. When North-American adults mention "lack of time" as a main reason for inactivity [10], while spending half their waking hours at work [11], the workplace should be considered an attractive arena for increasing physical activity levels. This could be done by increasing work-

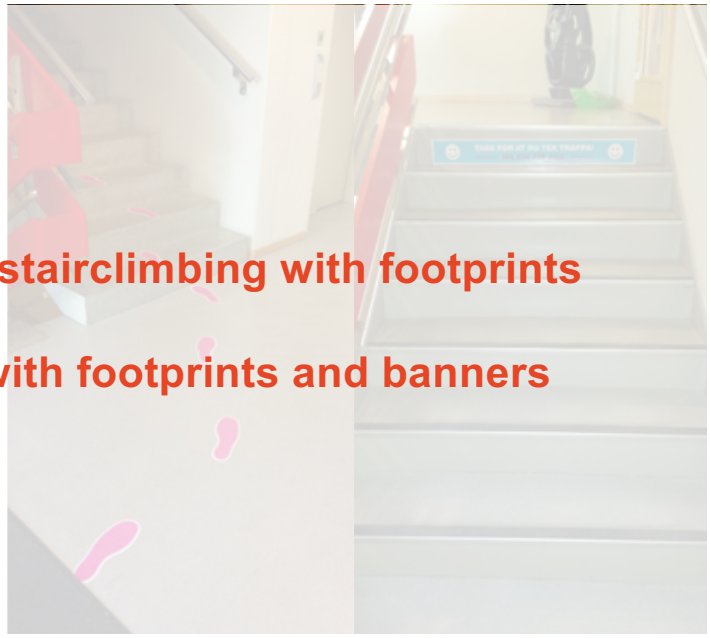
METs [12] and 9.6 METs [13], and can therefore be categorized as a vigorous activity. Seven daily minutes of vigorous physical activity has been associated with a 62.0% decrease in coronary death [2], thus seven daily minutes of stair climbing should provide the same benefit. Stair climbing has been associated with higher peak VO_2 [14], lower blood pressure [15], improved fitness [16], and is also timesaving, compared to elevator [17, 18]. There exist several studies specifically designed with the purpose to increase workplace stair use. Some have not been able to obtain the desired effect [19–22], while others have managed to show a significant increase [23–25]. Similar interventions have also been carried out in public locations, such as shopping centers [26], train/tram stations [27], airports [28] and univer-

Archives of Public Health

RESEARCH Open Access

Promoting workplace stair climbing: sometimes, not interfering is the best

Andreas Åvitsland, Arne Kristiansen Solbraa and Amund Riiser



5.1% reduction in stairclimbing with footprints

5.7% reduction with footprints and banners

International Journal of Environmental Research and Public Health

MDPI

Article

Occupational Physical Activity Habits of UK Office Workers: Cross-Sectional Data from the Active Buildings Study

Lee Smith [1,†], Alexia Sawyer [2,†], Benjamin Gardner [3], Katri Seppala [2], Marcella Ucci [4], Alexi Marmot [5], Pippa Lally [2] and Abi Fisher [2,*]

1 The Cambridge Centre for Sport and Exercise Sciences, Anglia Ruskin University, Cambridge CB1 1PT, UK; Lee.Smith@anglia.ac.uk
2 Department of Behavioural Science and Health, University College London, 1-19 Torrington Place, London WC1E 6BT, UK; alexia.sawyer@ucl.ac.uk (A.S.); katri.seppala.15@alumni.ucl.ac.uk (K.S.); p.lally@ucl.ac.uk (P.L.)
3 Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, De Crespigny Park, London SE5 8AF, UK; benjamin.gardner@kcl.ac.uk
4 UCL Institute for Environmental Design and Engineering, Bartlett Faculty of the Built Environment, University College London, Central House, 14 Upper Woburn Place, London WC1H 0NN, UK; m.ucci@ucl.ac.uk
5 UCL Bartlett Faculty of the Built Environment, University College London, Gordon House, 29 Gordon Square, London, WC1H OPP, UK; a.marmot@ucl.ac.uk
* Correspondence: abigail.fisher@ucl.ac.uk
† Joint first authors.

