PRIVACY AND PERSONAL SPACE: ADDRESSING INTERACTIONS AND INTERACTION DATA AS A PRIVACY CONCERN

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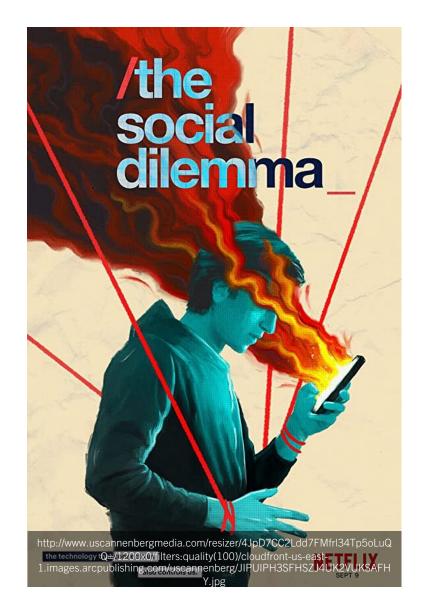Trinity College Dublin, Ireland

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SHIFTING PERSPECTIVE

- Data privacy is typically associated with personal data conveyed through the internet.
  - Bank account, credit card, address, phone number, etc.
  - Social media: Facebook, Instagram, Twitter, Snapchat, etc.

- Algorithms are good at knowing and manipulating you…

Facebook reveals news feed experiment to control emotions

Protests over secret study involving 689,000 users in which friends' postings were moved to influence moods

From The Guardian, 2014

SHIFTING PERSPECTIVE

- What about data from virtual reality (VR) users?

- A lot of people still aren't thinking about it much.

2021 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW)

Privacy and Personal Space: Addressing Interactions and Interaction Data as a Privacy Concern

Lauren E. Buck*   Bobby Bodenheimer[†]
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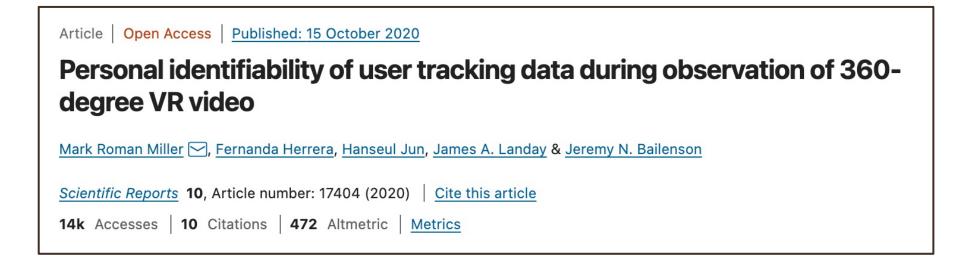
Current Privacy Work → My Work → Implications of Data → Future Privacy Work

CURRENT LITERATURE

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CURRENT LITERATURE: BIOMETRIC DATA

- People can be easily identified by a ML algorithm with just a small amount of motion data.

- Nonverbal data from motion capture *is* personally identifiable data.

Article | Open Access | Published: 15 October 2020

Personal identifiability of user tracking data during observation of 360-degree VR video

Mark Roman Miller ✉, Fernanda Herrera, Hanseul Jun, James A. Landay & Jeremy N. Bailenson

Scientific Reports **10**, Article number: 17404 (2020) | Cite this article

14k Accesses | **10** Citations | **472** Altmetric | Metrics

CURRENT LITERATURE: BIOMETRIC DATA

- Motion data from VR can be used to analyze an individual's gait.

- Can be used to diagnose and treat Parkinson Disease.
  - Manipulate sensorimotor contingencies
  - Simulate otherwise dangerous scenarios
  - Assess balance

- But who will have access to this kind of data if motion tracking data is readily available?

