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TECHNOLOGY

Impact of Human Aspects on Software Engineering (and AI & Cybersecurity engineering…)

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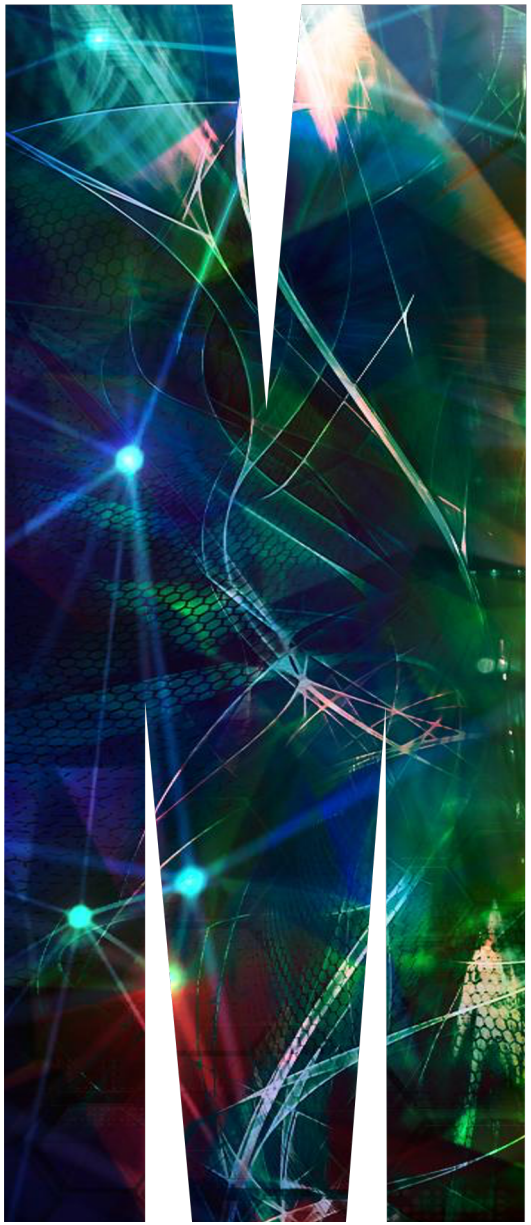
https://www.monash.edu/it/humanise-lab

HUMANISE



Acknowledgement of Country

As we gather for this meeting physically dispersed and virtually constructed let us take a moment to reflect the meaning of place and doing so recognise the various traditional lands on which we do our business today.

We acknowledge the Elders – past, present and emerging of all the land we work and live on and their Ancestral Spirits with gratitude and respect.

I acknowledge the people of the Kulin nations, the traditional owners of the land on which I am meeting with you from today.

Outline

Why human aspects critical to consider during Software Engineering – and AI/Cybersecurty ☺

Examples of developer and end user human aspects and what happens when DON'T adequately consider

