BAH Dataset for Ambivalence/Hesitancy Recognition in Videos for Digital Behaviour Change

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Outline

- Context
- *BAH* dataset:
  - Collection
  - Annotation
  - Statistics
  - License
  - Access
  - Benchmarks / Challenges
  - Competitions

Context: Behaviour change and online interventions

Health-related behaviour change refers to processes that support individuals in adopting and maintaining healthy behaviours to:

- Prevent the development or worsening of chronic diseases
- Reduce early mortality
- Improve mental and physical health and well-being

During **in-person interventions**, therapists/clinicians are able to identify when individuals are **ambivalent and hesitant** towards changing a behaviour, and are able to help them overcome it.

https://www.bozemancounseling.org/blog/2024/3/24/exploring-therapy-a-guide-to-different-types-of-mental-health-therapists

Context: Behaviour change and online interventions

Ambivalence and hesitancy:

- **Ambivalence:** The **simultaneous** presence of **competing positive and negative** feelings, ideas, thoughts or emotions towards one same object or goal (attitude)
- **Hesitancy: Simultaneous** feeling of being **resistant and willing** to do something (intention)
- Conflicting/subtle affect

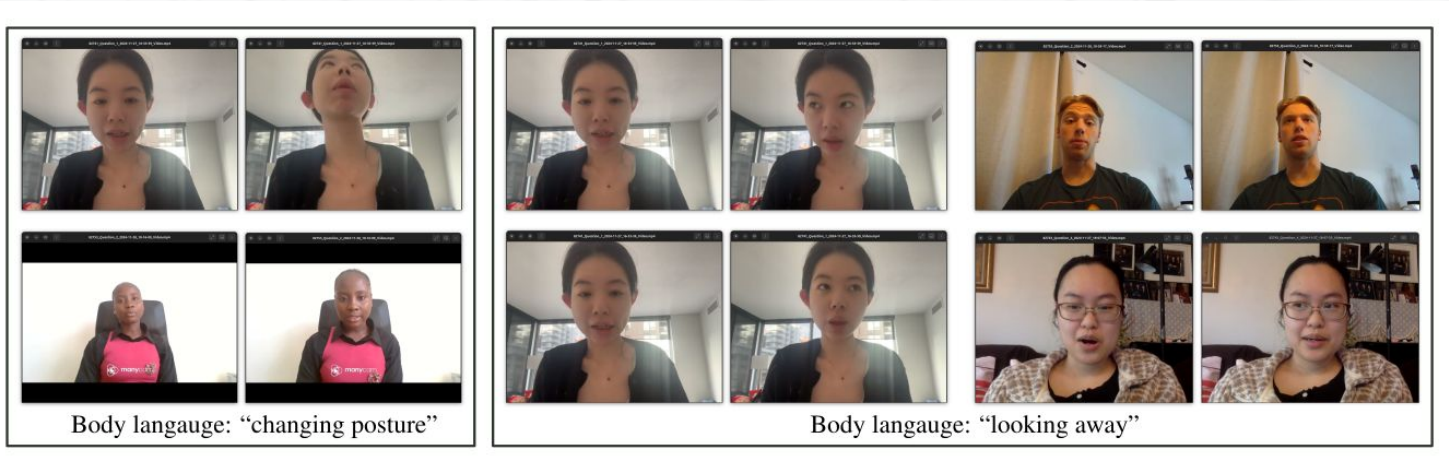
Context: Behaviour change and online interventions

Online interventions:

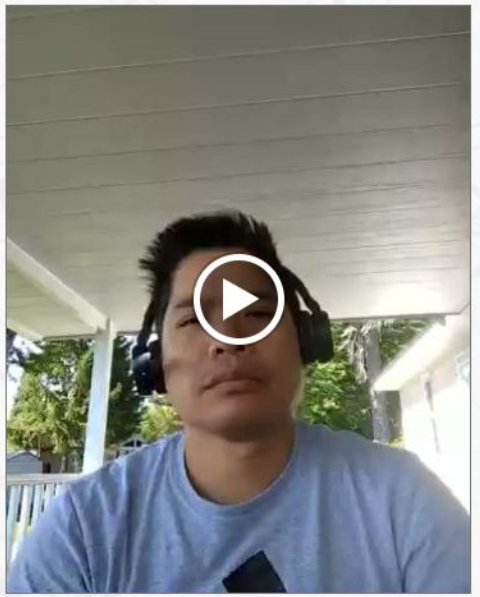
- Personalised digital health (eHealth) interventions
- Easily scalable / cheap
- Fully automatic
- Requires an automatic system to recognise ambivalence/hesitancy moments to act accordingly

No available A/H datasets.

BAH Dataset



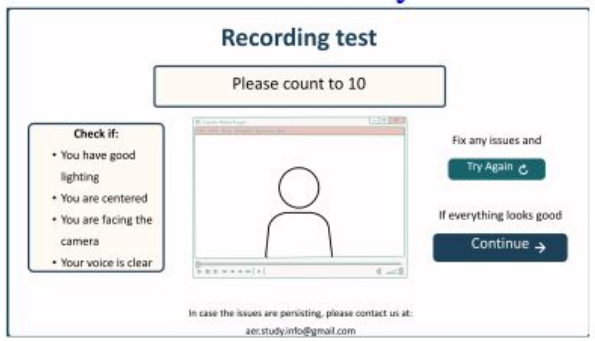
- ***BAH***: ***B***ehavioural ***A***mbivalence/***H***esitancy (A/H) dataset
- Task: A/H recognition in videos
- 300 participants in Canada
- Online videos: answers to 7 predefined questions
- 1,427 videos (~10.6 hours where ~1.8 hours contain A/H)
- 916,618 frames
- Annotation: video/frame level, cues, inconsistencies



Video example of BAH

BAH Dataset: Collection

1 Our online platform for data collection
www.aerstudy.ca



Participant

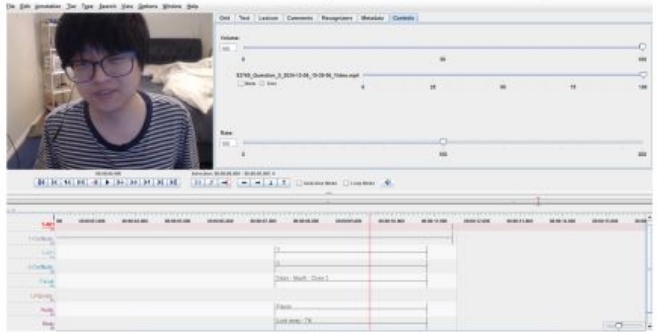
Task: answer the designed questions while recording themselves via webcam

2 Data transfer by Administrator

Secured access

Our local secured storage server for videos

3 Video annotation for A/H at multiple levels: video-, frame-level, cues



Our behavioural expert annotator

BAH Dataset: Collection

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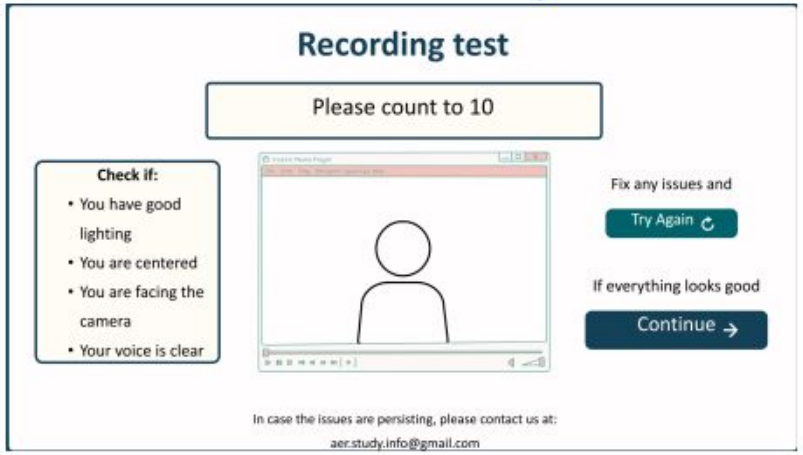
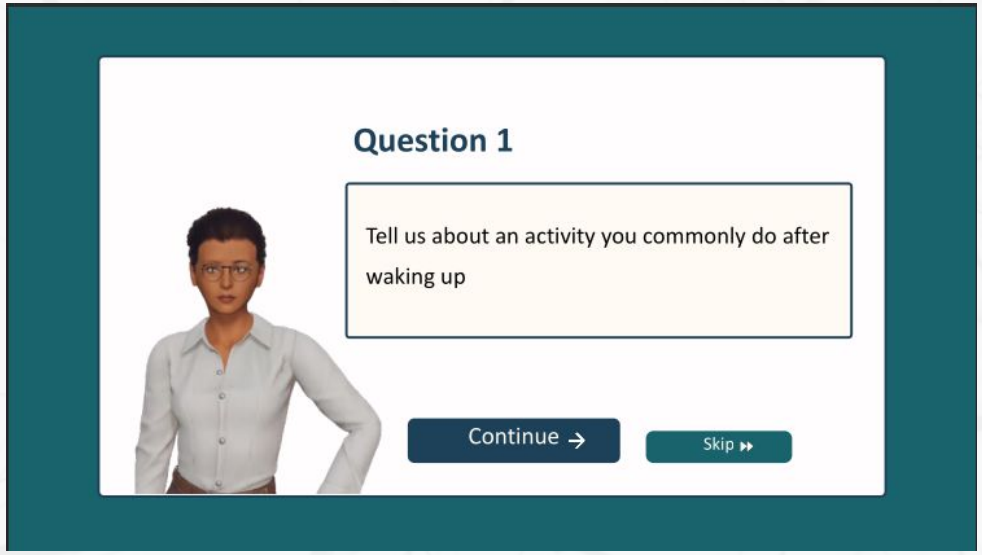


Participant 

Task: answer the designed questions while recording themselves via webcam

BAH Dataset: Collection



1 Our online platform for data collection

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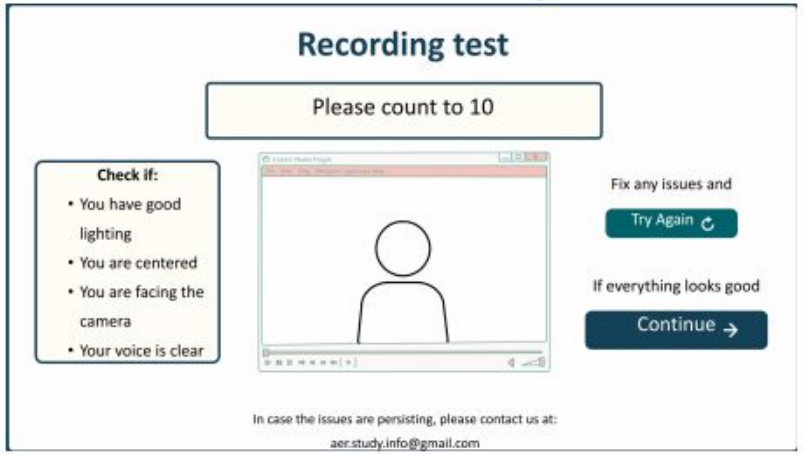


Participant

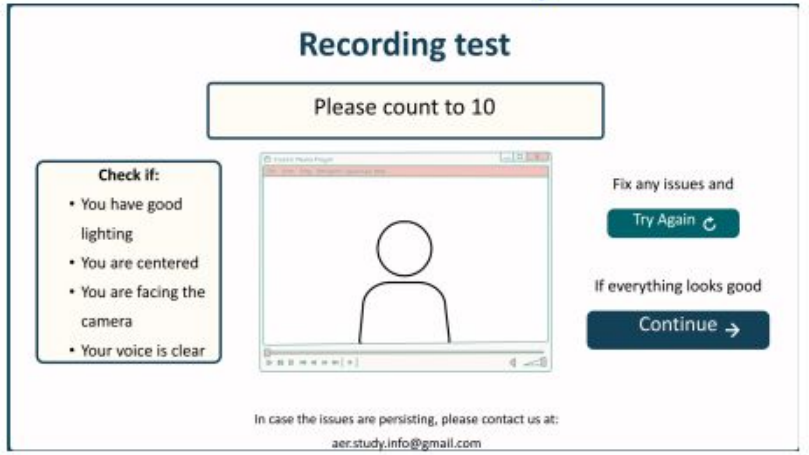
Task: answer the designed questions while recording themselves via webcam

BAH Dataset: Collection

Question no.	Response	Prompt
1	Neutral	Tell us about an activity you commonly do after waking up.
2	Positive	Talk about an activity that brings you joy, for example, a hobby. Tell us why.
3	Negative	Talk about an activity you dislike doing, for example, a chore or something you find boring or annoying. Tell us why.
4	Ambivalent	Tell us about something you enjoy doing but wish you stopped doing (like a guilty pleasure) or something you don't do but wish you did.
5	Willing	Tell us about an activity you are almost always willing to do, for example with friends, at work, at home.
6	Resistant	Tell us about something people around you do, but that you would not be willing to do, for example, with friends, at work, at home.
7	Hesitant	Tell us about something you could have done already but haven't done yet, for example, something you are procrastinating or haven't made up your mind about.