Review Article | Published: 26 June 2020

Virtual reality in research and rehabilitation of gait and balance in Parkinson disease

Colleen G. Canning ✉, Natalie E. Allen, Evelien Nackaerts, Serene S. Paul, Alice Nieuwboer & Moran Gilat

Nature Reviews Neurology **16**, 409–425 (2020) | Cite this article

2421 Accesses | **21** Citations | **28** Altmetric | Metrics

WHAT'S BEEN DONE SO FAR: BIOMETRIC DATA

- Eye trackers are now available in consumer grade head-mounted displays (i.e., Vive Pro).

- Provide information about preferential gaze fixation.

- We tend to focus on objects and people that are most meaningful to us.

An Eye Fixation Database for Saliency Detection in Images

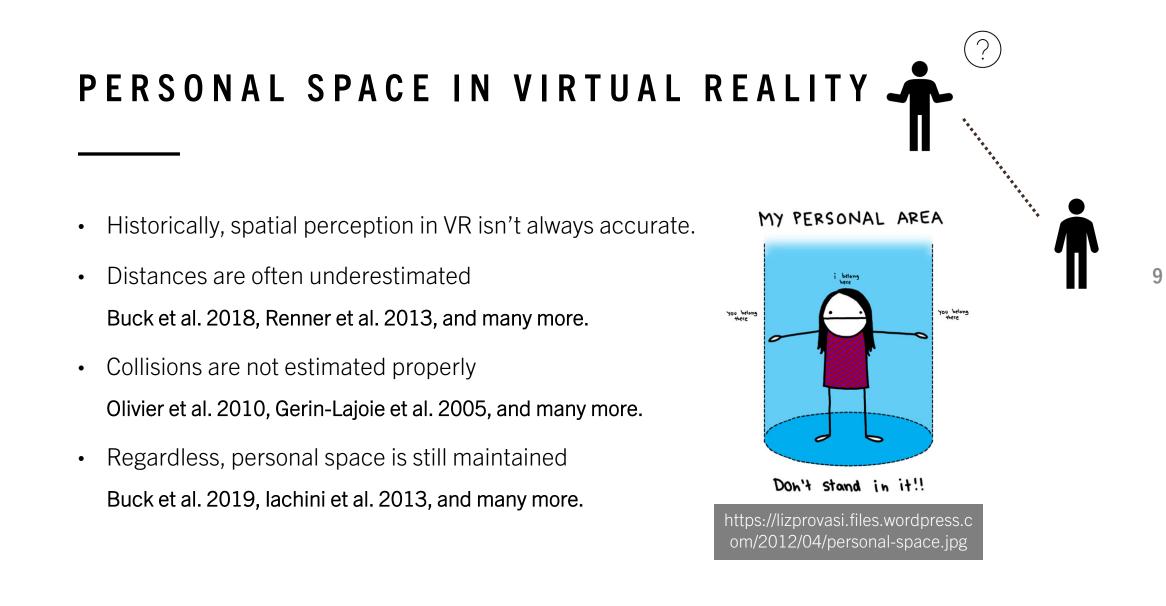Subramanian Ramanathan[1], Harish Katti[2], Nicu Sebe[1], Mohan Kankanhalli[2], and Tat-Seng Chua[2]

[1] Department of Information Engineering and Computer Science, University of Trento, Italy
[2] School of Computing, National University of Singapore (NUS), Singapore
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The Security-Utility Trade-off for Iris Authentication and Eye Animation for Social Virtual Avatars

Brendan John, *Student Member, IEEE*, Sophie Jörg, Sanjeev Koppal, *Senior Member, IEEE*, and Eakta Jain

MY WORK: UNDERSTANDING PERSONAL SPACE

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PERSONAL SPACE IN VIRTUAL REALITY

- Historically, spatial perception in VR isn't always accurate.

- Distances are often underestimated

  Buck et al. 2018, Renner et al. 2013, and many more.

- Collisions are not estimated properly

  Olivier et al. 2010, Gerin-Lajoie et al. 2005, and many more.

- Regardless, personal space is still maintained

  Buck et al. 2019, Iachini et al. 2013, and many more.