Examples of our recent work to improve the situation…

Research Roadmap needed

Summary

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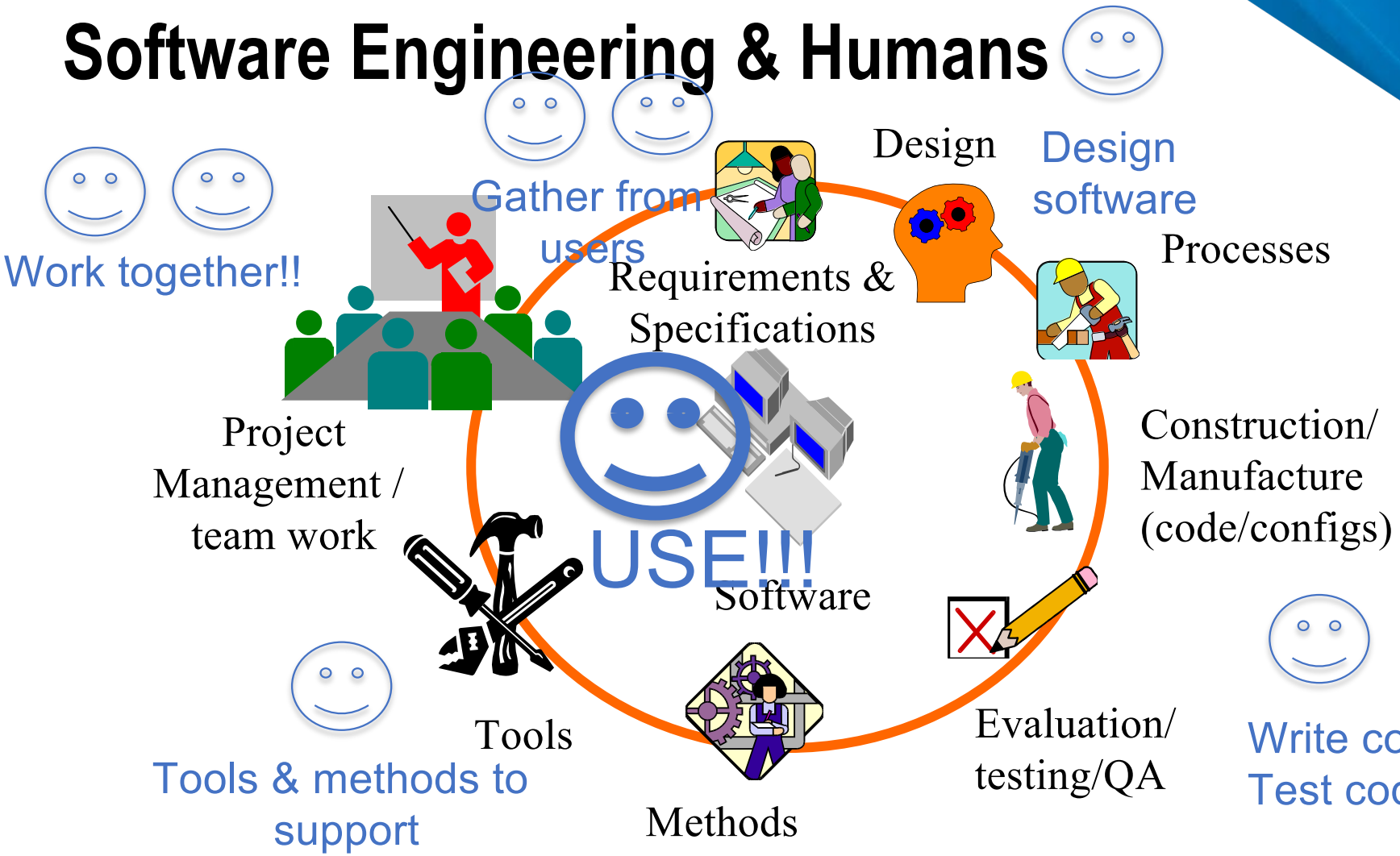
Software Engineering & Humans



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Human aspects & Software Engineering/AI/Cybersecutity

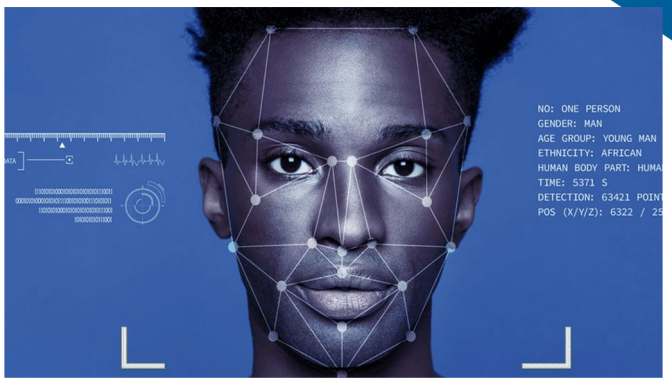
Gender bias – UIs, health apps, reactions to phishing emails

Ethnic bias –don't recognize faces, mis-classify

Culture bias – inappropriate words, phrases, colours, icons, workflow

Language bias – over-technical, wrong dialect, impersonal, confusing, distracting

Age bias – too complex, too simple, inappropriate words, symbols, workflow



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Human aspects & Software Engineering/AI/Cybersecurity

All Can Apply to TEAM and USERS!!!