1 Our online platform for data collection

www.aerstudy.ca

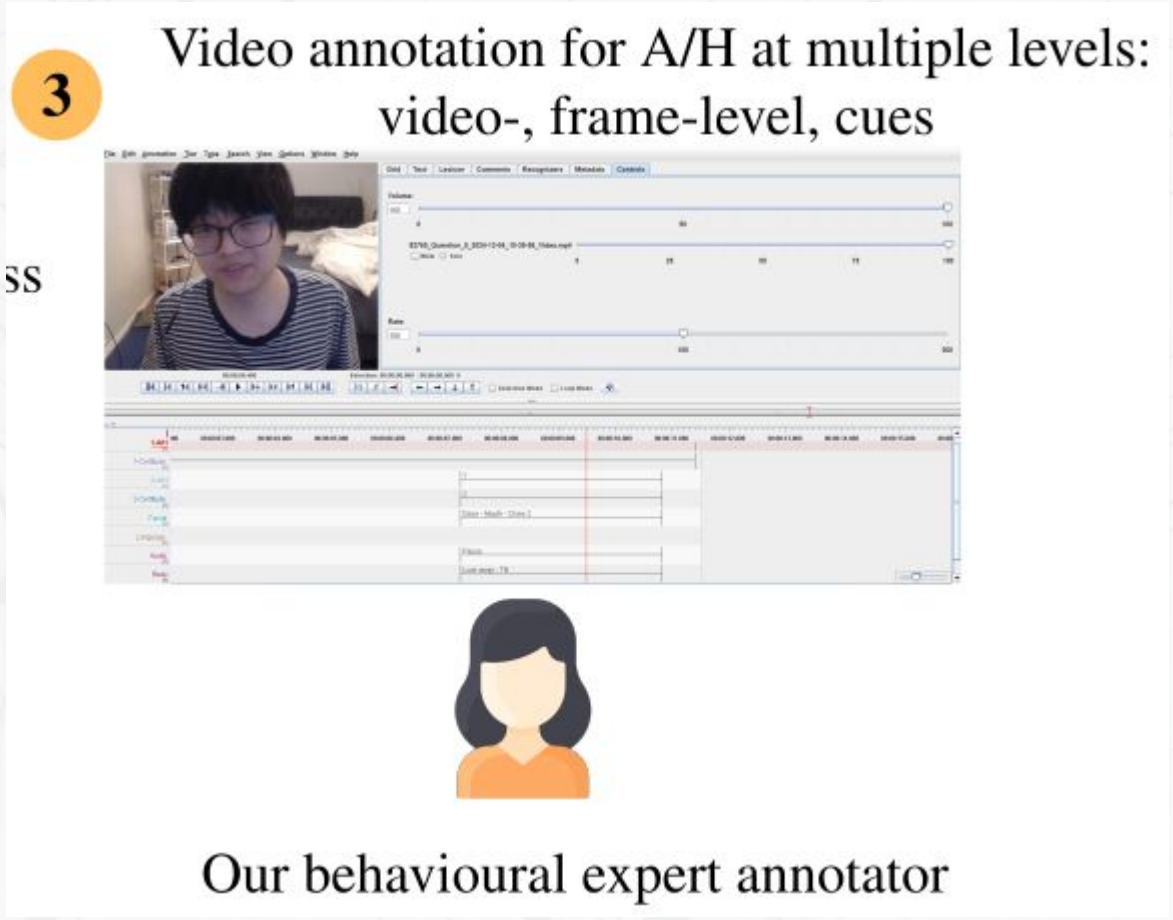


Participant

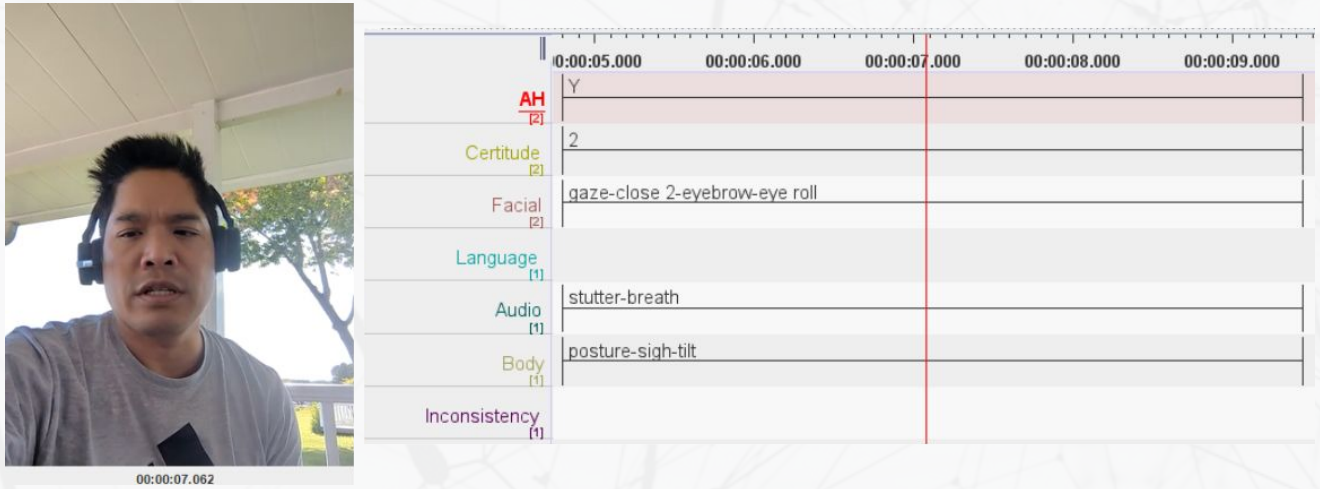
Task: answer the designed questions while recording themselves via webcam

BAH Dataset: Annotation

- 3 behavioural expert annotators
- Use of codebooks: annotation, cues (face, body, audio, language), cross-modality inconsistencies
- Annotation: indicate the presence/absence of A/H
- Levels: videos/frames, timestamps: start/end A/H
- Additional information: annotation cues, inconsistencies



BAH Dataset: Annotation



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Video annotation for A/H at multiple levels: video-, frame-level, cues

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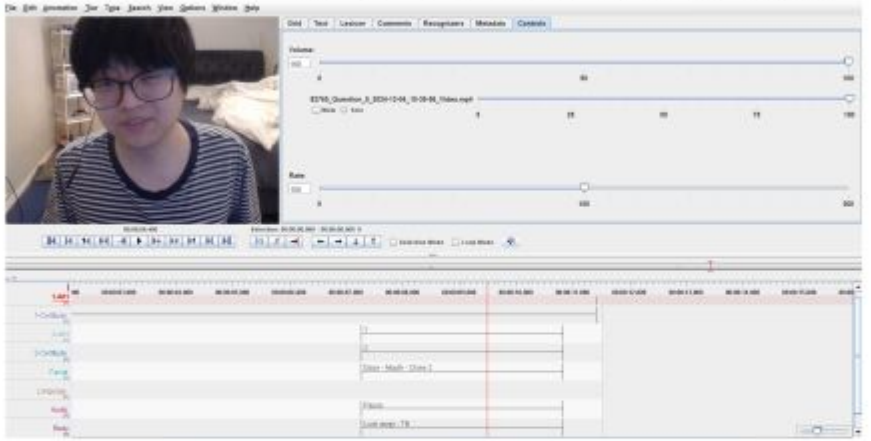
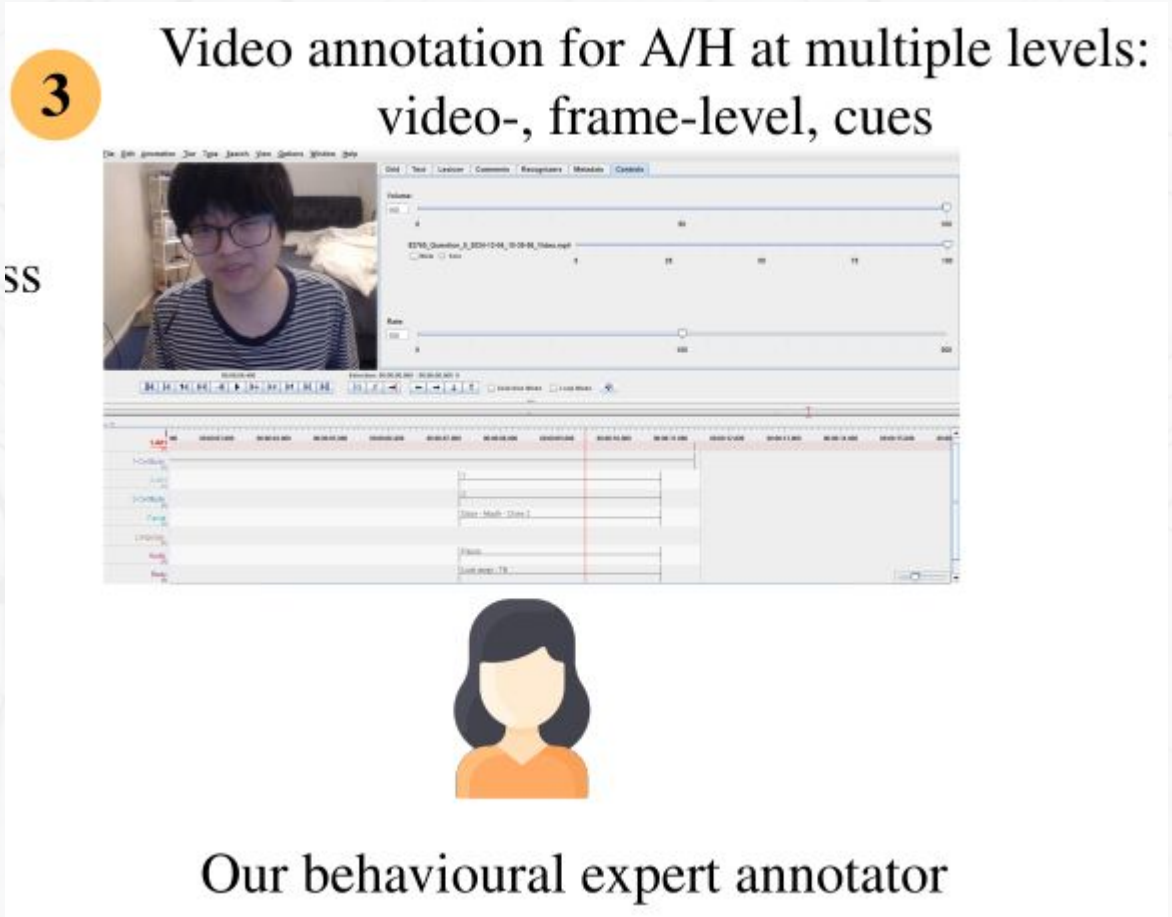


Our behavioural expert annotator

BAH Dataset: Annotation

Annotation levels	Description	Annotated variables				
		Presence of AH	Level of certitude	Time stamps	Modality used	Cues
Level 1	Global annotation	Yes	Yes	No	No	No
Level 2	Frame level	Yes	Yes	Yes	No	No
Level 3	Modality focused	Yes	Yes	Yes	Yes	No
Level 4	Cue focused	Yes	Yes	Yes	Yes	Yes



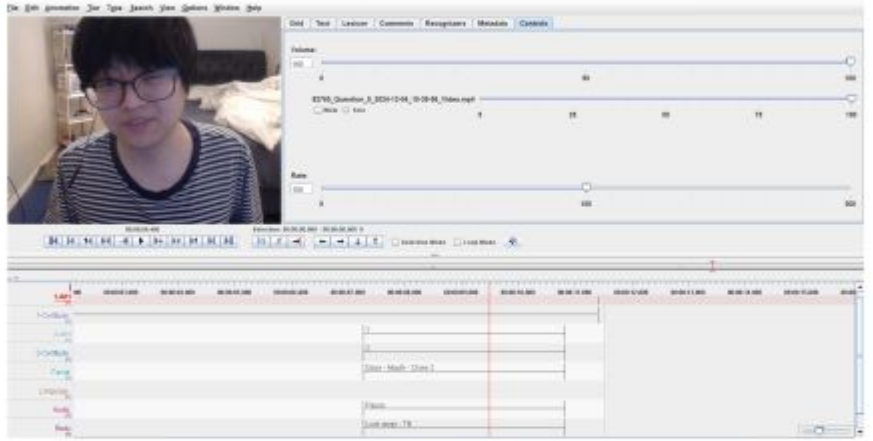
BAH Dataset: Annotation

Term	Definition
Ambivalence/Hesitancy	The simultaneous presence of competing positive and negative feelings, ideas, thoughts, or emotions towards one same object or goal. A state in which a person has not entirely made up their mind about doing something; when they aren't fully decided on how to act (towards a behaviour or object; not necessarily the goal behaviour; excluding towards language or answering questions)
Facial Cues	Different motions of the muscles in the face. Facial expressions commonly occur around the mouth and eyes, including changes in a person's gaze. They can be used to assess a person's emotional state.
Language Cues	Includes verbal/speech-based expressions of ambivalence or hesitancy. Some common verbal expressions can include the use of 'I want to... but...', 'mmmm', among others.
Audio Cues	Changes in a person's non-verbal language, such as changes in tone, speed and pitch.
Body Cues	Non-verbal signals that include gestures, body posture and movements. Some of the cues that can be annotated as body language are hand movements, head tilts, shoulders shrugging and sighs (chest movement).
Cross-modal inconsistency Cues	Simultaneous incompatibility between two or more modalities or different types of cues. For example, this could be represented by someone saying 'yes' while shaking their head side to side.

