Attention!

This is a *representative* syllabus.

The syllabus for the course when you enroll may be *different*.

Use the syllabus provided by *your* instructor for the most up-to-date information. Please refer to your instructor for more information for the specific requirements for a given semester.

Feel free to contact the Psychology Advising Office for any questions regarding psychology courses either by email (psychadvising@osu.edu) or phone (614.292.5750).

Thank you!

SYLLABUS
PSYCHOLOGY 5620

Technology, Efficiency, and Happiness

Autumn 2021 – Online – Class #: 35299 (undergraduate)
35298 (graduate)

COURSE OVERVIEW

Course description

This course will examine various ways of evaluating behavioral aspects of new technologies (e.g., mobile communication devices, social media, social robots, transportation innovations, sports equipment). Many new products seem like they might improve our lives through increased efficiency, convenience, or power in performing specific tasks. However, it is difficult to predict whether new technology will make us happy, enhance social interactions, increase creativity, or generally improve our quality of life. Technology often has hidden costs and benefits such as unexpected effects on cultural manners, new forms of distributed cognition and social cooperation, increased multi-tasking, and destabilizing environmental impacts. This course will consider many behavioral dimensions of technology that may impact decisions about designing, choosing, and using new devices.

Course learning outcomes

By the end of this course, students should:

1. Better understand the many behavioral dimensions of technology
2. Better evaluate the costs and benefits of new technology prior to adopting new devices
3. Be better able to critically review research on the effects of technology

HOW THIS COURSE WORKS

Mode of delivery:

- 100% online delivery.
- Students are required to attend synchronous class sessions held at the original time/day pattern of this course – T/Th 5:30-6:50 p.m. Please unmute your microphone and ask questions whenever anything is unclear or if you have a relevant comment to add.
- Additionally, students may arrange individual Zoom meetings with the instructor.

Credit hours and work expectations: This is a **3-credit-hour course**. According to Ohio State policy, students should expect around 3 hours per week of time spent on direct instruction (instructor content and Carmen activities, for example) in addition to 6 hours of homework (reading and assignment preparation, for example) **to receive a grade of (C) average**. If you feel you need additional academic support services (hppt://advising.osu.edu) or access to student services and resources (hppts://contactbuckeyelink.osu.edu) to succeed in this course, please use these links.

COURSE MATERIALS AND TECHNOLOGIES

Required readings are available on Carmen (Canvas).

Key Power Point slides for the lectures will be posted on Carmen (Canvas).

Course technology

TECHNOLOGY SUPPORT

For help with your password, university email, Carmen, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

TECHNOLOGY SKILLS NEEDED FOR THIS COURSE

- Basic computer and web-browsing skills
- Navigating Carmen (go.osu.edu/canvasstudent)
- CarmenZoom virtual meetings (go.osu.edu/zoom-meetings)

REQUIRED EQUIPMENT

- Computer: current Mac (MacOs) or PC (Windows 10) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed and tested
- Microphone: built-in laptop or tablet mic or external microphone
- Other: a mobile device (smartphone or tablet) to use for BuckeyePass authentication

REQUIRED SOFTWARE

- Microsoft Office 365: All Ohio State students are now eligible for free Microsoft Office 365. Full instructions for downloading and installation can be found at go.osu.edu/office365help.

CARMEN ACCESS

You will need to use BuckeyePass (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions (go.osu.edu/add-device).
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application (go.osu.edu/install-duo) to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357(HELP) and IT support staff will work out a solution with you.

GRADING AND FACULTY RESPONSE

How your grade is calculated

ASSIGNMENT CATEGORY	POINTS
Short-answer quizzes every two weeks	24
2-page commentary	10
Written 6-8 page paper	35
Oral presentation of paper	25
Class attendance during student presentations and participation throughout the course	6
Total	100

See course schedule below for due dates.

Descriptions of major course assignments

SHORT-ANSWER QUIZZES EVERY TWO WEEKS

Description: In place of a midterm, there will be five 20-minute short answer quizzes spaced every other week. You can consult your notes and readings. However, these quizzes will be strictly timed, so there will be little opportunity to do so. There will be no make-up quizzes. Your lowest quiz score will be dropped to accommodate any unexpected absence, illness, or unusually poor performance.