Physical challenge bias – guesture, sound, sight, voice inappropriate

Cognitive challenge bias – raise anxiety, poor fit to mental model, doesn't support neuro-atypical

Enjoyment bias – boring, unengaging, distracting

Emotional bias – stressful, anxiety-inducing, frightening, confusing, make mistakes

Personality bias – workflow, lack of engagement, disconnected

And… many others :-(

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Need for human aspects …

AI – more trustable, fair, explainable, de-biased, …

AI – more robust with diverse human data

AI – align to human values

Cybersecurity – do diverse humans act differently?

Cybersecurity – do developers understand their software users and context of use sufficiently well?

Cybersecurity – vulnerabilities introduced due to human-centric issues

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Requirements Challenges

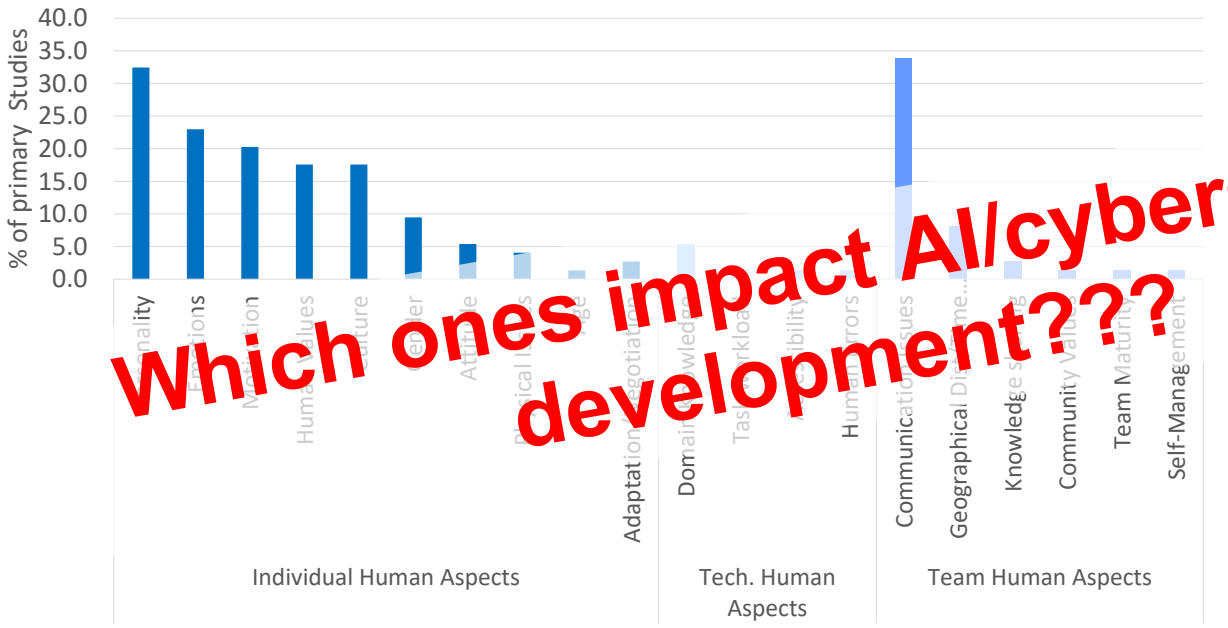
Some of the problems:

- What human aspects impact the RE process for AI/cybersecurity?
- Who are the stakeholders/users we need to take into account?
- How do we elicit/fully consider the human aspects of these stakeholders/users?
- How do we model and reason about their human aspects?

Solutions / research needs:

- Better ways to identify stakeholders, elicit requirements
- New ways to find, extract human aspect-related requirements
  Extend/new domain-specific (visual) languages to model these

RE Process + Human aspects



Which ones impact AI/cybersecurity development???