Table 8 BAH dataset annotation codebook: definitions.

3

Video annotation for A/H at multiple levels: video-, frame-level, cues

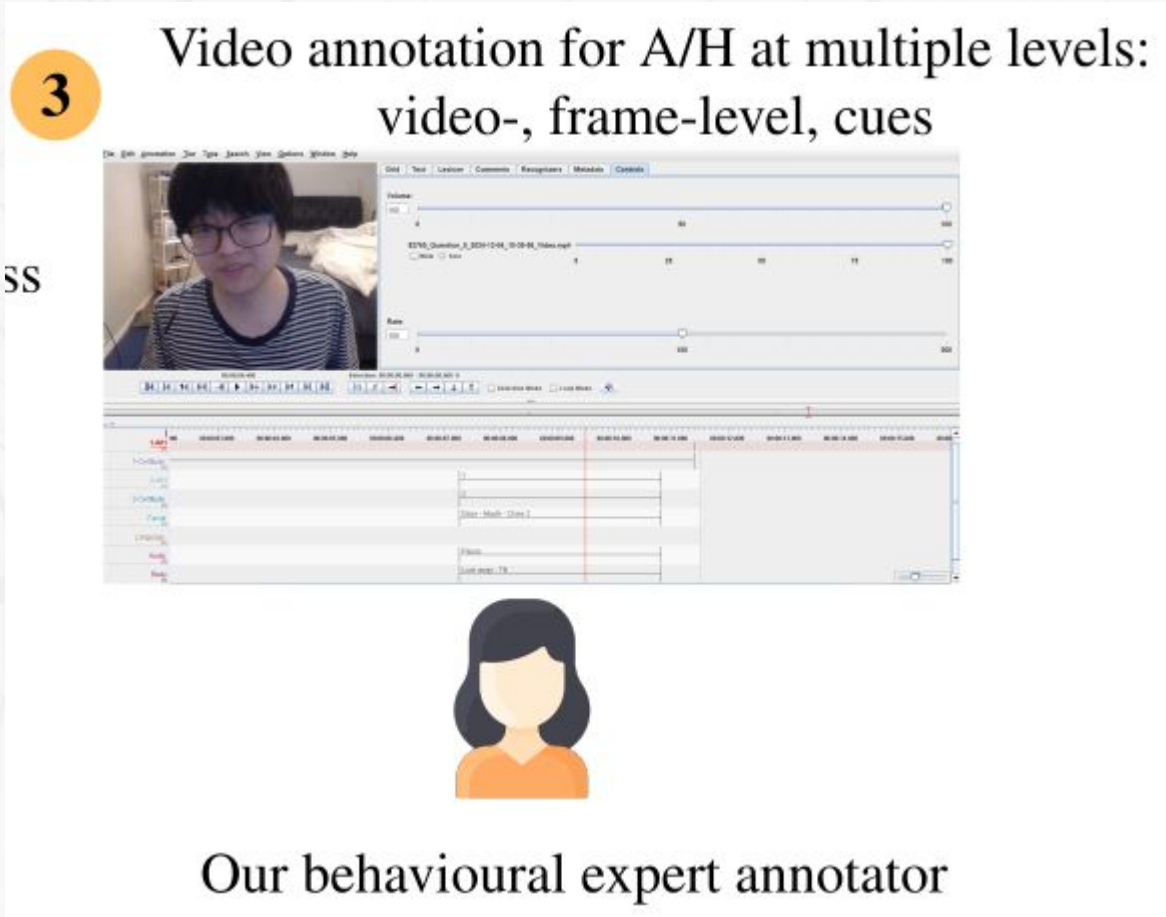


Our behavioural expert annotator

BAH Dataset: Annotation

Body cues	Definition
Look away	Moving the orientation of the head away from the baseline position such that eyes or the gaze will look away. Includes the head facing down, head facing up, looking down, looking up, looking from side to side, lowering head, raising head.
Shake	Turning the head from side to side, it can be done with repetitive head movements or with a slight turn of the head to one or both sides. Includes shaking head "no". Rotation is on the horizontal plane
Tilt	Angling the head to the side without focusing on something else, and holding the position. Changing the position of the head so it is in a sloping position. It can be accompanied by changes in the gaze but not necessarily. Includes head tilting up and down, tilting head to the side, tilted head. Includes bobbling head.
Throw	Throwing the head in a rapid movement in a particular direction.
Sigh	Movements of the chest, shoulder or head that accompany a sigh or a deep breath. It includes long sigh, deep breath, sigh, big sigh. Noticeable bringing the chest or diaphragm muscles up and down. Change determined in comparison to the person's own baseline.
Nod	Moving the head up and down. Lowering and raising the head, it can be done by slight or clearly marked movements. Includes movements such as back and forward or a single small nod.
Shrug	Raising of the shoulders, it can be a momentary or slight rise or a longer movement where one or both shoulders is raised. It includes shrugging shoulders, shrugs
Hands	Movements or placement of the hands that differs from baseline
Posture	Movements in the overall positioning of the spine, body or arms (independent from the head). The changes are determined by each person's baseline. It includes movements like readjusting in the seat, sloughing, turning to the sides. Needs to involve more than just the head. Excludes shrugging.
Scratch	Movements in the hands and arms to scratch or caress another part of the body or face. It includes scratching head, scratching neck, scratching eyes, scratching chin
Restless	Rhythmic and repeated movements. Can be swaying, shaking, being jittery.

Table 12 BAH dataset annotation codebook: body cues.



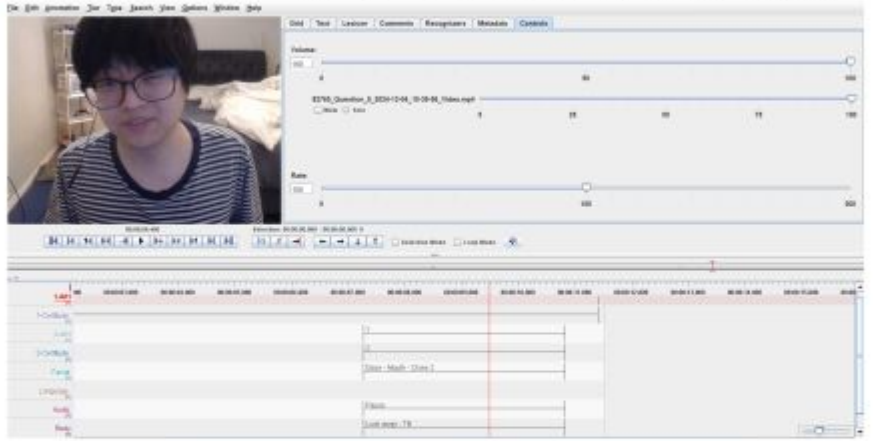
BAH Dataset: Annotation

Cross-modal inconsistency	Definition
FL	Face and language/speech do not match. E.g., looking uncomfortable while saying yes, looking annoyed or uncomfortable while saying they are happy, smiling while saying they are worried.
FA	Face and audio do not match. E.g., speaks in a sad, energetic tone while smiling.
FB	Face and body do not match. E.g., Nodding while looking afraid or concerned, showing disgust but leaning forward
LA	Language/speech and audio do not match. E.g., speaks in a sad, energetic tone while saying they are happy.
LB	Language/speech and body do not match. E.g., seems like they are about to say something but do not, nod is discrepant with verbal speech, shaking head while saying yes
AB	Body and language/speech do not match. E.g., unengaged tone while nodding (in agreement)

Table 13 BAH dataset annotation codebook: cross-modal inconsistency cues - occurring simultaneously.

3

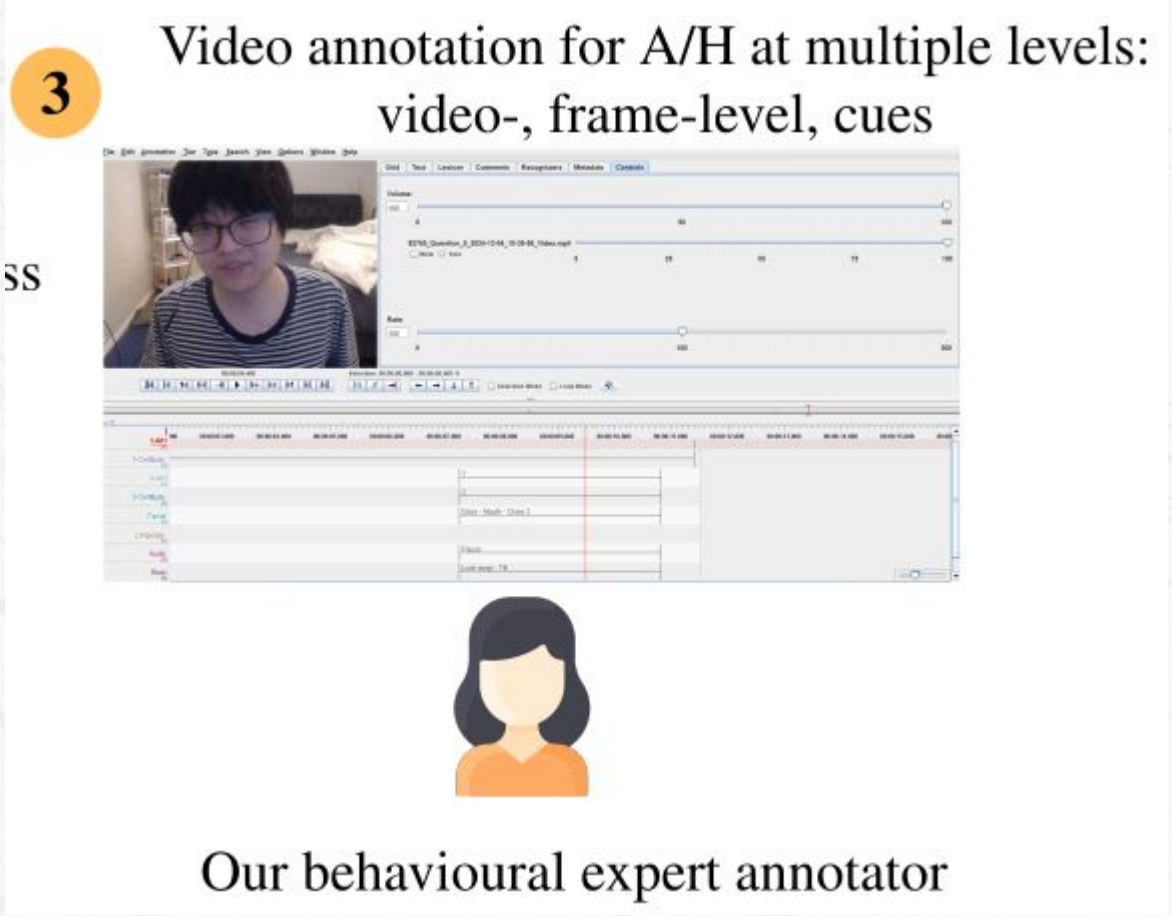
Video annotation for A/H at multiple levels: video-, frame-level, cues