Received: 20 April 2018; Accepted: 7 June 2018; Published: 9 June 2018

check for updates

Abstract: Habitual behaviours are learned responses that are triggered automatically by associated environmental cues. The unvarying nature of most workplace settings makes workplace physical activity a prime candidate for a habitual behaviour, yet the role of habit strength in occupational physical activity has not been investigated. Aims of the present study were to: (i) document occupational

International Journal of Environmental Research and Public Health

MDPI

Article

Occupational Physical Activity Habits of UK Office Workers: Cross-Sectional Data from the Active Buildings Study

Lee Smith [1,†], Alexia Sawyer [2,†], Benjamin Gardner [3], Katri Seppala [2], Marcella Ucci [4], Alexi Marmot [5], Pippa Lally [2] and Abi Fisher [2,*]

1 The Cambridge
Lee.Smith@angli
2 Department of Behavioural Science and Health, University College London, 1-19 Torrington Place, London WC1E 6BT, UK; alexia.sawyer@ucl.ac.uk (A.S.); katri.seppala.15@alumni.ucl.ac.uk (K.S.); p.lally@ucl.ac.uk (P.L.)
3 Department of Psychology, Institute of Psychiatry, Psychology and Neuroscience, King's College London, De Crespigny Park, London SE5 8AF, UK; benjamin.gardner@kcl.ac.uk
4 UCL Institute for Environmental Design and Engineering, Bartlett Faculty of the Built Environment, University College London, Central House, 14 Upper Woburn Place, London WC1H 0NN, UK; m.ucci@ucl.ac.uk
5 UCL Bartlett Faculty of the Built Environment, University College London, Gordon House, 29 Gordon Square, London, WC1H 0PP, UK; a.marmot@ucl.ac.uk
* Correspondence: abigail.fisher@ucl.ac.uk
† Joint first authors.

Received: 20 April 2018; Accepted: 7 June 2018; Published: 9 June 2018

check for updates

Abstract: Habitual behaviours are learned responses that are triggered automatically by associated environmental cues. The unvarying nature of most workplace settings makes workplace physical activity a prime candidate for a habitual behaviour, yet the role of habit strength in occupational physical activity has not been investigated. Aims of the present study were to: (i) document occupational

62% reported having a habit for stairclimbing

International Journal of Environmental Research and Public Health

MDPI

Article

Occupational Physical Activity Habits of UK Office Workers: Cross-Sectional Data from the Active Buildings Study

Lee Smith [1,†], Alexia Sawyer [2,†], Benjamin Gardner [3], Katri Seppala [2], Marcella Ucci [4], Alexi Marmot [5], Pippa Lally [2] and Abi Fisher [2,*]

Received: 20 April 2018; Accepted: 7 June 2018; Published: 9 June 2018

Abstract: Habitual behaviours are learned responses that are triggered automatically by associated environmental cues. The unvarying nature of most workplace settings makes workplace physical activity a prime candidate for a habitual behaviour, yet the role of habit strength in occupational physical activity has not been investigated. Aims of the present study were to: (i) document occupational

62% reported having a habit for stairclimbing

but these people had lower daily steps counts

JRRD Volume 45, Number 7, 2008
Pages 1077–1090
Journal of Rehabilitation Research & Development

How humans walk: Bout duration, steps per bout, and rest duration

Michael S. Orendurff, MS;[1–2*] Jason A. Schoen, BS;[1] Greta C. Bernatz, BA;[1] Ava D. Segal, MS;[1] Glenn K. Klute, PhD[1,3–4]

[1]Motion Analysis Laboratory, Rehabilitation Research and Development Service, Department of Veterans Affairs Puget Sound Health Care System, Seattle, WA; Departments of [2]Rehabilitation Medicine, School of Medicine, [3]Mechanical Engineering, and [4]Electrical Engineering, University of Washington, Seattle, WA

Abstract—Much is known about human walking, but it is not known how walking is used during typical activities. Since improving walking ability is a key goal in many surgical, pharmacological, and physiotherapeutic interventions, understanding typical community mobility demands regarding the length of walking bouts, the number of sequential steps frequently performed, and the duration of common nonwalking (rest) behavior seems prudent. This study documents the gait of daily living in 10 nondisabled employed adults to define walking bout duration, sequential step counts, and length of rest periods over a 2-week period. Subjects wore a StepWatch™ Activity

INTRODUCTION

Human gait has been the focus of a substantial number of investigations. Many have focused on joint motions [1–4], moments, and powers using two- and three-dimensional inverse dynamics approaches [5–6]. Straight-ahead, steady-state walking across a range of speeds comprises the vast majority of nondisabled human gait studies, although work has expanded into turning [7–14], obstacle avoidance [15–18], walk-to-run transitions [19–21], and even backward walking [22–23]. Human gait