From 2020 Systematic Literature Review:

-personality, emotions, motivation, human values studied

-communication, geographic location studied

Inconclusive which ones actually impact RE teams & their stakeholders…

Figure 2: Categorization of the human aspects studied [6]

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Example: Multi-lingual Requirements

- Software developed by teams
- Teams may be diverse in many ways: Location, Language, Gender, Culture, Organization…
- Explored one aspect in Malaysian context with multi-lingual teams (also have multi-cultural aspect… and female-dominated teams!!)
- Added multi-lingual support to Essential use case-based requirements tool - MReq
- Used to capture several types of security requirements - MSecReq

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English Essen
Pattern

Essential Interaction

1. Save record
2. Save information
3. Save data

customer for the pickup and returns locations of the reservation, as well as the pickup and return dates and times. The customer indicates the desired locations and dates.
3. The system prompts for the type of vehicle the customer desires. The customer indicates the vehicle type.
4. The system presents all matching vehicles available at the pickup location for the selected date and time. If the customer requests detailed information on a particular vehicle, the system

Update Model

Keperluan (Malay)

1) Use Case bermula apabila pengguna menyatakan hasrat utk membuat tempahan untuk menyewa kereta.
2) Sistem bertanyakan tempat untuk mengambil dan menghantar tempahan besertakan tarikh dan masa untuk mengambil tempahan. Pengguna menyatakan tempat dan tarikh yang dikehendaki.
3) Sistem bertanyakan jenis kenderaan yang dikehendaki oleh pengguna. Pengguna menyatakan jenis kenderaan yang dikehendaki

1. choose
2. offer choice
3. provides information (memberi maklumat)
3. view detail
4. request identification
4. view detail (memaparkan maklumat)

1. membuat pilihan
2. memberi pilihan
3. memberi maklumat
4. memaparkan maklumat (view detail)
4. memaparkan maklumat
4. meminta pengesahan (request identification)

User Interaction
System Responsibility

A
2. offer choice
1
3. provides information (memberi maklumat)
3. view detail
4. request identification
4. view detail (memaparkan maklumat)
3
5. identify self
5. request identification (meminta pengesahan)
2
6. confirm booking

Impact culture, language on AI/cybersecurity development???

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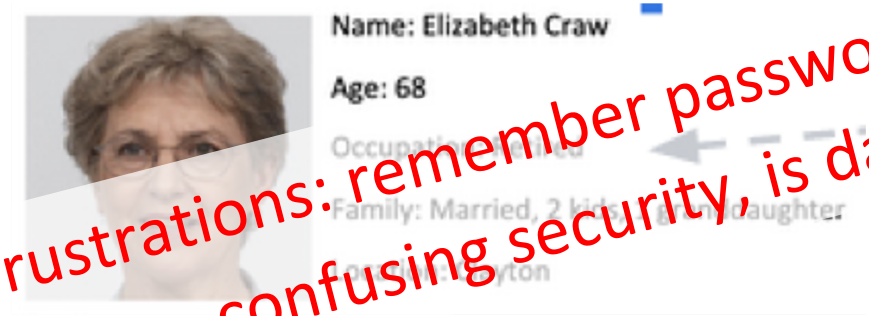
Using personas to improve Requirements Engineering

- Software engineers do not understand many critical human aspects
- Example: “Smart” parking app



Need: To quickly find a parking spot at peak hours

Human aspect: Suffers from (red) colour blindness

Issue: App uses the red colour to identify available parking spots

Frustrations: remember password, add banking info, confusing security, is data private???

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Design Challenges

Problems:

- Do developers understand diverse human aspects?
- How do we translate human aspects of requirements to designs?
- How do we know these models are complete, correct, effective?
- How do we improve designs to address wide range of human aspects?
- How do we support developers to do this more effectively?