Our behavioural expert annotator

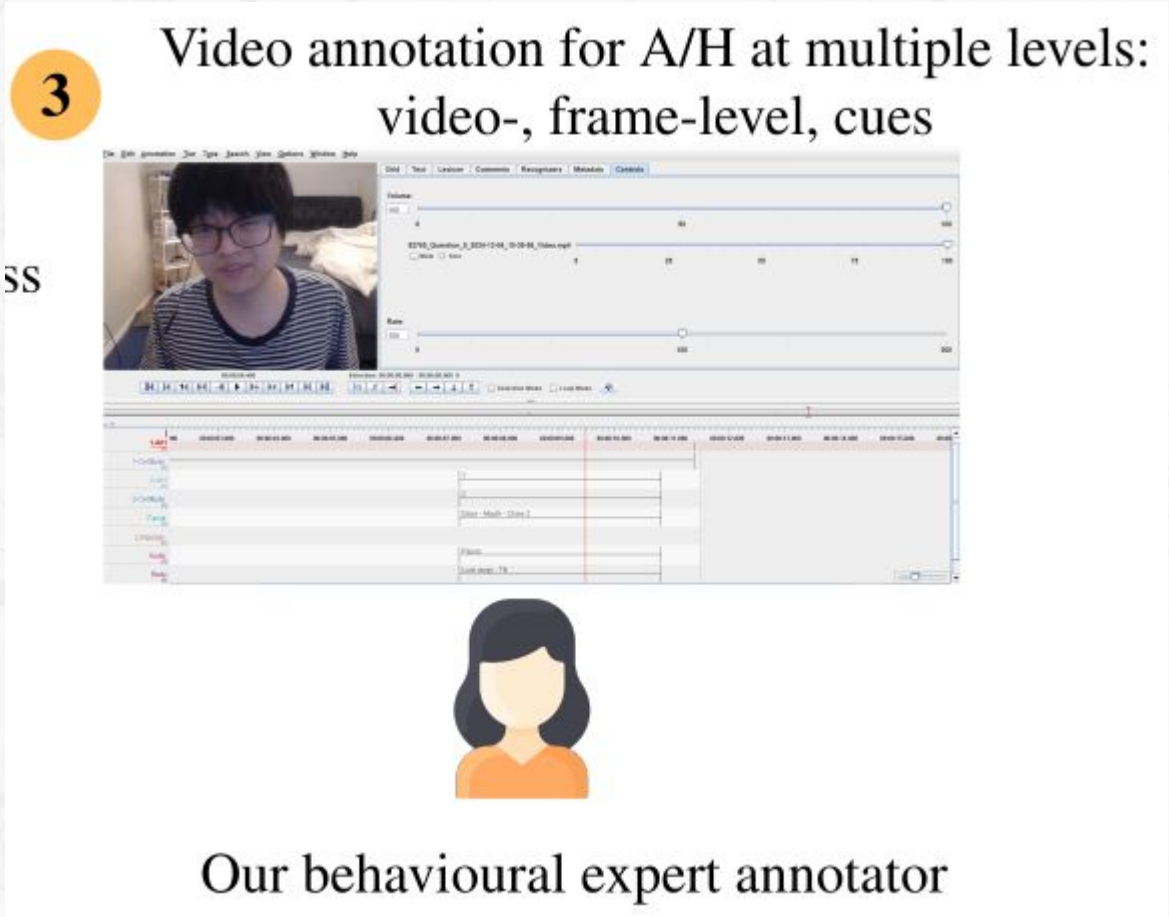
BAH Dataset: Annotation

```
92991 Videos/82569/Visite_1/82569_Question_2_2024-10-02_16-02-30_Video.mp4:
92992   all_cues:
92993   - audio: null
92994     body: look away
92995     facial: Eyebrows-hanging-gaze
92996     inconsistencies: null
92997     language: filler sound-hedging
92998   - audio: breath
92999     body: sigh-nod-restless
93000     facial: gaze-close 2
93001     inconsistencies: LB - FL
93002     language: positive-opp
93003   - audio: slow
93004     body: null
93005     facial: gaze
93006     inconsistencies: null
93007     language: positive-filler sound-repetition
93008   annotator_id: MGG
93009   certainty_ah:
93010   - 1
93011   - 2
93012   - 1
93013   fr_detailed_ah:
93014   - - 55
93015     - 134
93016   - - 311
93017     - 389
93018   - - 755
93019     - 868
93020   frame_annotation:
93021   - - Videos/82569/Visite_1/82569_Question_2_2024-10-02_16-02-30_Video.mp4/frame-0.jpg
93022     - 0
93023   - - Videos/82569/Visite_1/82569_Question_2_2024-10-02_16-02-30_Video.mp4/frame-1.jpg
93024     - 0
93025   - - Videos/82569/Visite_1/82569_Question_2_2024-10-02_16-02-30_Video.mp4/frame-2.jpg
93026     - 0
93027 ...
93028   global_ah: 1
93029   time_detailed_ah:
93030   - - '00:00:02.360'
93031     - '00:00:05.630'
93032   - - '00:00:13.040'
93033     - '00:00:16.260'
93034   - - '00:00:31.540'
93035     - '00:00:36.230'
```

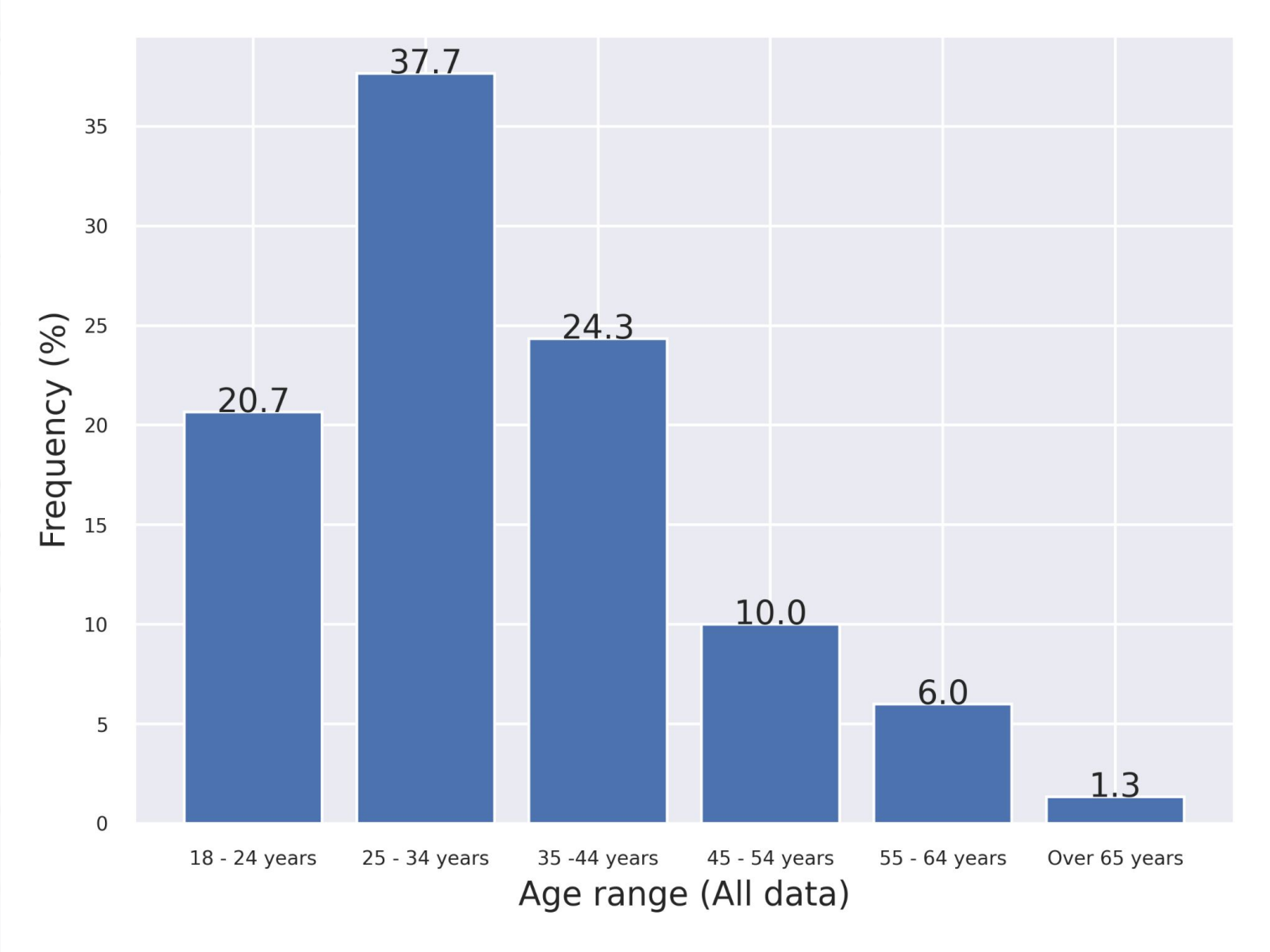


BAH Dataset: Annotation

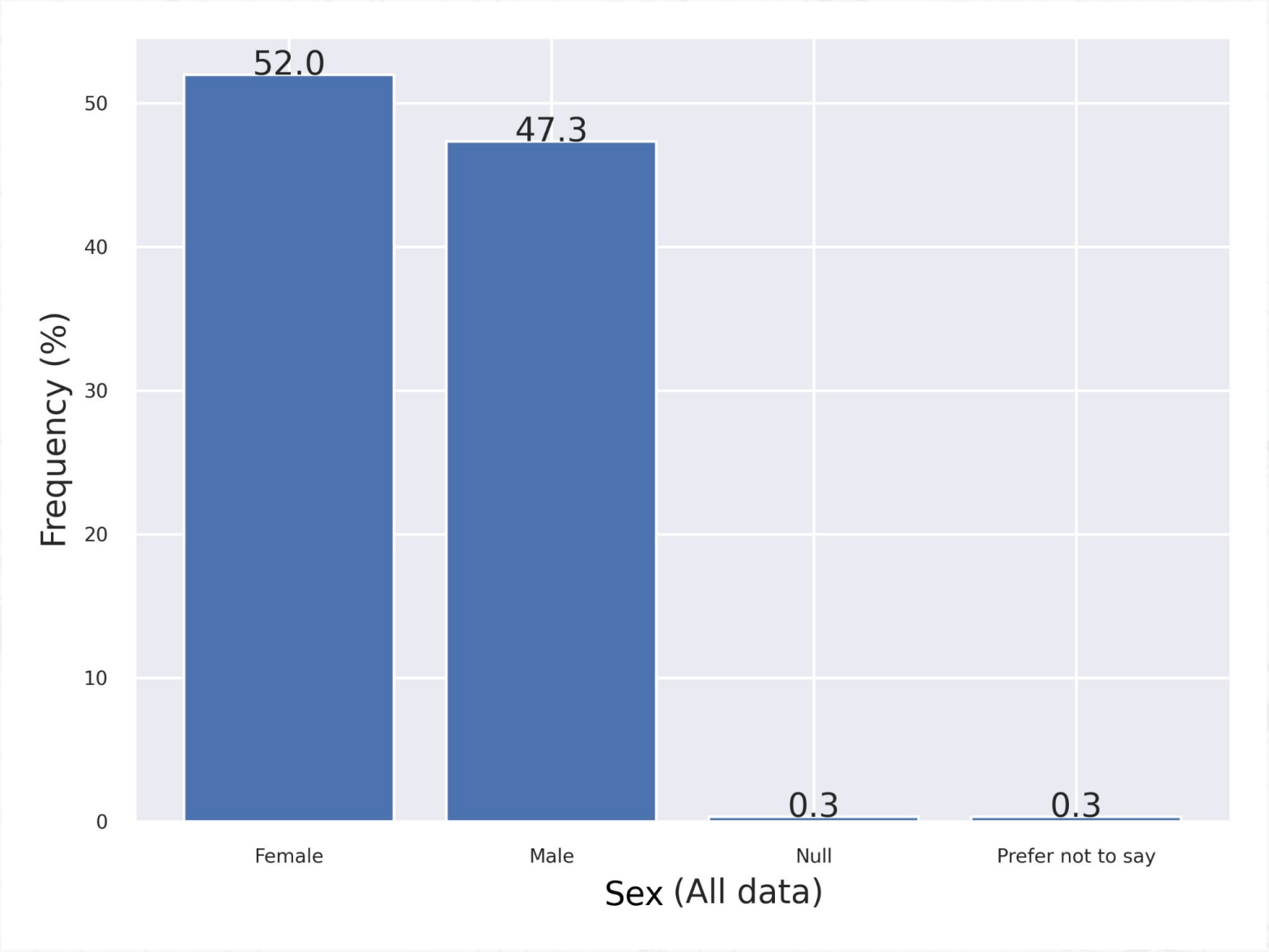
```
transcript:
  chunks:
  - language: english
    text: ' The activity that brings me joy, like a hobby, I guess it''s cycling.'
    timestamp: !!python/tuple
    - 0.8
    - 5.3
  - language: english
    text: ' I do like to go, especially in the summertime, take a long bicycle ride.'
    timestamp: !!python/tuple
    - 5.54
    - 9.42
  - language: english
    text: ' I have an e-bike, so it''s not super strenuous, but it''s more of an
      enjoyable activity where'
    timestamp: !!python/tuple
    - 9.56
    - 14.54
  - language: english
    text: ' I could relax and just take in the scenery.'
    timestamp: !!python/tuple
    - 14.54
    - 17.34
  - language: english
    text: ' And it''s de-stressing going out in nature, and again, for not really
      doing something'
    timestamp: !!python/tuple
    - 18.4
    - 23.52
  - language: english
    text: ' super strenuous, but for example, having the wind to your face and the
      sunshine coming'
    timestamp: !!python/tuple
    - 23.52
    - 29.36
  - language: english
    text: ' down on a nice beautiful day and going on a nice route. It is enjoyable
      and relaxing for me.'
    timestamp: !!python/tuple
    - 0.0
    - 8.4
  text: ' The activity that brings me joy, like a hobby, I guess it''s cycling.
    I do like to go, especially in the summertime, take a long bicycle ride. I have
    an e-bike, so it''s not super strenuous, but it''s more of an enjoyable activity
    where I could relax and just take in the scenery. And it''s de-stressing going
    out in nature, and again, for not really doing something super strenuous, but
    for example, having the wind to your face and the sunshine coming down on a
    nice beautiful day and going on a nice route. It is enjoyable and relaxing for
    me.'
```