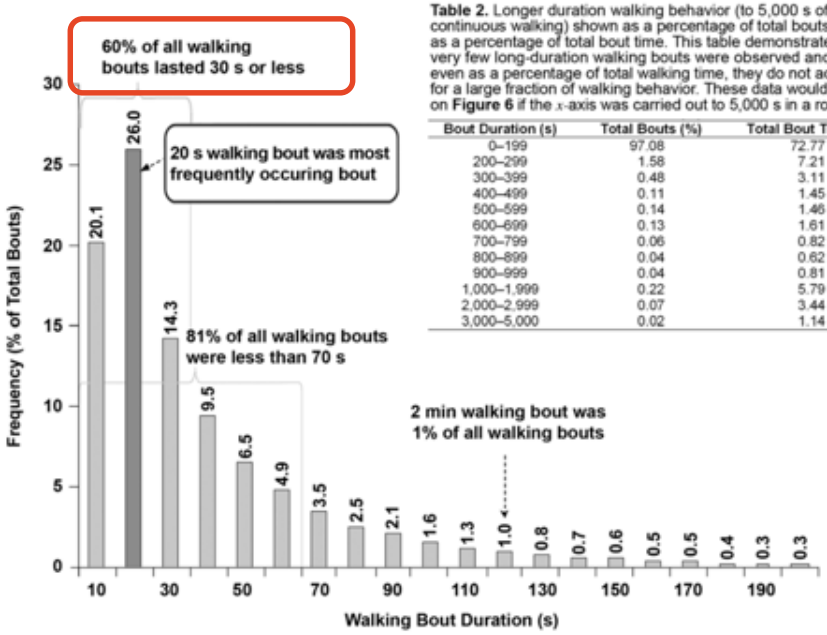


Table 2. Longer duration walking behavior (to 5,000 s of continuous walking) shown as a percentage of total bouts and as a percentage of total bout time. This table demonstrates that very few long-duration walking bouts were observed and that even as a percentage of total walking time, they do not account for a large fraction of walking behavior. These data would appear on **Figure 6** if the *x*-axis was carried out to 5,000 s in a row.

Bout Duration (s)	Total Bouts (%)	Total Bout Time (%)
0–199	97.08	72.77
200–299	1.58	7.21
300–399	0.48	3.11
400–499	0.11	1.45
500–599	0.14	1.46
600–699	0.13	1.61
700–799	0.06	0.82
800–899	0.04	0.62
900–999	0.04	0.81
1,000–1,999	0.22	5.79
2,000–2,999	0.07	3.44
3,000–5,000	0.02	1.14

Limits of Predictability in Human Mobility

Chaoming Song,[1,2] Zehui Qu,[1,2,3] Nicholas Blumm,[1,2] Albert-László Barabási[1,2,*]

A range of applications, from predicting the spread of human and electronic viruses to city planning and resource management in mobile communications, depend on our ability to foresee the whereabouts and mobility of individuals, raising a fundamental question: To what degree is human behavior predictable? Here we explore the limits of predictability in human dynamics by studying the mobility patterns of anonymized mobile phone users. By measuring the entropy of each individual's trajectory, we find a 93% potential predictability in user mobility across the whole user base. Despite the significant differences in the travel patterns, we find a remarkable lack of variability in predictability, which is largely independent of the distance users cover on a regular basis.

When it comes to the emerging field of human dynamics, there is a fundamental gap between our intuition and the current modeling paradigms. Indeed, although we rarely perceive any of our actions to be random, from the perspective of an outside observer who is unaware of our motivations and schedule, our activity pattern can easily appear random and unpredictable. Therefore, current models of human activity are fundamentally stochastic (*1*) from Erlang's formula (*2*) used in telephony to Lévy-walk models describing human mobility (*3*–*7*) and their applications in viral dynamics (*8*–*10*), queuing models capturing human communication patterns (*11*–*13*), and models capturing body balancing (*14*) or panic (*15*). Yet the probabilistic nature of the existing modeling framework raises fundamental questions: What is the role of randomness in human behavior and to what degree are individual human actions predictable? Our goal here is to quantify

[1]Center for Complex Network Research, Departments of Physics, Biology, and Computer Science, Northeastern University, Boston, MA 02115, USA. [2]Department of Medicine, Harvard Medical School, and Center for Cancer Systems Biology, Dana-Farber Cancer Institute, Boston, MA 02115, USA. [3]School of Computer Science and Engineering, University of Electric Science and Technology of China, Chengdu 610054, China.