Academic integrity and collaboration: You may not communicate with any other person during the quiz. The quiz will be uploaded onto Canvas at the end of the 20-minute period.

2-PAGE COMMENTARY

Description: Write a 2-page double-spaced commentary on the primary issues involved in any of the topics marked with an asterisk (*) in the syllabus. These commentaries may rely on the course readings and/or additional sources. The commentaries are due at the class period in which these topics are discussed (Weeks 1-10). Individuals who prepare commentaries should help to lead our class discussions of these topics.

Academic integrity and collaboration: You may discuss your commentary with other students and instructional staff. Your written commentary must be your own individual work, should reflect your unique thoughts, and be written in your own words.

6-8 PAGE RESEARCH PAPER AND ORAL PRESENTATION

Description: In place of a final exam, a 6-8 page double-spaced paper on any topic relevant to the material covered in this course will be due Tuesday, Oct. 26, the 10th week of the semester. The paper should present a critical review of several articles not included in the required readings, followed by suggestions for new research in this area and/or suggestions for new approaches to conceptualizing and/or modeling human-technology interaction. Try to be as creative as possible in your suggestions for new conceptual approaches, quantitative models, qualitative models, and/or measurement procedures. Also, make a 15-minute Power Point presentation of your work during the final weeks of the course, followed by class discussion. Possible topics include behavioral effects of electronic, mechanical, and/or biological technologies, new measures or methods for evaluating or predicting the impact of technologies, or historical trends in the evolution of particular technologies.

Academic integrity and collaboration: You may discuss your topic with other students and instructional staff. Your paper and oral presentation must be your own individual work, should reflect your unique thoughts, and be written in your own words.

CLASS ATTENDANCE DURING STUDENT PRESENTATIONS AND PARTICIPATION THROUGHOUT THE COURSE

Description: You will be expected to ask questions and make suggestions during lectures and after each student presentation. It is not expected that every student will ask a question every day, but on average everyone should actively participate. Please use your full name in Zoom so the instructor knows who you are.

Late assignments

- Turn in your written assignment on the due date to avoid a late penalty
- Class presentations must be given on the scheduled date

Grading scale

The grading scale will be adjusted to reflect the difficulty of the quizzes.

Instructor feedback and response time

If you have any questions or would like to discuss ideas for your paper, send me an email a day or two in advance to schedule a Zoom meeting at a convenient time.

Zoom/Videoconferencing Guidelines

- **Technical Issues:** If you encounter a technical issue with Zoom during a session, first make sure you are using the latest version of Zoom. Next, contact the IT Service Desk at http://go.osu.edu/it or 614-688-4357(HELP). If issues continue, contact the instructor after the session.
- **Preparation:** Stay up to date with the readings, so you can raise informed questions.
- **Participation:** Show your face on camera if we are not having problems with pausings. Mute your microphone whenever you are not talking to minimize background noise.
- Use your full name on your Zoom connection rather than a nickname, so the instructor is aware of who you are.

Academic integrity policy

See **Descriptions of major course assignments**, above, for my specific guidelines about collaboration and academic integrity in the context of this online class.

OHIO STATE'S ACADEMIC INTEGRITY POLICY

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's *Code of Student Conduct* (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- Committee on Academic Misconduct web page (go.osu.edu/coam)
- Ten Suggestions for Preserving Academic Integrity (go.osu.edu/ten-suggestions)
- Eight Cardinal Rules of Academic Integrity (go.osu.edu/cardinal-rules)

Copyright for instructional materials

The materials used in connection with this course may be subject to copyright protection and are **only** for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options at titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

Commitment to a diverse and inclusive learning environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, on-demand resources are available at go.osu.edu/ccsondemand. You can reach an on-call counselor when CCS is closed at 614-292-5766, and 24-hour emergency help is also available through the 24/7 National Prevention Hotline at 1-800-273-TALK or at suicidepreventionlifeline.org. The Ohio State Wellness app is also a great resource available at go.osu.edu/wellnessapp.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact

information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with me.