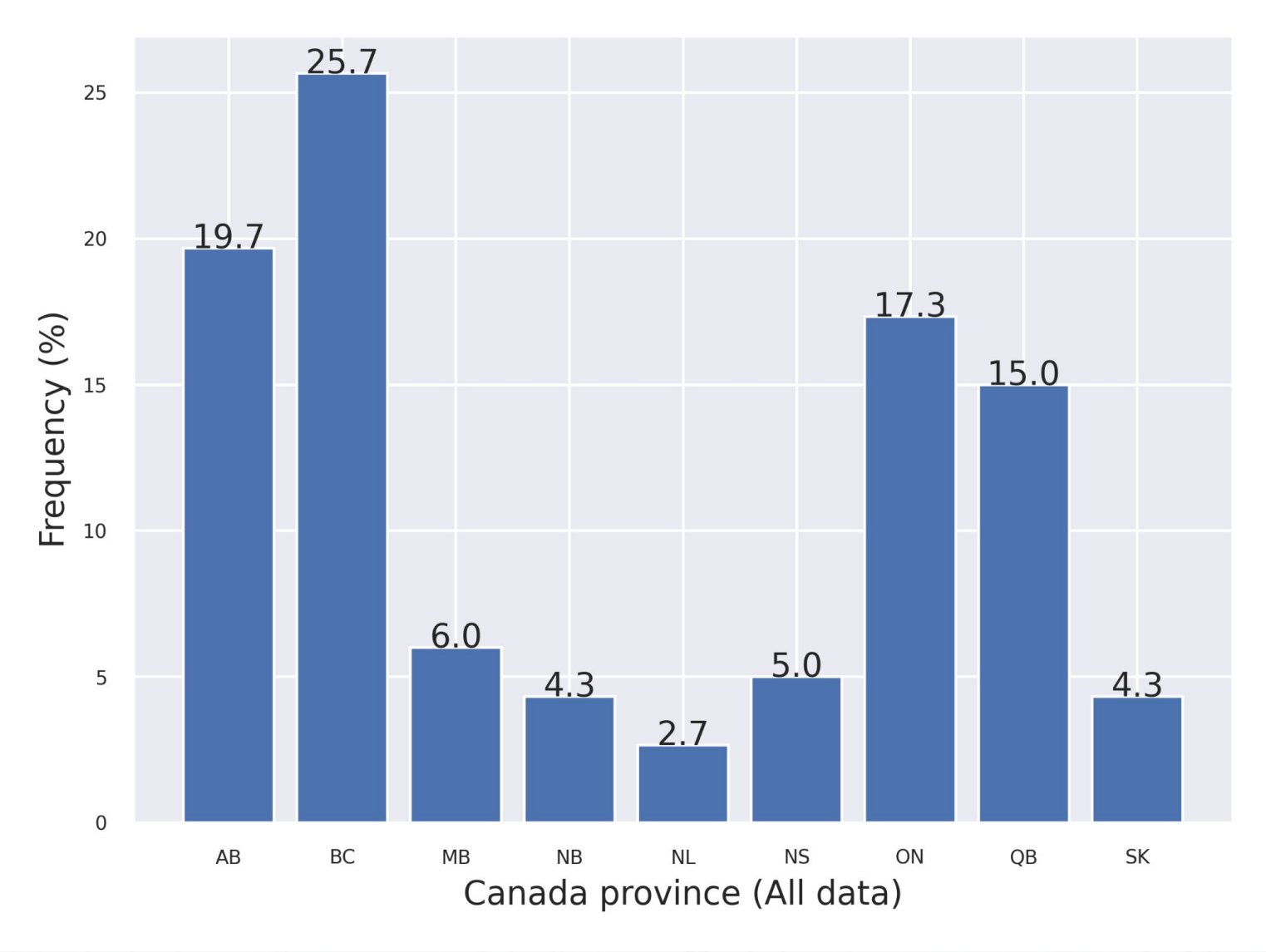
BAH Dataset: Statistics – Age



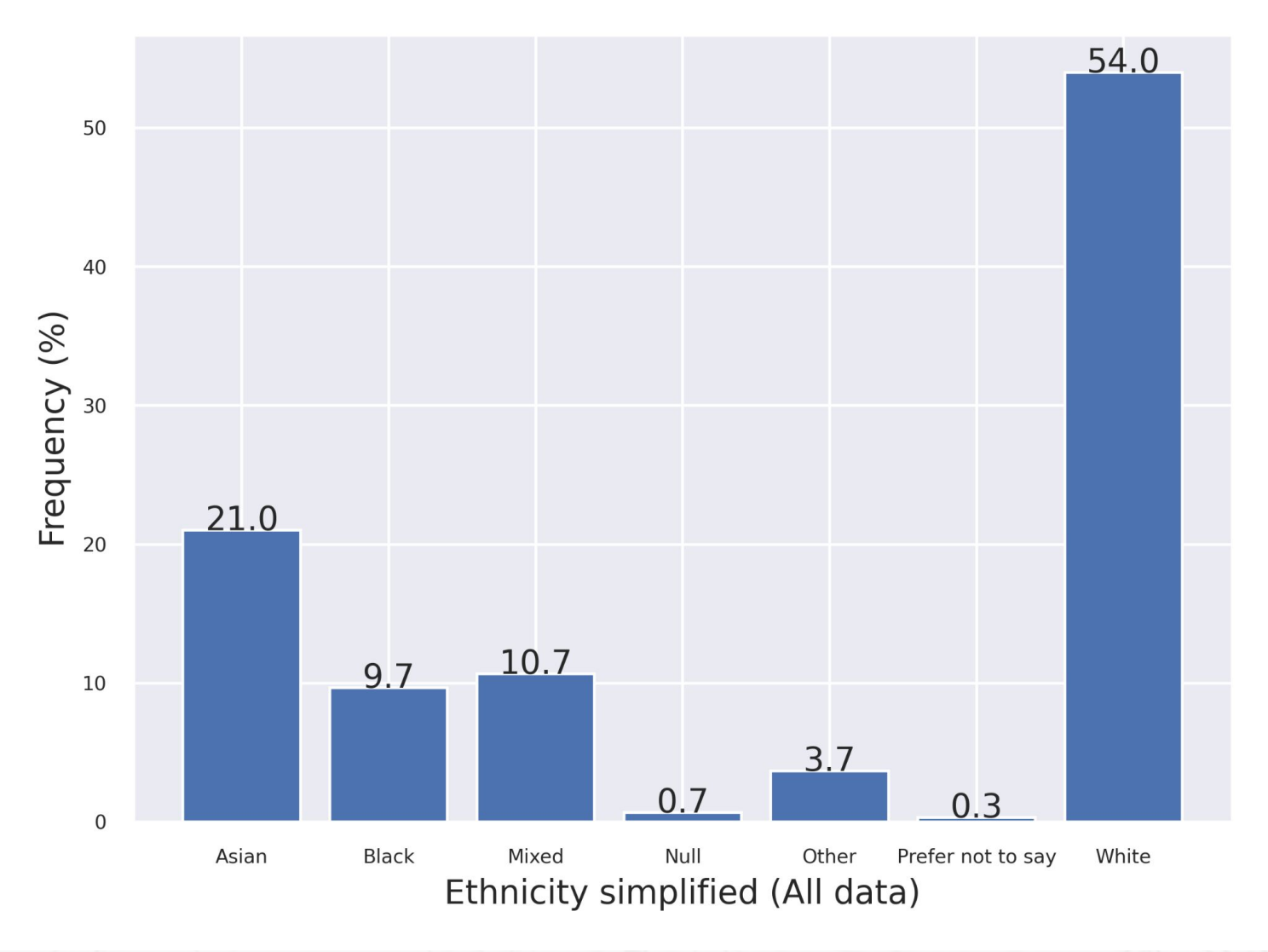
BAH Dataset: Statistics – Sex



BAH Dataset: Statistics – Province



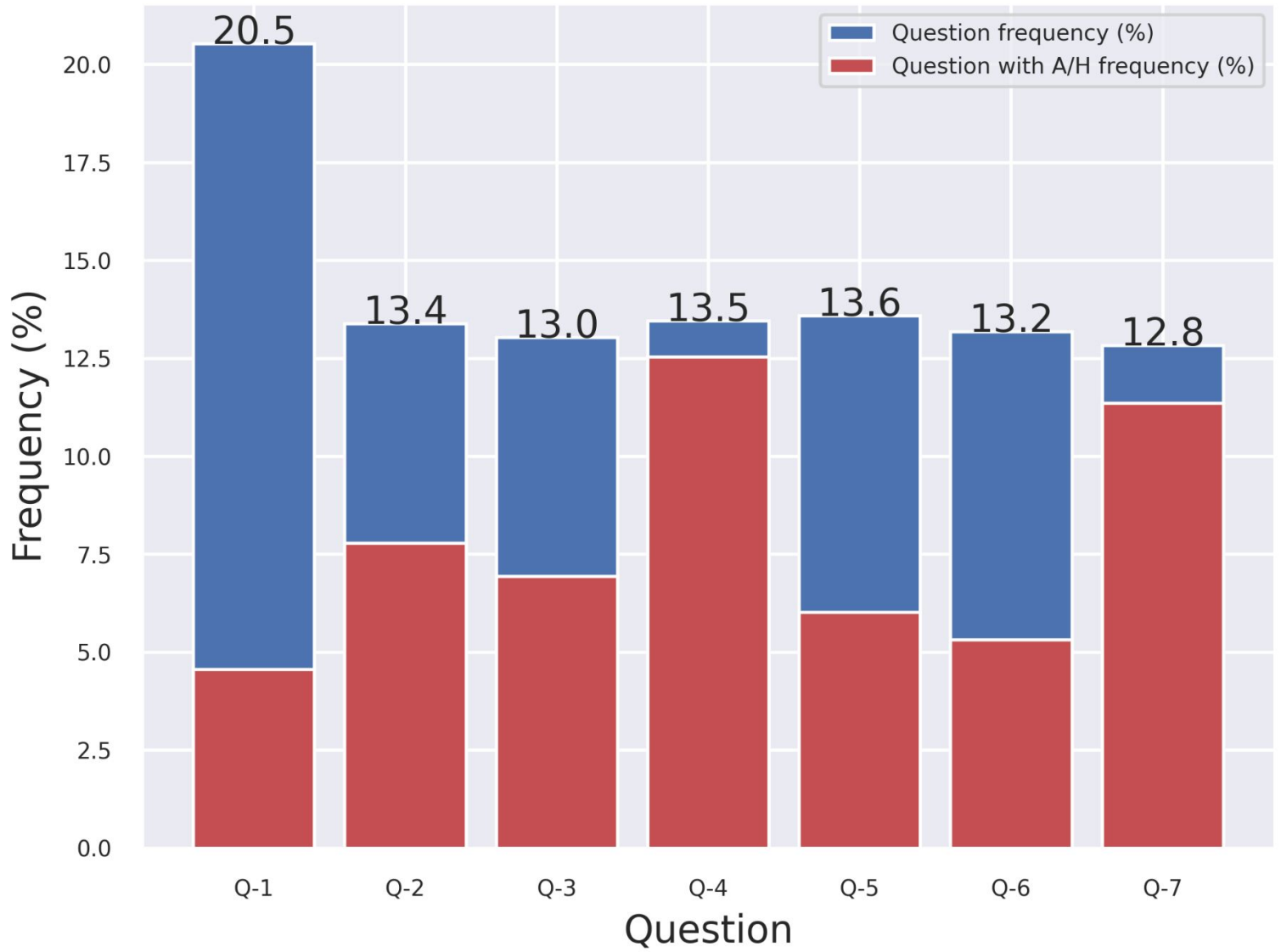
BAH Dataset: Statistics – Ethnicity



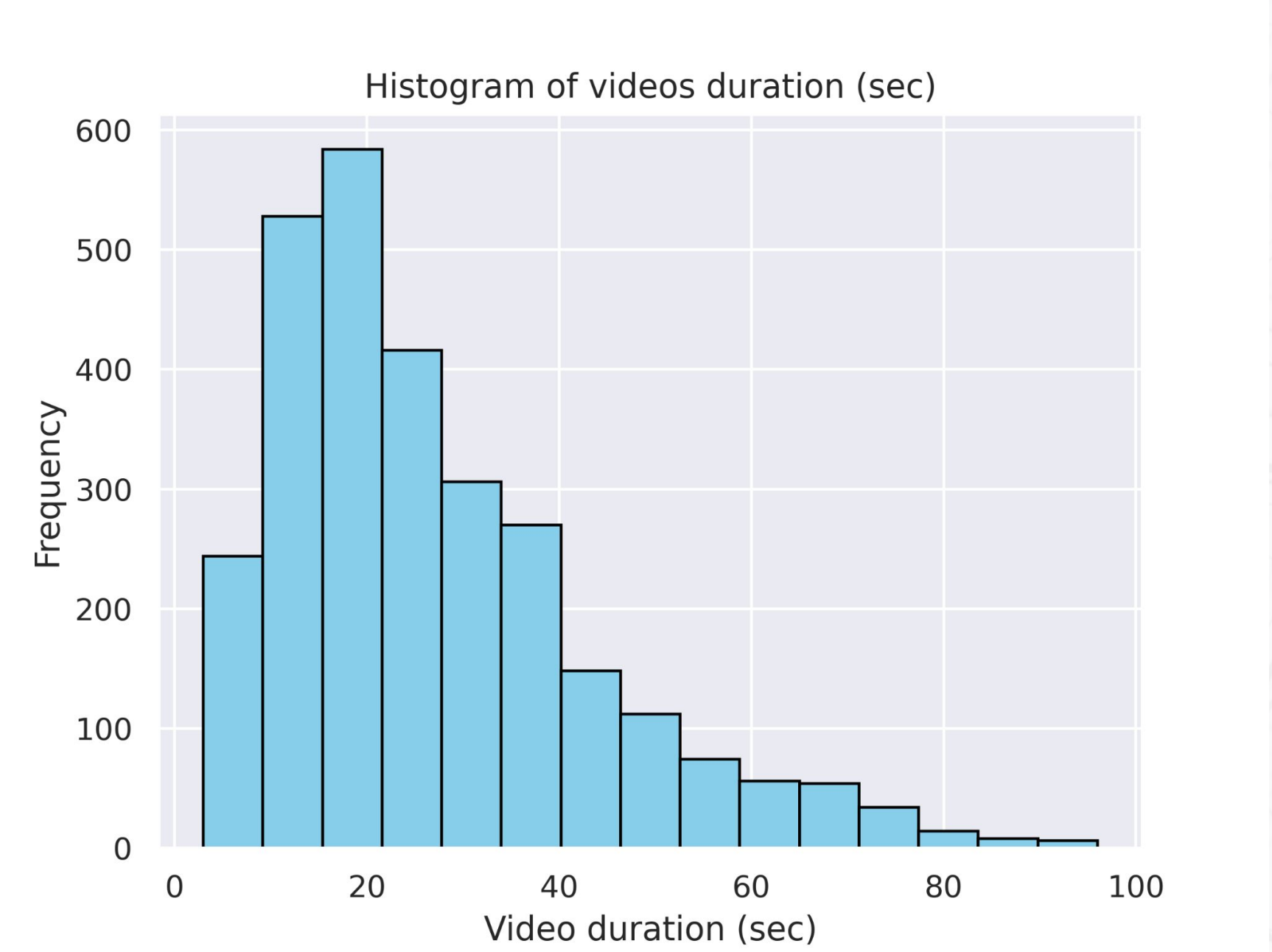
BAH Dataset: Statistics – Birth Country

- Algeria: 1
- Australia: 2
- Bangladesh: 2
- Belize: 1
- Bulgaria: 1
- Canada: 132
- China: 9
- Colombia: 1
- France: 1
- Germany: 3
- Ghana: 1