MY PERSONAL AREA

i belong here

you belong there   you belong there

Don't stand in it!!

https://lizprovasi.files.wordpress.com/2012/04/personal-space.jpg

PERSONAL SPACE IN VIRTUAL REALITY

- Virtual interaction ≠ real interaction

  - Distributed environments

    Users are not located in the same tracking space

  - Virtual avatar appearance

    Disproportionate body dimensions

    Different gender than user

    Different appearance than user

  - (Sometimes) no collisions

    Users can pass through one another, objects

- Purpose: applications that require realism

  Medicine, Defense, Education, Entertainment, etc.

https://cdn.redshift.autodesk.com/2017/06/virtual-reality-in-architecture-header_kss.jpg

https://i0.wp.com/www.vrfitnessinsider.com/wp-content/uploads/2017/06/healthcare-vr.jpg?fit=2508%2C1672&ssl=1
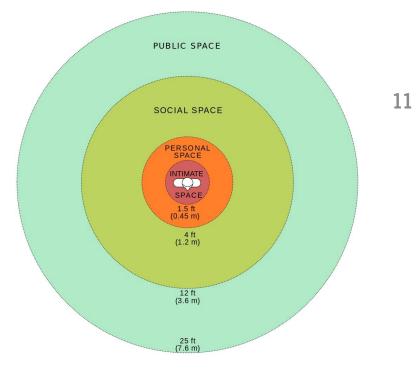
PERSONAL SPACE IN VIRTUAL REALITY

- Peripersonal Space (neuroscience)

  The functional reaching and grasping distance encoded by the brain.

- Interpersonal Space (cognitive psychology)

  The space that individuals maintain between one another.

- Both components are sensitive to contextual information.

  Coello and Cartaud 2021

PERSONAL SPACE IN VIRTUAL REALITY

Responses to *external changes*

- Responses to objects

  Dissimilar to real world responses.

- Responses to agents

  Similar to real world responses

Responses to *self (bodily) changes*

- Responses when changing Embodiment

  Peripersonal and interpersonal space affected.

- Responses when Manipulating Body Dimension

  Peripersonal and interpersonal space not affected.

Determining Peripersonal Space Boundaries and Their Plasticity in Relation to Object and Agent Characteristics in an Immersive Virtual Environment

Lauren E. Buck [*]
Vanderbilt University, USA

Sohee Park [†]
Vanderbilt University, USA

Bobby Bodenheimer[‡]
Vanderbilt University, USA

The Impact of Embodiment and Avatar Fit on Personal Space in Immersive Virtual Environments
Lauren E. Buck, Soumyajit Chakraborty, and Bobby Bodenheimer
In Press, Transactions on Visualization and Computer Graphics

PERSONAL SPACE IN VIRTUAL REALITY

- How do schizophrenia patients treat personal space?

  Self-other boundary is disturbed.

- Schizophrenic patients do not mediate personal space the same way as healthy patients.

Altered Peripersonal Space and the Bodily Self in Schizophrenia: A Virtual Reality Study

Hyeon-Seung Lee, Seok-Jin J Hong, Tatiana Baxter, Jason Scott, Sunil Shenoy, Lauren Buck, Bobby Bodenheimer, Sohee Park ✉

Schizophrenia Bulletin, Volume 47, Issue 4, July 2021, Pages 927–937,

MY WORK: IMPLICATIONS

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IMPLICATIONS

- Every individual maintains space that they consider intimate space.

  We experience varying degrees of discomfort when it's intruded upon.
  Quesque et al. 2017
  - Cortisol levels increase
  - Electrodermal activity increases
  - Activation of the amygdala increases

- This space is dependent on:

  Culture, race, gender, age, mental state, and many other things.