- Canvas accessibility (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- CarmenZoom accessibility (go.osu.edu/zoom-accessibility)

COURSE SCHEDULE

Week	Dates	Topics, Assignments
1	8/24, 26	1. Efficiency, complexity, and multi-tasking Cell phones: Multiple dimensions of technology
2	8/31, 9/2	Usability and complexity Physical constraints: Speed, accuracy, and muscular stress
3	9/7, 9	2. Happiness and pleasure Behavioral correlates Measurement issues Quiz 1 on 9/7
4	9/14, 16	Adaptation and design implications Affective relationships with technology
5	9/21, 23	3. Creativity Enhancing multi-person creativity and distributed cognition

		Quiz 2 on 9/21
6	9/28, 30	Media effects on conceptual thinking and communication
7	10/5, 7	4. Environmental impact Sport utility vehicles, trucks, and the car culture Quiz 3 on 10/5
8	10/12	Voluntary simplicity
9	10/19,21	5. Social impact Luddites and cultural disruption Quiz 4 on 10/19
10	10/26, 28	Internet Sports: Technology and culture 6-8 page paper due 10/26 Student presentations of 6-8 page paper start 10/28
11	11/2, 4	Student presentations of 6-8 page papers Quiz 5 on 11/2
12	11/9	Student presentations of 6-8 page papers
13	11/16, 18	Student presentations of 6-8 page papers
14	11/23	Student presentations of 6-8 page papers
15	11/30, 12/2	Student presentations of 6-8 page papers
16	12/7	Student presentations of 6-8 page papers
17	12/15	Student presentations of 6-8 page papers (This is our final exam time slot, Weds, 8-9:45 p.m.)

READINGS

1. Efficiency, complexity, and multi-tasking (Weeks 1-2)

Cell phones: Multiple dimensions of technology

Cognitive constraints

Strayer, D. L., Drews, F. A., & Johnston, W. A. (2003). Cell phone-induced failures of visual attention during simulated driving. Journal of Experimental Psychology: Applied, 9, 23-32.

Strayer, D. L. et al. (2019). Visual and cognitive demands of CarPlay, Android Auto, and five native infotainment systems. Human Factors, 61, 1371-1386.

Misra, S., Cheng, L, Genevie, J., & Yuan, M. (2014). The iPhone effect: The quality of in-person social interactions in the presence of mobile devices. Environment and Behavior, 1-24.

*Cultural constraints

Olson, E. (July 15, 2003). Sound, fury and cellphone users and abusers. New York Times, Section C, 6.

Jones, C. (October 1, 2019). Cellphones are disrupting theaters everywhere. Here is a solution. Chicago Tribune.

Senning, D. P. (2013). Manners in a digital world ("A captive audience," pp. 29-38). New York: Open Road.

Sclove, R. E. (1995). Democracy and technology ("Spanish waters, Amish farming: Two parables of modernity?", pp. 3-9). New York: Guilford Press.

Granville, K. & Gilbertson, A. (Sept. 15, 2017). In Amish country, the future is calling. New York Times, BU6.

Emergency communication

Brunwasser, M. (Aug. 26, 2015). A 21st-century migrant's essentials: Food, shelter, smartphone. New York Times, A1.

Loomis, M. (2015). The signal and the noise. Sierra, 35-37

*Usability and complexity

Norman, D. A. (1988). The psychology of everyday things (pp. 30-31; 142-145). New York: Basic Books.

Norman, D. A. (2011). Living with complexity (Common aspects of life that require months of study, pp. 20-31). Cambridge, Massachusetts: MIT Press.

Grossman, L. & Vella/Cupertino, M. (September 22, 2014). iNeed? Time (pp. 40-44, 47).

Carr, N. (2014). The glass cage: How our computers are changing us. (Automation for the people, pp. 158-176) New York: W. W. Norton.

Physical constraints: Speed, accuracy, and muscular stress

Schmidt, R. A. & Lee, T. D. (2011). Motor control and learning (Fitts' Law, pp. 224-229). Champaign, Illinois: Human Kinetics.