- India: 3
- Japan: 1
- Kenya: 2
- Macedonia: 1
- New Zealand: 1
- Nigeria: 10
- Null: 1
- Peru: 1
- Philippines: 4
- Russian Federation: 1
- Saint Lucia: 2
- Sri Lanka: 2
- Taiwan: 1
- Trinidad and Tobago: 1
- Tunisia: 1
- Turkey: 2
- Ukraine: 1
- United Arab Emirates: 1
- United Kingdom: 5
- United States: 4
- Vietnam: 1

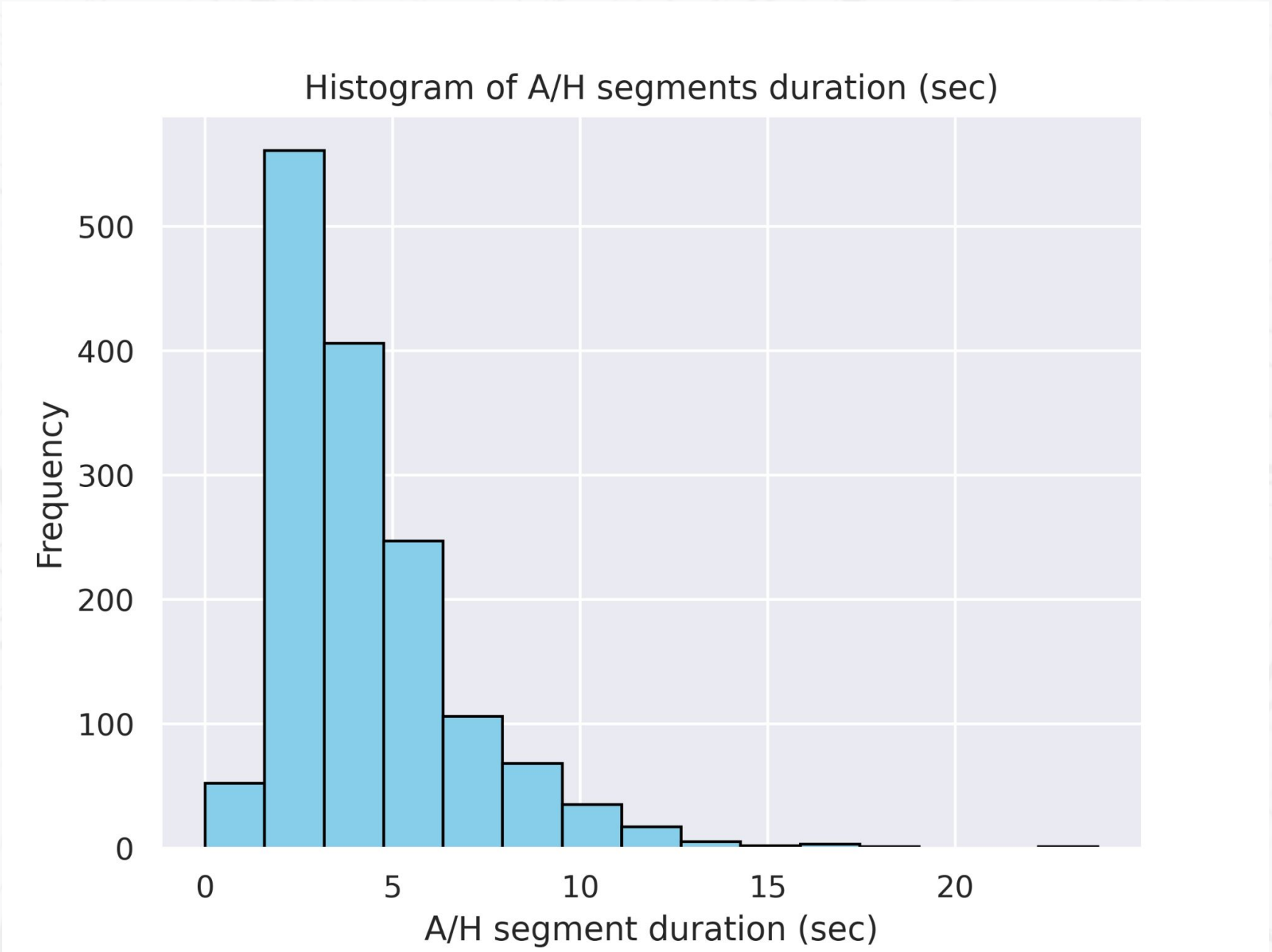
BAH Dataset: Statistics – Questions / A/H



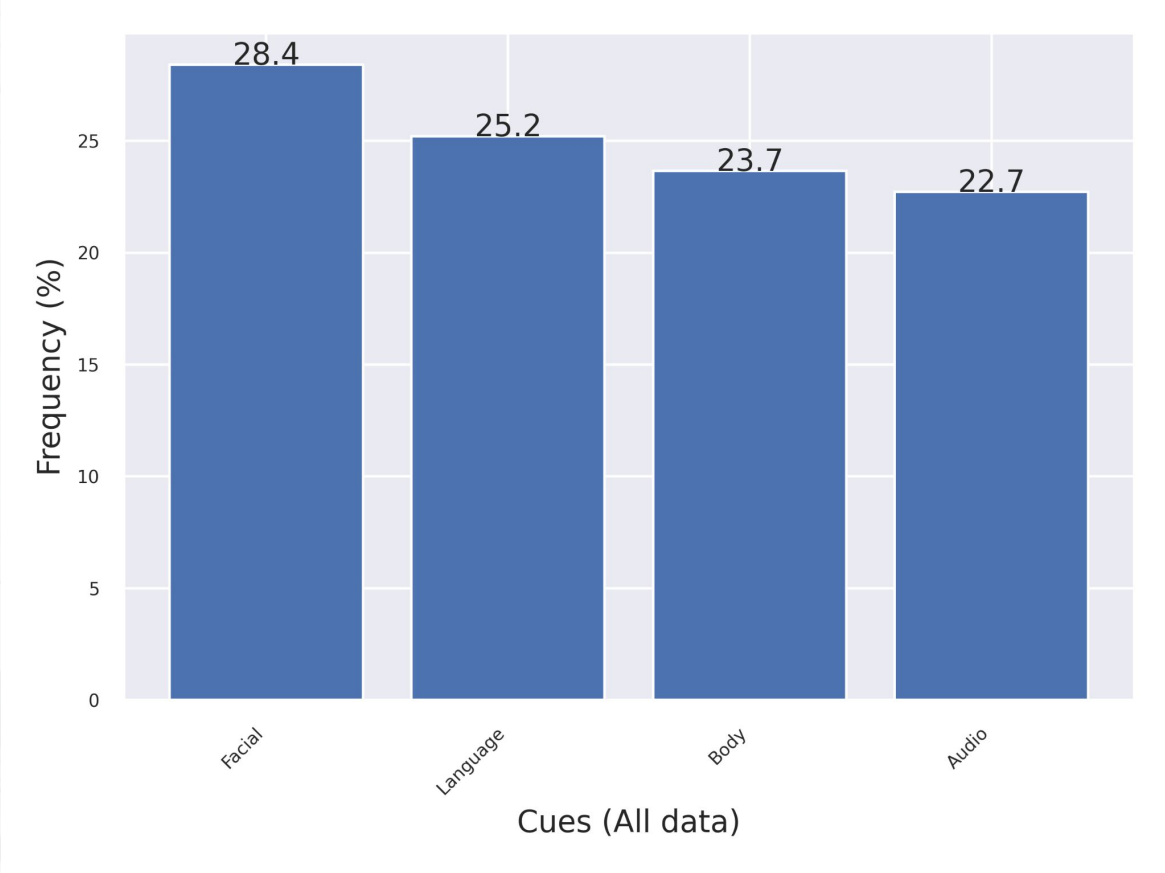
BAH Dataset: Statistics – Videos duration

