PETs for *Everyday Augmented Reality*
Understanding Bystanders' Varying Needs for Awareness and Consent
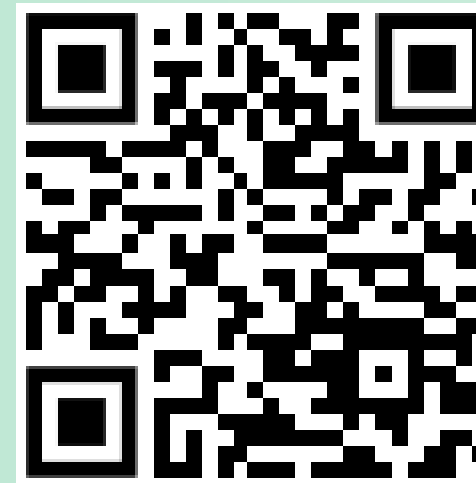
Dr Mark McGill, University of Glasgow
Dr Mohamed Khamis, University of Glasgow
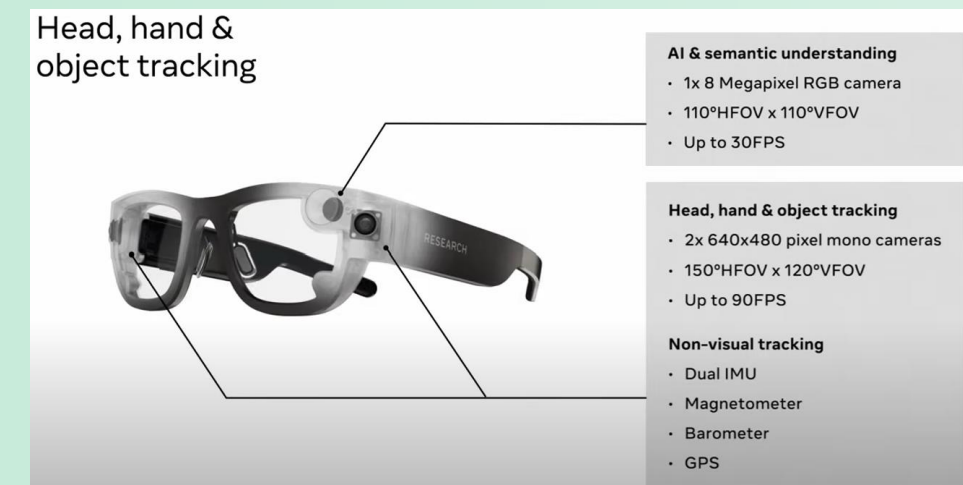Dr Pejman Saeghe, University of Glasgow

University of Glasgow | School of Computing Science

Motivation

- **Augmented Reality** (AR) is moving towards **everyday always-on, wearable, and eventually fashionable** form factors such as glasses

- Such consumer AR devices will eventually become as essential to our everyday lives as smartphones are today, seeing mass adoption and uptake.

- These devices will **expose bystanders to privacy risks**, thanks to the myriad of requisite on-device sensors, and the activities they will enable - such as augmented perception, volumetric capture, and biometric identification.

IMWUT paper

Meta's project Aria glasses

Head, hand & object tracking

AI & semantic understanding
- 1x 8 Megapixel RGB camera
- 110°HFOV x 110°VFOV
- Up to 30FPS

Head, hand & object tracking
- 2x 640x480 pixel mono cameras
- 150°HFOV x 120°VFOV
- Up to 90FPS

Non-visual tracking
- Dual IMU
- Magnetometer
- Barometer
- GPS

YouTube Video

Did you know AR headsets have this capability?