  Hall 1966

https://img.reality.news/img/52/06/63601432674278/0/vtime-brings-human-interaction-virtual-reality.w1456.jpg

IMPLICATIONS

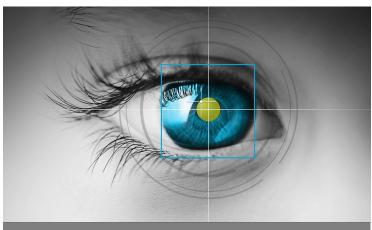https://www.onmsft.com/wp-content/uploads/2015/12/eye-tracking1.jpg

- Biometric data is inescapable.

  Virtual environments are designed to mimic the real world.

- Preferences become clear through interactions.

  Reveals likes and dislikes, affinity and aversions, biases, mental disorders.

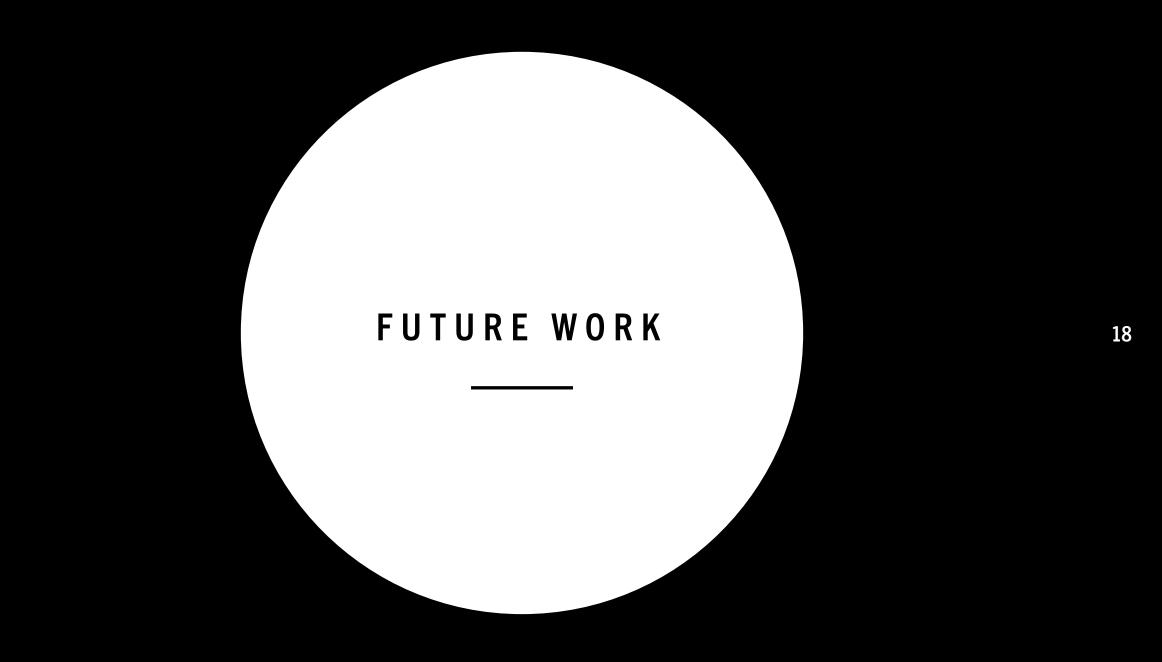- Who gets this data? How will they use it?

IMPLICATIONS

- How do we protect the user?

- Online interaction ≠ real life interaction

  Anonymity encourages destructive behaviors.

  How does this pan out when we move from 2D to 3D?

- Interactions need to stay in line with a user's preferences.

https://roadtovrlive-5ea0.kxcdn.com/wp-content/uploads/2017/04/facebook-spaces-social-vr-app-3.jpg

FUTURE WORK

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FUTURE WORK

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- Understanding human behavior in social situations

  How much are VR users willing to disclose?

  What kinds of decisions will VR users make?

- Gathering physiological data

  Galvanic skin response

  Heart rate

  Breathing rate

THANKS FOR YOUR ATTENTION!

Questions? Comments? Email me or find me on LinkedIn!

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