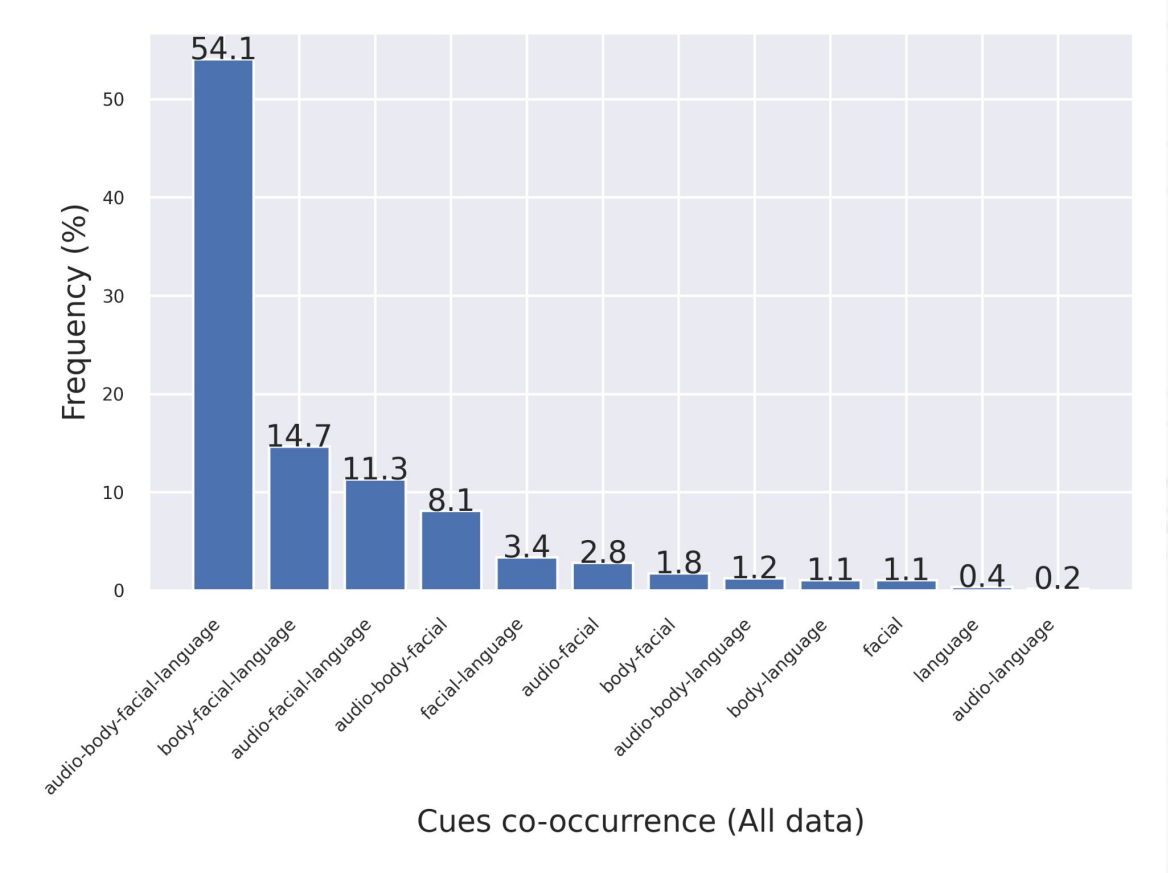


BAH Dataset: Statistics – A/H segments duration

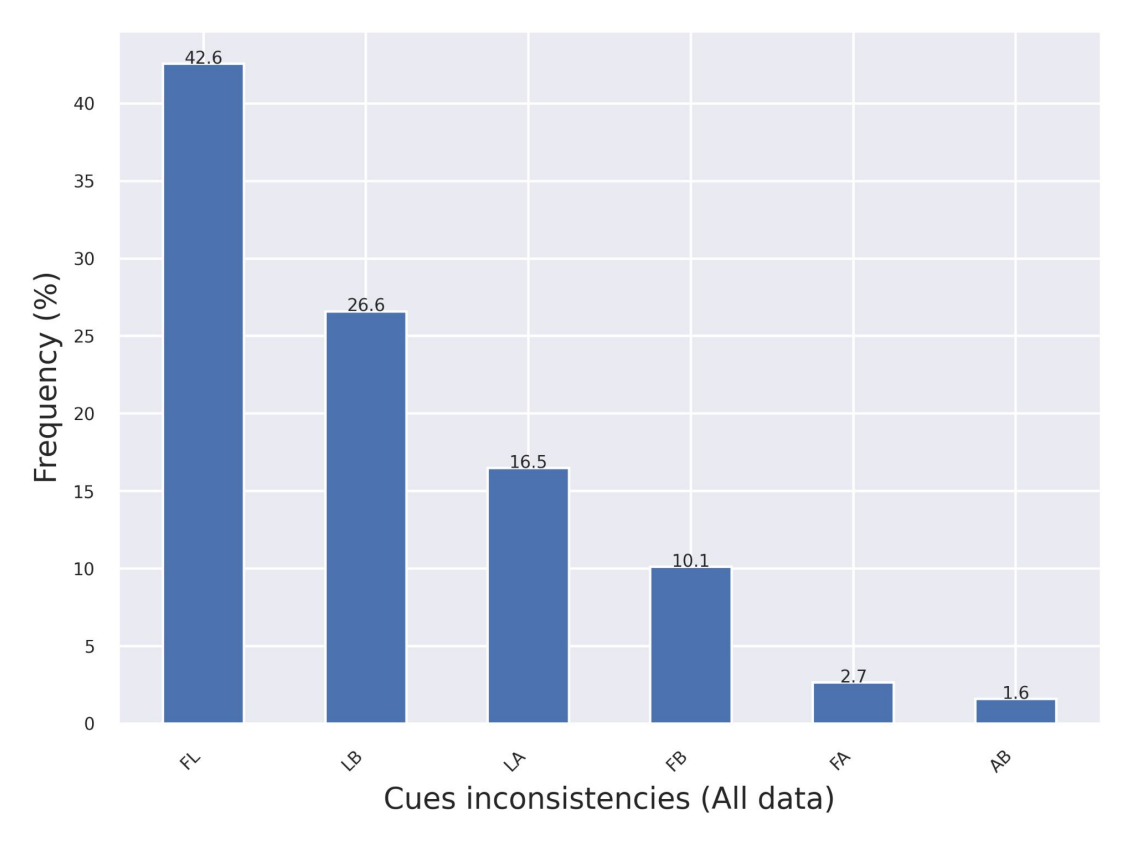


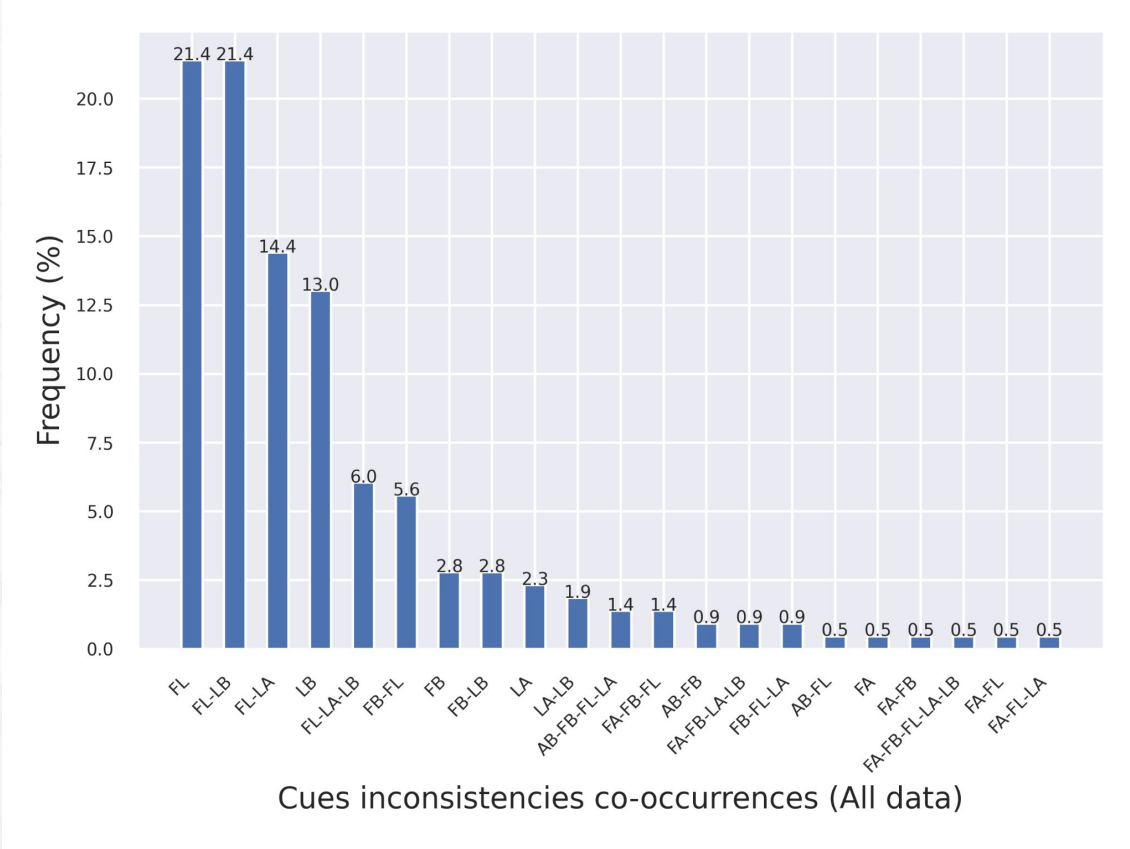
BAH Dataset: Statistics – Annotation Cues





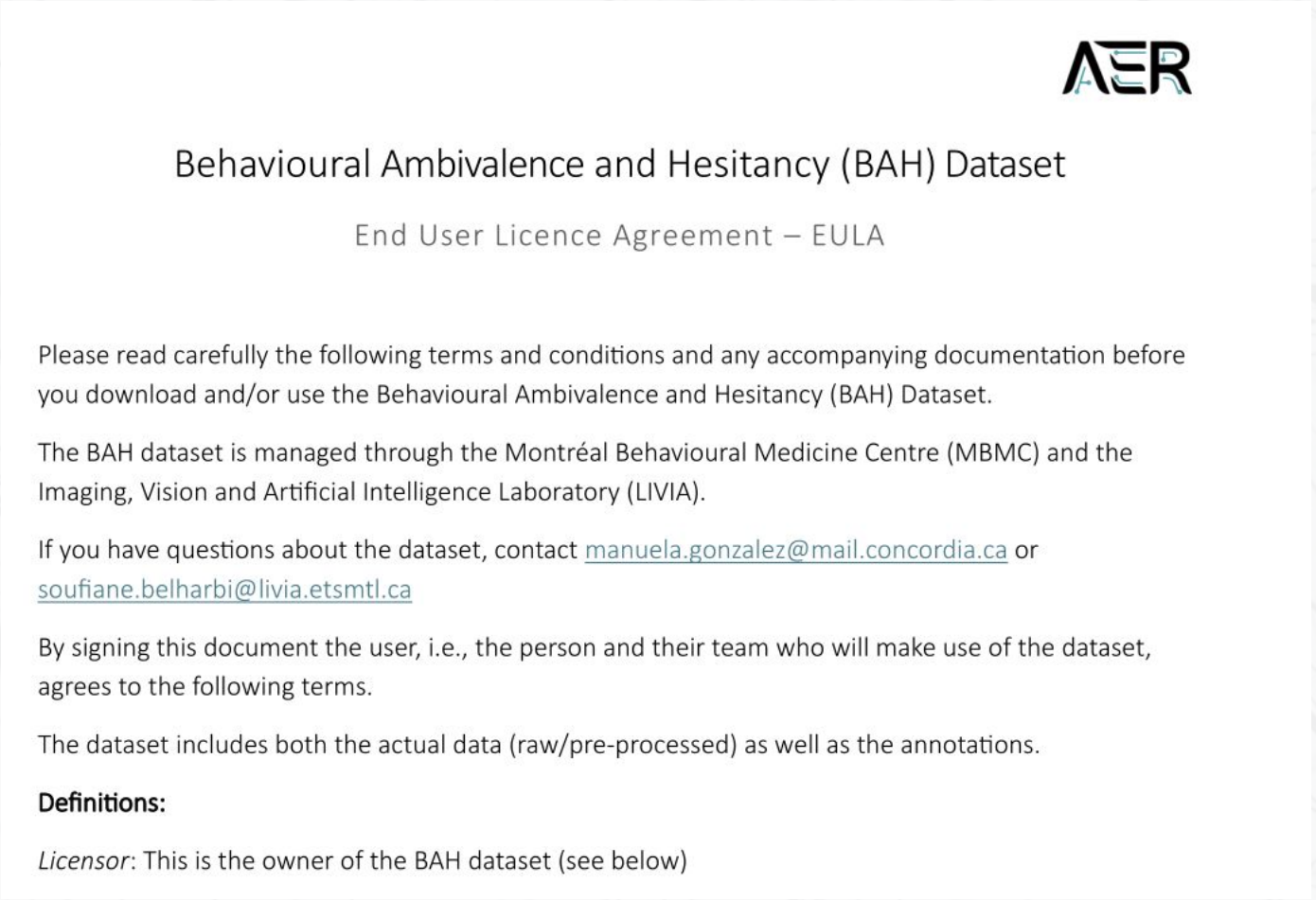
BAH Dataset: Statistics – Annotation Cues





BAH Dataset: License

- ***BAH*** is open-access
- Research, non-commercial and not-for-profit use



Behavioural Ambivalence and Hesitancy (BAH) Dataset

End User Licence Agreement – EULA

Please read carefully the following terms and conditions and any accompanying documentation before you download and/or use the Behavioural Ambivalence and Hesitancy (BAH) Dataset.

The BAH dataset is managed through the Montréal Behavioural Medicine Centre (MBMC) and the Imaging, Vision and Artificial Intelligence Laboratory (LIVIA).

If you have questions about the dataset, contact manuela.gonzalez@mail.concordia.ca or soufiane.belharbi@livia.etsmtl.ca

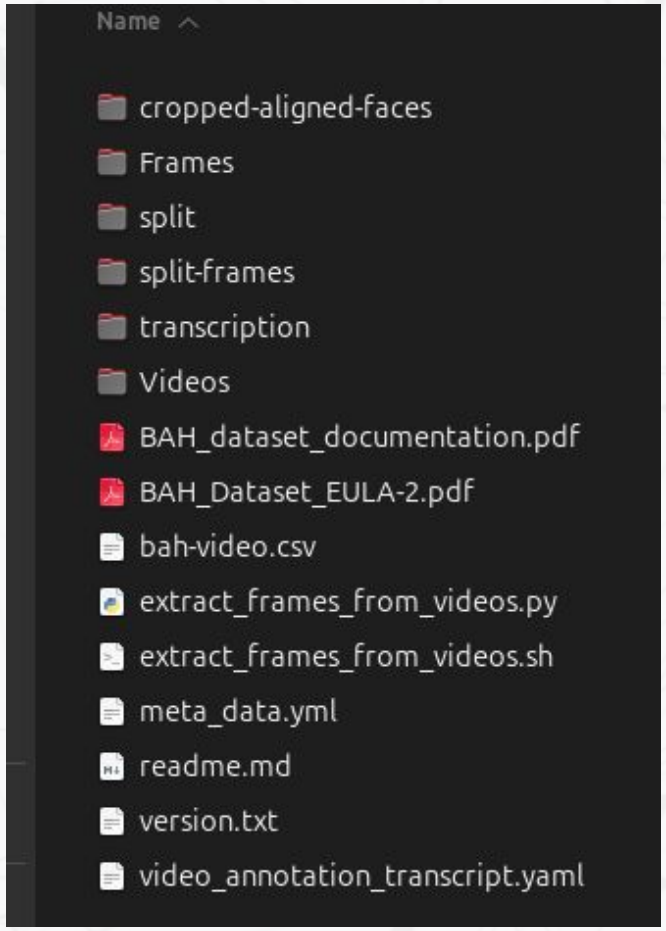
By signing this document the user, i.e., the person and their team who will make use of the dataset, agrees to the following terms.