- Camera usage
- Microphone usage
- Activity tracking
- Volumetric capture
- Personal characteristics
- Biometric ID
- Internal state
- Physiological state
- Augmented appearance
- Diminished reality
- Augmented perception

0%   25%   50%   75%   100%

Did not know   Somewhat aware   Aware
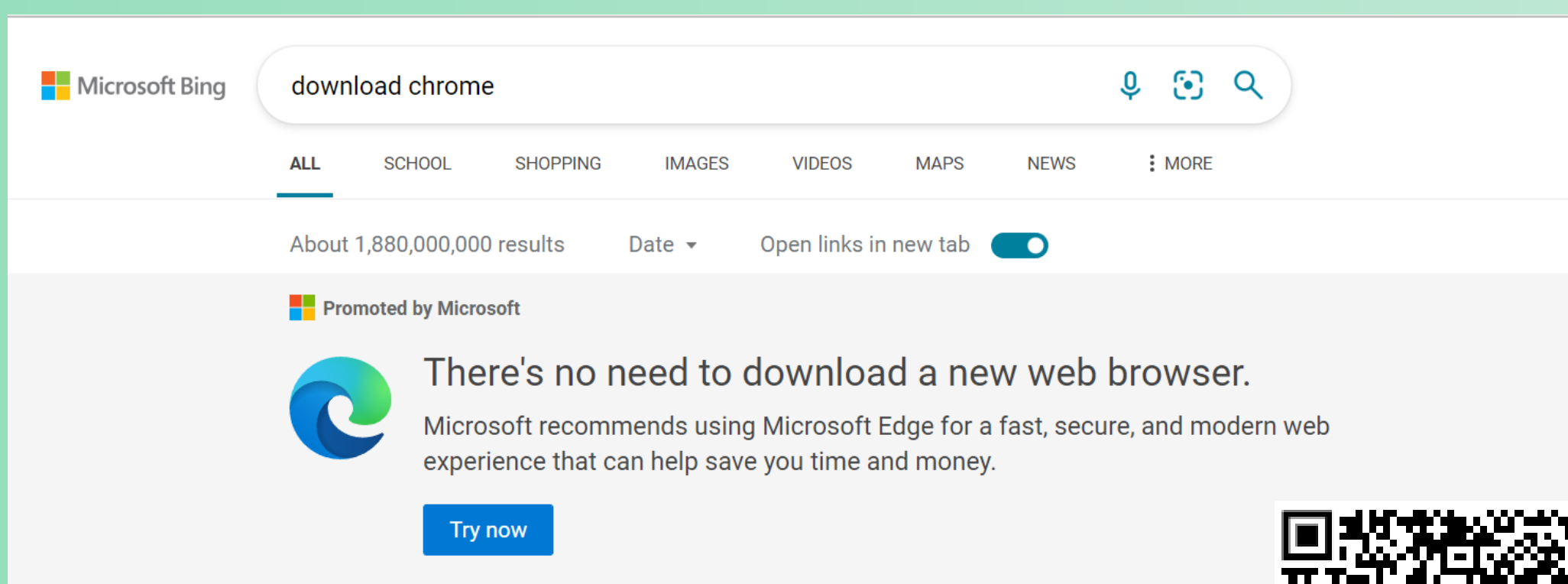
Our recently published paper highlights key findings…

- **Low awareness** regarding AR's ability to unlock insights into our **affective**, **cognitive**, and **psychological states**.

- **Opt-in/out** preference varied significantly, influenced by **activity type** and **relationship to AR user**.

- Attitudes towards **consent shaped by** the **intent** behind the use of the sensing, and extent to which **the sensing seemingly pierced the veil of bystander privacy**.