*To whom correspondence should be addressed. E-mail: alb@neu.edu

19 FEBRUARY 2010 VOL 327 SCIENCE www.sciencemag.org

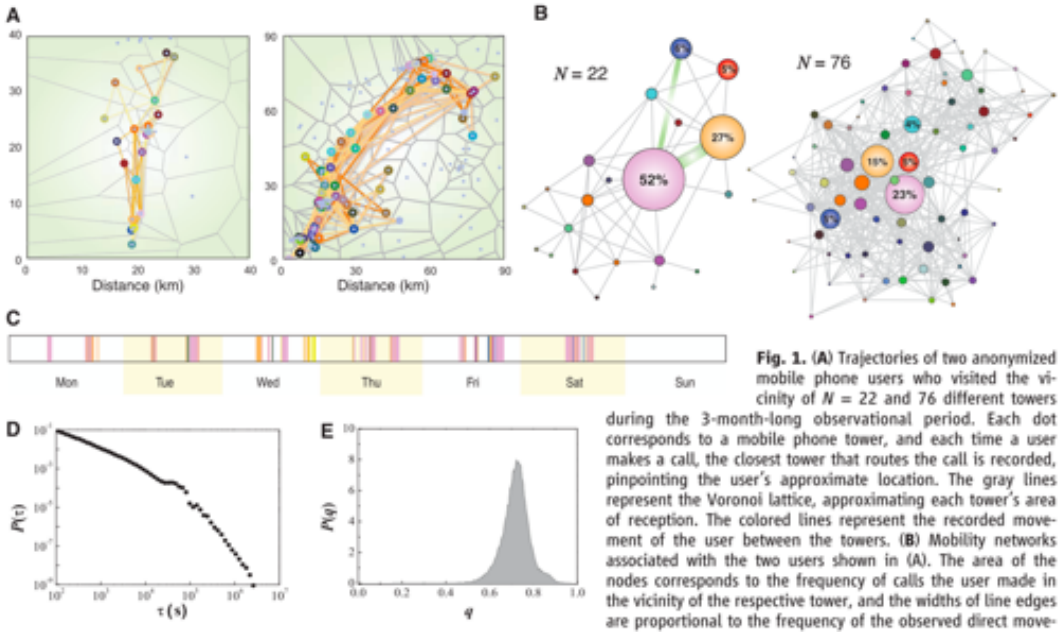
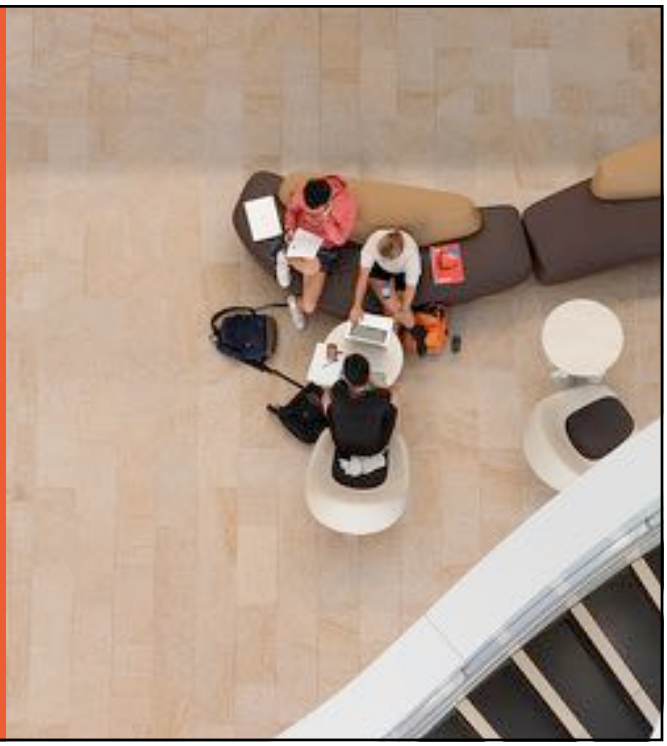


Fig. 1. (**A**) Trajectories of two anonymized mobile phone users who visited the vicinity of $N = 22$ and 76 different towers during the 3-month-long observational period. Each dot corresponds to a mobile phone tower, and each time a user makes a call, the closest tower that routes the call is recorded, pinpointing the user's approximate location. The gray lines represent the Voronoi lattice, approximating each tower's area of reception. The colored lines represent the recorded movement of the user between the towers. (**B**) Mobility networks associated with the two users shown in (A). The area of the nodes corresponds to the frequency of calls the user made in the vicinity of the respective tower, and the widths of line edges are proportional to the frequency of the observed direct move-

Predictably Immobile? Analysing the spatiotemporal movement behaviour of office workers.

Thank you



Supervisors
Dr Lina Engelen
Professor Richard de Dear