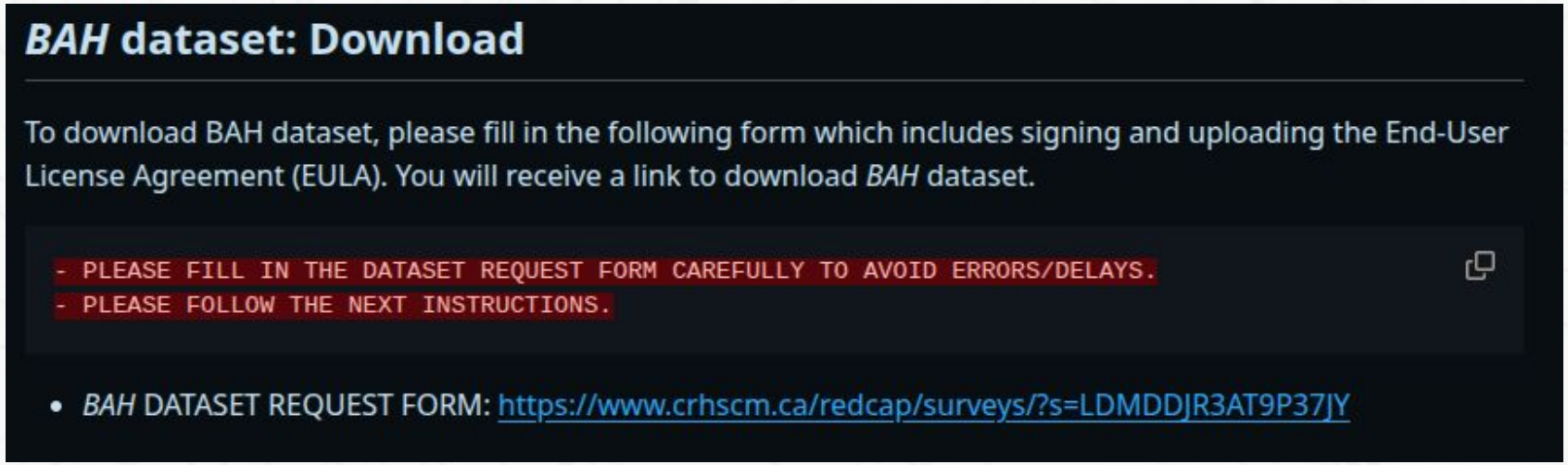
The dataset includes both the actual data (raw/pre-processed) as well as the annotations.

Definitions:

Licensor: This is the owner of the BAH dataset (see below)

BAH Dataset: Access





Request ***BAH*** dataset at:
https://github.com/LIVIAETS/bah-dataset

BAH Dataset: Benchmarks / Challenges

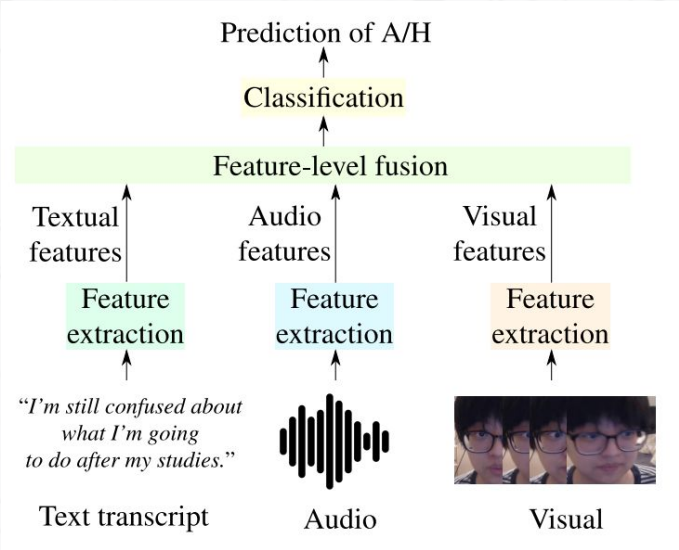
Experiments on A/H recognition:

- Supervised
- Zero-shot inference with M-LLMs
- Domain adaptation / personalisation

BAH Dataset: Benchmarks / Challenges

Supervised A/H recognition:

- Importance of fusion



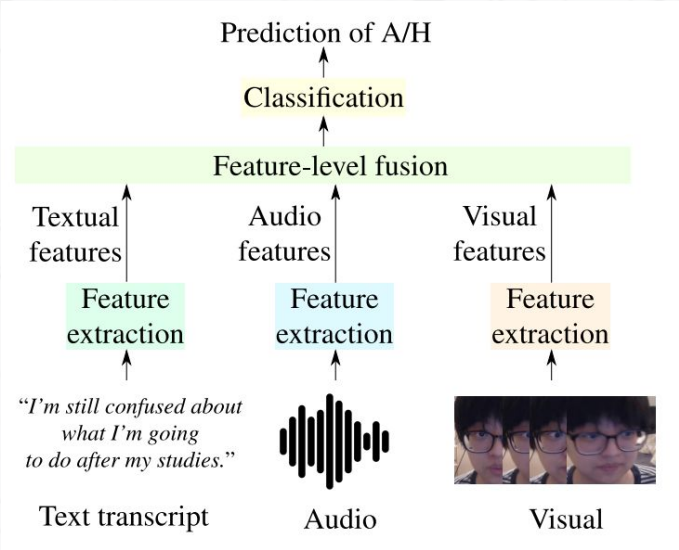
Importance of temporal/context modeling

	Without context		With context (TCN)	
Backbone	AVGF1	AP	AVGF1	AP
APViT (Xue et al., 2022)	0.5051	0.1906	0.5019	0.2069
ResNet18 (He et al., 2016)	0.5074	0.1940	0.5079	0.1993
ResNet34 (He et al., 2016)	**0.5138**	0.1952	0.4998	0.1984
ResNet50 (He et al., 2016)	0.4737	0.1942	0.4985	0.1915
ResNet101 (He et al., 2016)	0.4929	**0.1967**	**0.5165**	**0.2070**
ResNet152 (He et al., 2016)	0.4889	0.1843	0.5084	0.2058

BAH Dataset: Benchmarks / Challenges

Supervised A/H recognition:

- Importance of fusion

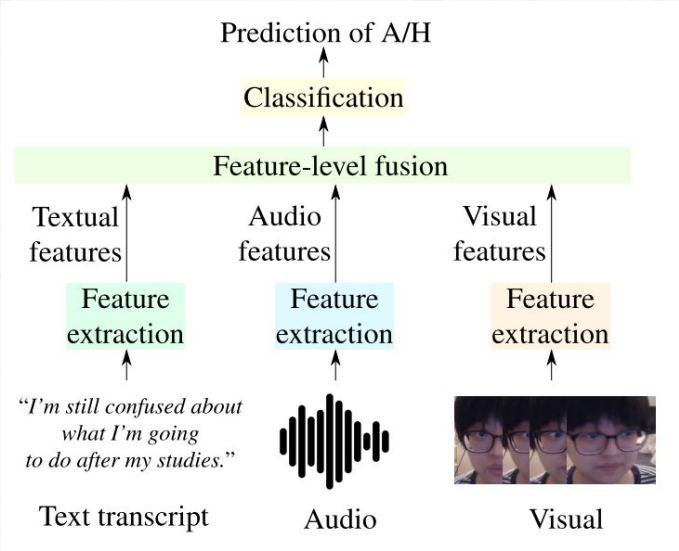


Importance of multimodal learning

Modalities	AVGF1	AP
Visual	0.5165	0.2070
Audio	0.4658	0.2238
Text	0.5497	0.2519
Visual + Audio	0.5205	0.2225
Visual + Text	0.5547	0.2479
Audio + Text	**0.5586**	**0.2609**
Visual + Audio + Text	0.5502	0.2548

BAH Dataset: Benchmarks / Challenges

Supervised A/H recognition:



Importance of fusion

Method	Fusion Approach	AVGF1	AP
LFAN (Zhang et al., 2023b) *(cvprw,2023)*	Co-attention	0.5502	0.2548
CAN (Zhang et al., 2023b) *(cvprw,2023)*	Concatenation	**0.5526**	**0.2631**
MT (Waligora et al., 2024) *(cvprw,2024)*	Transformer	0.5137	0.2134
JMT (Waligora et al., 2024) *(cvprw,2024)*	Cross-attention	0.5241	0.2139

BAH Dataset: Benchmarks / Challenges

Zero-shot inference with M-LLM

Prompt	AVGF1
Simple	0.2827
Definition Only 1	0.3326
Definition Only 2	0.3772
Transcript + Def 1	**0.6341**
Transcript + Def 2	0.3945

Personalisation using Domain Adaptation

Methods	AVGF1	AP
Source-only	0.4894 ± 0.0999	0.3565 ± 0.1841
UDA (MMD) [88]	0.4931 ± 0.0943	0.3589 ± 0.1831
UDA (Sub-Based) [111] *(fg,2024)*	$\mathbf{0.5417 \pm 0.0728}$	$\mathbf{0.3739 \pm 0.1789}$
SFUDA (SHOT) [51] *(icml,2020)*	0.4919 ± 0.1056	0.3520 ± 0.1656
SFUDA (NRC) [110] *(neurips,2021)*	0.5174 ± 0.1041	0.3688 ± 0.1487
Oracle	0.5864 ± 0.0751	0.4181 ± 0.1750

BAH Dataset: Benchmarks / Challenges

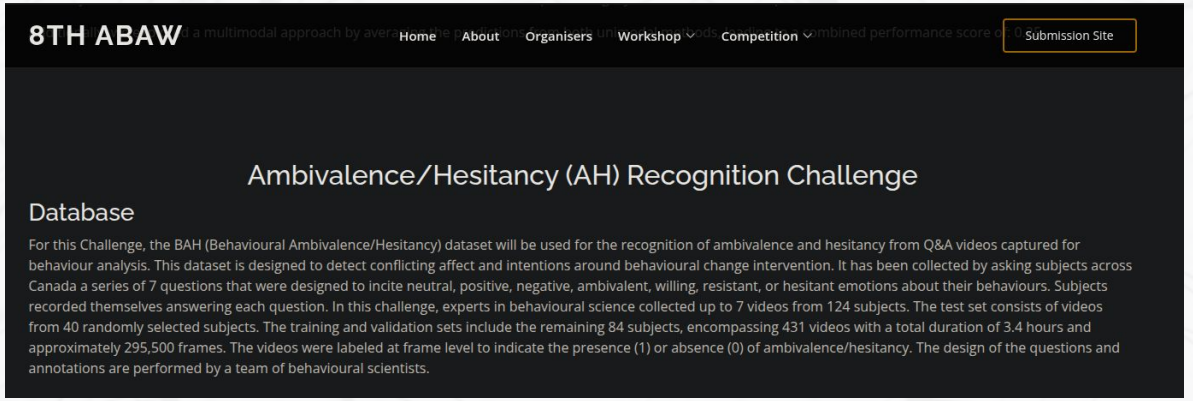
Supervised A/H recognition:

- Still a very difficult task
- Code, models are available!

Code: https://github.com/LIVIAETS/bah-dataset

BAH Dataset: Competitions

- 8th ABAW @ CVPR 2025



https://affective-behavior-analysis-in-the-wild.github.io/8th/

- 10th ABAW @ CVPR 2026

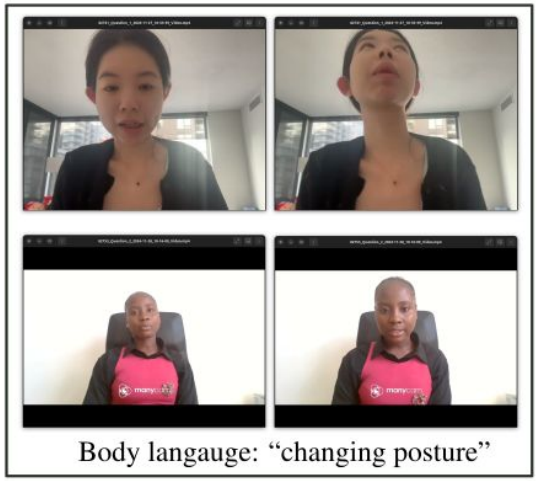
https://affective-behavior-analysis-in-the-wild.github.io/8th/

Leaderboard for Ambivalence/Hesitancy (AH) Video Recognition Challenge, 2nd

Leaderboard of Ambivalence/Hesitancy (AH) Video Recognition Challenge 2nd in ABAW 10th - CVPR 2026

Teams	AVGF1 (Macro F1)	Github	arXiv
VisPBF	0.7266	link	link
Fennec	0.7151	link	link
LEYA	0.7142	link	link
Lenovo PCIE	0.6748	link	link
Time Visão	0.5362	link	link
Baseline	0.3428	–	–

BAH Dataset



Body langauge: “changing posture”

Body langauge: “looking away”

Code: https://github.com/LIVIAETS/bah-dataset

For more discussions, please visit us at the **poster session**