Feathers, D. J., Rollings, K., & Hedge, A. (2013). Alternative computer mouse designs: Performance, posture, and subjective evaluations for college students aged 18-25. Work, 44, S115-S122.

2. Happiness and pleasure (Weeks 3-4)

Behavioral correlates

Myers, D. G. (2000). The funds, friends, and faith of happy people. American Psychologist, 55, 56-67.

Kahneman, D., & Deaton, A. (2010). High income improves evaluation of life but not emotional well-being. Proceedings of the National Academy of Sciences, 107, 16489-16493.

Dunn, E. W., Aknin, L. B., & Norton, M. I. (2014). Prosocial spending and happiness: Using money to benefit others pays off. Psychological Science, 23(1), 41-47.

Keohane, J. (August, 2021). The surprising benefits of talking to strangers. *The Atlantic*.

Denier, E., Oishi, S., & Lucas, R. E. (2015). National accounts of subjective well-being. American Psychologist, 70, 234-242.

*Measurement issues

Kahneman, D. (1999). Objective happiness. In D. Kahneman, E. Diener, & N. Schwarz (Eds.), Well-being: The foundations of hedonic psychology (pp. 3-25). New York: Russell Sage Foundation.

Park, S. Q., Kahnt, T., Dogan, A., Strang, S., Fehr, E., & Tobler, P. N. (2017). A neural link between generosity and happiness. Nature Communications, DOI: 10.1038/ncomms15964.

*Adaptation and design implications

Brickman, P., Coates, D., & Janoff-Bulman, R. (1978). Lottery winners and accident victims. Is happiness relative? Journal of Personality and Social Psychology, 36, 917-927.

Norman, D. A. (2004). Emotional design: Why we love (*or* hate) everyday things (pp. 99-123). New York: Basic Books.

*Affective relationships with technology

Busch, A. (2004). The uncommon life of common objects (The refrigerator, pp. 100-110). New York: Metropolis Books.

Yang, J.-Y., Jo, Y-H, Kim, J.-C., & Kwon, D.-S. (2013). Affective interaction with a companion robot in an interactive driving assistant system. Proceedings of the IEEE Intelligent Vehicles Symposium (IV) (pp. 1392-1397). Gold Coast, Australia.

Carman, A. (June 19, 2019). They welcomed a robot into their family, now they're mourning its death: The story of Jibo. The Verge.

3. Creativity (Weeks 5-6)

Nickerson, R. S. (1999). Enhancing creativity. In R. J. Sternberg (Ed.), Handbook of creativity (pp. 392-407). Cambridge, UK: Cambridge University Press.

Shneiderman, B. (2003). Leonardo's laptop: Human needs and the new computing technologies (Mega-creativity, pp. 209-231, 249). Cambridge, Massachusetts: MIT Press.

*Enhancing multi-person creativity and distributed cognition

Pentland, A. (2014). Social physics. (Collective intelligence, Shaping organizations, pp. 96-114; Reality mining, pp. 217-224). New York: Penguin Press.

Good, B. M. & Su, A. I. (2011). Games with a scientific purpose. Genome Biology, 12:135.

Clark, A. (2003). Natural-born cyborgs: Minds, technologies, and the future of human intelligence. (Global swarming, pp. 143-153). New York: Oxford University Press.

Norman, D. A. (2013). The design of everyday things (Things that make us smart, pp. 284-288). New York: Basic Books.

Brynjolfsson, E. & McAfee, A. (2014) The second machine age: Work, progress, and prosperity in a time of brilliant technologies (Learning to race *with* machines, pp. 187-193). New York: W. W. Norton.

Giles, M. (March/April, 2018). The GANfather: The man who's given machines the gift of imagination. MIT Technology Review, 121, 48-53.

*Media effects on conceptual thinking and communication

Shaw, G., Brown, R., & Bromiley, P. (May-June,1998). Strategic stories: How 3M is rewriting business planning. Harvard Business Review, *76(3),* 41 - 50. Not available on Carmen. This journal is in top floor of the OSU Law Library (K 8 .A677). It is also available on-line:
http://proxy.lib.ohio-state.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&jid=HBR&site=ehost-live

Mueller, P. & Oppenheimer, D. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. Psychological Science, 25, 1159-1168.