Solutions / research needed:

- Extend design models with human aspects
- “Design critic”-style analysis of requirements and design models
- Better leverage augmented design models, personas during SE
- Provide developers with guidelines, processes, tools to better address end user human aspects in design (and implementation)

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Impact of diverse human aspects on response to phishing emails

Conducted experiment to see if demographics/personality/online security behaviour could predict susceptibility to Phishing emails

- 68 uni students ; 27 male/41 female ; 19 < 25 ; 34 26-35 ; 15 > 35
- Personality test via five factor model questionnaire
- Online security behaviour questionnaire

Difference in male/female security behaviours; males trust a lot more

Extroverts, open to experience update passwords/details more

Conscientious more aware of threats, more careful

Training, proactive awareness, neuroticism +ve correlate to phishing susceptibility ; extrovert, open, male –ve correlate…

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Implementation Challenges

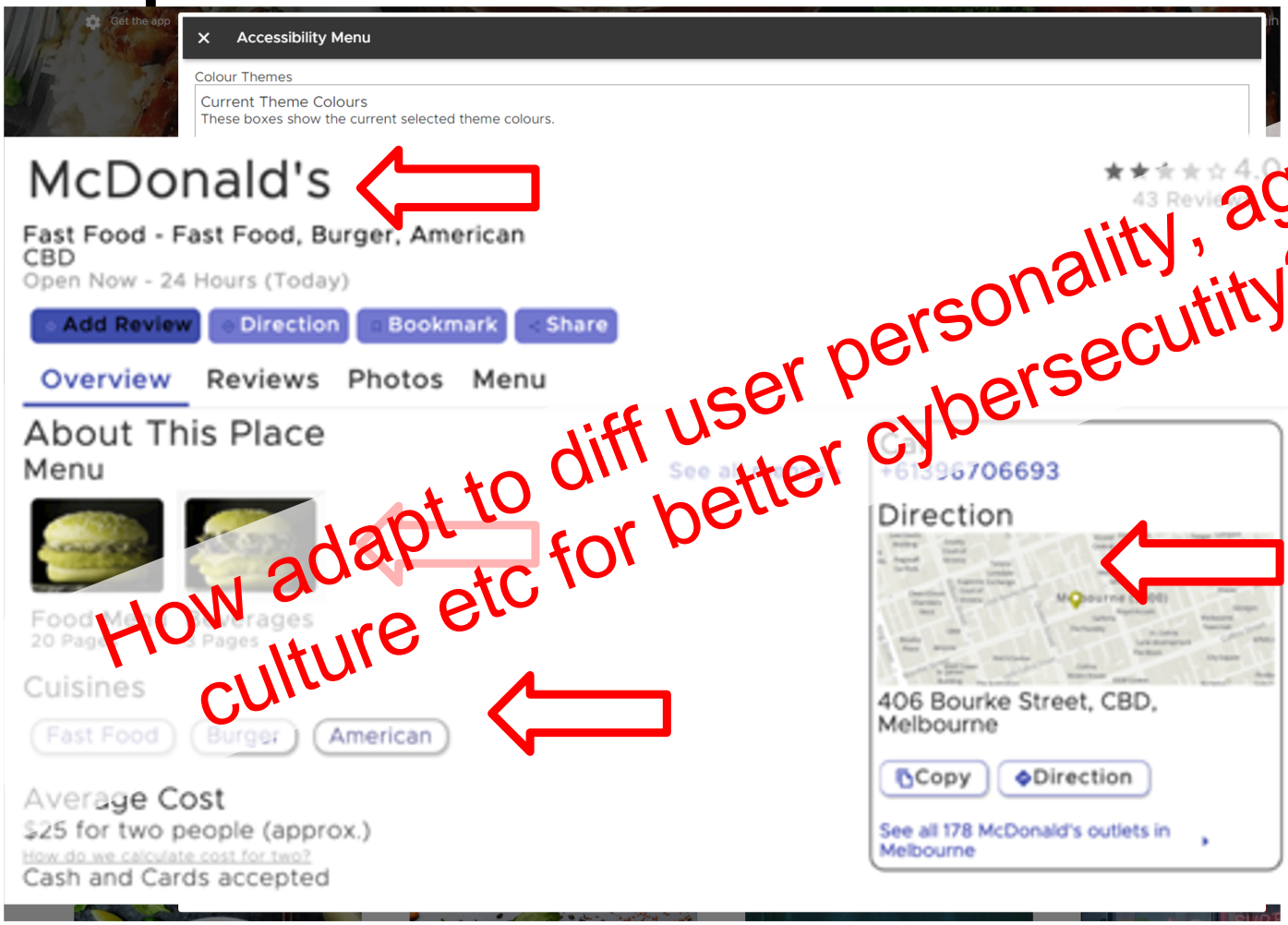
Problems:

- How do we realise different designs for end user human aspects?
- Do we have multiple versions of app vs highly adaptable app or both?
- Can end users change their own apps to better suit them?

Solutions / research directions:

- End user development tools to support end users to build, reconfigure software
- Adaptive user interfaces and associated architectures
- End users specify their preferences for software to incorporate

Adaptive User Interfaces



How adapt to diff user personality, age, culture etc for better cybersecutity?

Example on left of configuring web site for colour blindness, sight challenges, dyslexia, etc

Also done for hearing, motor control issues

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Evaluation Challenges

Problems:

- Personality of Software Testers vs Performance
- How do end users report human aspect-related defects in software?
- How do we present these human-centric defects to developers to help them understand, appreciate, and suitably fix the defects
- Can we leverage large datasets of user reviews to diagnose and fix human aspect defects in apps?

Solutions / research directions:

- Develop more human-centric defect reporting - better capture defects AND better support diverse end users reporting them
- Human values-based evaluation of app reviews to identify major problems

Tester personality vs others

200 Testers & Developers, 50 question Five Factor personality test…

	Agreeableness	Conscientiousness	Extraversion	Neuriticism	Openness
Testers - High	59.76	60.98	23.17	4.88	52.44
Non testers - High	53	43	21	9	46
Testers - Medium	39.02	36.59	64.63	57.32	47.56
Non testers - Medium	47	57	69	57	54
Testers - Low	1.22	2.44	12.2	37.8	0
Non testers - Low	0	0	10	34	0

Impact on implementing, tesing AI? Cybersecurity??

Testers are from Mars, Developers from Venus…?

Sig diff in Agreeableness (Medium), Conscientiousness (High, Medium)

We expected Neuroticism to be more pronounced, but no sig diff…

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Key things we need to work on

- lack of a **taxonomy** of human aspects including keywords, phrases and examples – how do we talk about them??
- lack of **diversity** in software, AI, cybersecurity teams
- lack of studies focusing on how ***software engineers*** and **software engineering teams** influence and address end user human aspects in software / AI / cybersecurity solutions
- lack of tools to identify challenging human aspects to address during development
- a range of design and evaluation guidelines and tools but lack of connectivity, consistency, and applicability of these tools in many domains e.g. for mobile app development, cybersecurity

Key things we need to work on

- overly-complex, inaccessible and incomplete design and implementation guidelines to address many challenging end user human aspects
- Lack of understanding of how dev teams are impacted by their own human aspects and their end user human aspects
- difficulty in end users reporting human aspect defects in software; difficulty in software engineers understanding these defects
- development processes that still don't sufficiently include diverse stakeholder perspectives
- deficiencies in the education of software engineers regarding human aspects of their end users and their team mates

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Summary

Stakeholders and end users of software are very diverse

Software developers often quite different to their stakeholders

We currently don't have good ways to incorporate end user human diversity into software, AI & cybersecurity engineering

Software engineers themselves are humans (yes, true!! ☺) with many diverse human aspects that impact DOING software engineering and WORKING with stakeholders (and each other)...

Need ways to fully engage, include end users/stakeholders

Need ways to better capture, model, reason about, design and implement for, adapt, evaluate, receive feedback on and improve software

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