- **Strong desire for awareness** re the type of activity inc. real-time awareness of what the AR headset is doing.
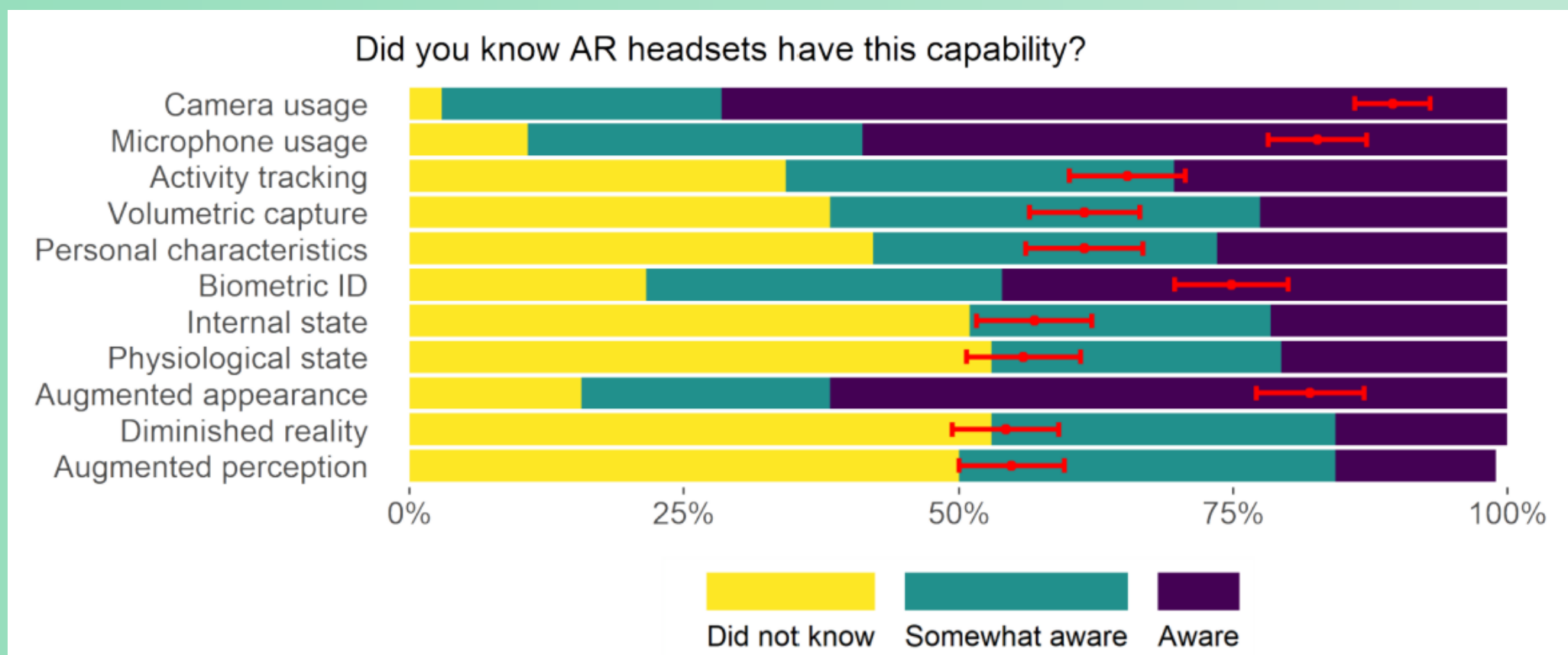
XR Dark Patterns

Motivation:

- **Personal computing is going beyond 2D screens on the web** towards **spatial computing** on augmented and virtual reality (XR) devices (e.g., **the metaverse**).
- **Dark patterns manipulate users to benefit service owners** at the expense of the users.
- XR dark patterns can introduce **significant safety, security, and privacy risks**.
- If not mitigated, dark patterns can **erode users' trust** in the underlying technology.

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Our recent grant from Meta: a toolkit for identification and mitigation of XR dark patterns

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Societal Challenges of XR

Sensing   Social Spaces   Social Identity   Recommendation   Manipulation   Censorship

Mass adoption of Augmented / Mixed / Extended Reality devices will pose new challenges to citizens and society

- Impinging on **privacy**, typically due to captured data via the plethora of embedded sensors and subsequent processing (including artificial intelligence).

- **Manipulation** of users via behavioural modeling and nudges.

- Altering users' **perception** of reality via mis-/dis-/mal-information.

- Posing new tensions around **augmented social expression of identity** and our perception of self and others.

These are some of the challenges our team are now actively looking at….