Singer, L. M. & Alexander, P. A. (2017). Reading across mediums: Effects of reading digital and print texts on comprehension and calibration. The Journal of Experimental Education, 85, 155-172.

4. Environmental impact (Weeks 7-8)

Gardner, G. T., & Stern, P. C. (1996). Environmental problems and human behavior (Choosing the behaviors to change and the points of intervention, pp. 253-265). Needham Heights, MA: Allyn & Bacon.

Van der Ryn, S. & Cowan, S. (1996). Ecological design (pp. 25-31, 58- 63, 90-96). Washington, D. C.: Island Press.

Brown, L. R. (2009). Plan B 4.0: Mobilizing to save civilization (Water tables falling, pp. 38-45; Melting glaciers, shrinking harvests, 66-69). New York: W. W. Norton.

Shannon, N. G. (July 19, 2018). The water wars of Arizona. New York Times Magazine.

Lokting, B. (2020). The startup turning human bodies into compost. MIT Technology Review, 123(6), 64-67.

*Sport utility vehicles, trucks, and the car culture

Worth, P. (Spring, 2015). Shipping smarter. Catalyst, 12-16. Cambridge, MA: Union of Concerned Scientists.

Kay, J. H. (1997). Asphalt nation: How the automobile took over America and how we can take it back (The cost of the car culture, pp. 115-137). Berkeley, CA: University of California Press.

Wikipedia (2021). Car-free movement. (https://en.wikipedia.org/wiki/Car-free_movement)

Finn, E. (Jul/Aug, 2018). Going driverless in the city of cars. MIT Technology Review, 121(4), 46-53.

*Voluntary simplicity

Maniates, M. (2002). In search of consumptive resistance: The voluntary simplicity movement. In T. Princen, M. Maniates,. & K. Conca (Eds.), Confronting consumption (pp. 199-213). Cambridge, Massachusetts: MIT Press.

Leonard, A. with A. Conrad (2010). The story of stuff (pp. 158-166). New York: Free Press.

Wikipedia (2021). Tiny house movement. (https://en.wikipedia.org/wiki/Tiny-house_movement)

Motesharrei, S., Rivas, J., & Kalnay, E. (2014). Human and nature dynamics (HANDY): Modeling inequality and use of resources in the collapse or sustainability of societies. *Ecological Economics*, *101*, 90-120.

5. Social Impact (Weeks 9-10)

Luddites and cultural disruption

Fox, N. (2002). Against the machine (The frame breakers, pp. 24-40). Washington, D.C.: Island Press.

Meade, M. (Ed.) (1953). Cultural patterns and technical change (pp. 209-210; 257-259; 296-299;309-312). New York: UNESCO. (Reprinted by IJsel Press, Holland.)

*Internet

Fox, N. (2002). Against the machine (p. 20). Washington, D.C.: Island Press.

Penn, M. J. (2007). Microtrends (The new Luddites, pp. 257-260). New York: Twelve.

Carr, N. (2010). The shallows: What the internet is doing to our brains (pp. 192-195, 219-224). New York: W. W. Norton.

Berto, R. (2005). Exposure to restorative environments helps restore attentional capacity. Journal of Environmental Psychology, 25, 249-259.

Waytz, A., & Gray, K. (2018). Does online technology make us more or less sociable? A preliminary review and call for research. Perspectives on Psychological Science, 13, 473-491.

*Sports: Technology and culture

Gelberg, J. N. (1998). Tradition, talent and technology: The ambiguous relationship between sports and innovation. In A. Busch (Ed.), Design for sports: The cult of performance (pp. 89-94; 105-108). New York: Princeton Architectural Press.

Tenner, E. (1996). Why things bite back (Golf and the advantages of rationing progress, pp. 245- 253). New York: Alfred A. Knopf.

Chartier, T. (2014). Big data: How data analytics is transforming the world (Lecture 9: How new statistics transform sports). Chantilly, Virginia: The Teaching Company.