Valuation of the Weight-Specific Adolescent Instrument for Economic Evaluation using online personal utility functions in an adult population

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Overview

- This presentation will present the methods and results from the valuation of the Weight-Specific Adolescent Instrument for Economic Evaluation (WAItE) using online personal utility functions (OPUF) in a representative sample of UK adults.
- Before we dive in...
  - What is the WAItE?
  - What is OPUF?

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Background

What is the WAItE?

- The WAItE is the first weight-specific health related quality of life measure designed for use in adolescents which is appropriate for use in economic evaluation.
- It is composed of 7 attributes and 5 levels (*never, almost never, sometimes, often, always*) within each:
  - **Tired:** I ___ get tired.
  - **Walking:** I ___ struggle to keep up when walking around with others
  - **Sports:** I ___ avoid doing sport
  - **Concentration:** I ___ struggle to concentrate on my studies/work
  - **Embarrassment:** I ___ feel embarrassed shopping for clothes
  - **Unhappiness:** I ___ feel unhappy because I am unable to do the same things as others
  - **Treated differently:** People ___ treat me differently when I go out

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Background

What is OPUF?

- OPUF is a new type of online survey for valuing patient reported outcome measures using more efficient, compositional elicitation methods, which even allow estimating value sets on the individual level.
- Research has shown that the results are comparable with values estimated via discrete choice experiment.
- OPUF main structure:
  - Attribute weighting
  - Level rating
  - Anchoring task

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Aims

- To undertake a population-based valuation survey with adults using the WAItE OPUF to determine their preferences.
- To elicit a health state utility value for the WAItE PITS state.
- To explore preference heterogeneity within our sample and how it varies among different subgroups.

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Methods

Recruitment

- 300 adults were recruited to respond to a quality-of-life survey hosted online.
- Study participants were recruited based on specific quotas to form a representative sample based on UK census data.
- The survey was hosted on the Prolific platform which invited paid respondents to complete the WAItE OPUF survey.
- Participation in this survey was estimated to take approximately fifteen minutes to complete and participants received £2.50 as a payment upon completion.

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Survey structure

- Consent and Prolific ID
- WAItE descriptive system
- Attribute selection: *determine most important attribute*
- Attribute swing weighting: *determine relative importance of other attributes*
- Level rating: *determine importance of levels within each attribute*
- Anchoring: *determine the utility value of the worst WAItE health state*
- Survey feedback and demographic questions

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Utility value estimation

- Attribute ratings are normalised to sum to 1 to denote their relative importance.
- Attribute weighting is combined with level ratings to yield a coefficient matrix which defines the marginal disutilities associated with each attribute level combination for the WAItE. An example is shown below:

$$L_{ij} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.14 & 0.26 & 0.21 & 0.15 & 0.16 & 0.12 & 0.19 \\ 0.57 & 0.55 & 0.63 & 0.54 & 0.38 & 0.26 & 0.66 \\ 0.83 & 0.82 & 0.85 & 0.86 & 0.64 & 0.38 & 0.91 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{bmatrix} \quad (1)$$

$$w_j = \begin{bmatrix} 0.08 & 0.10 & 0.11 & 0.14 & 0.30 & 0.10 & 0.17 \end{bmatrix} \quad (2)$$

$$L_{ij} \cdot w_j = \tilde{M}_{ij} \quad (3)$$

Utility value estimation

- Combining attribute weightings with level ratings yields coefficient matrix $\tilde{M}_{ij}$

$$\tilde{M}_{ij} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.01 & 0.03 & 0.02 & 0.02 & 0.05 & 0.01 & 0.03 \\ 0.05 & 0.05 & 0.07 & 0.07 & 0.11 & 0.03 & 0.11 \\ 0.07 & 0.08 & 0.09 & 0.12 & 0.19 & 0.04 & 0.15 \\ 0.08 & 0.10 & 0.11 & 0.14 & 0.30 & 0.10 & 0.17 \end{bmatrix} \tag{4}$$

- Then anchoring the coefficient matrix using the PITS utility value ($P = 0.2$) yields the anchored coefficient matrix $\tilde{V}_{ij}$

$$\tilde{M}_{ij} \cdot (1 - P) \quad \ni \quad P = 0.2 \tag{5}$$

$$\tilde{V}_{ij} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0.01 & 0.02 & 0.02 & 0.02 & 0.04 & 0.01 & 0.02 \\ 0.04 & 0.04 & 0.06 & 0.06 & 0.09 & 0.02 & 0.09 \\ 0.06 & 0.06 & 0.07 & 0.10 & 0.15 & 0.03 & 0.12 \\ 0.06 & 0.08 & 0.09 & 0.11 & 0.24 & 0.08 & 0.14 \end{bmatrix} \tag{6}$$

Preference heterogeneity

- Investigating the heterogeneity of preferences between individuals, required a measure of dis/similarity to quantify how far apart two PUFs are.
- A utility value set was estimated for each individual in our sample and euclidean distance (EUD) was used to assess dis/similarity between preferences (shown below).
- We then used permutational analysis of variance (PERMANOVA) to explore which factors were influencing preference heterogeneity in our sample.

$$d_{EUD}(i,j) = \sqrt{\sum (u_i(s_1) - u_j(s_1))^2 + ... + (u_i(s_{78125}) - u_j(s_{78125}))^2} \quad (7)$$

$$\ni \qquad s = \{1111111, 2111111, ..., 5555555\}$$

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Participant Characteristics

Characteristic	N (%)	Characteristic	N (%)
Age		**Ethnicity**	
18-24	32 (10.9%)	White	251 (84%)
25-34	50 (17%)	Asian	23 (8%)
35-44	48 (16.3%)	Black	11 (4%)
45-54	49 (16.7%)	Mixed	10 (3%)
55-64	81 (27.6%)	Other	5 (2%)
65-90	34 (11.6%)	**Weight Status**	
Not Stated	6 (2.0%)	Normal	154 (51%)
Gender		Overweight	104 (35%)
Female	154 (51%)	Obese	30 (10%)
Male	144 (48%)	Underweight	8 (3%)
Non-binary	1 (0%)	Prefer not to say	4 (1%)
Education		Underweight	8 (3%)
Degree	147 (49%)	Prefer not to say	4 (1%)
A Level	64 (21%)	**Occupation**	
Higher Education	46 (15%)	Full-time	130 (43%)
Other	20 (7%)	Part-time	62 (21%)
GCSE A-C	18 (6%)	Not Paid	30 (10%)
GCSE D-G	5 (2%)	Other	31 (10%)
WAItE	**Mean (SD)**	Starting a New Job	3 (1%)
Tiredness	3.4 (0.8)		
Walking	2.1 (1.1)		
Sport	3.3 (1.3)		
Concentration	2.7 (1.0)		
Embarrassment	2.2 (1.2)		
Unhappiness	2.3 (1.0)		
Treated differently	1.9 (0.9)		
Total	17.8 (4.8)		

Level ratings

Level rating[α]	Mean (SD)	Median (Q1; Q3)	Min	Max
Tired				
Almost never	20.3 (23.2)	10 (5; 25)	0	100
Sometimes	36.3 (19.2)	33.5 (20; 50)	0	100
Often	62.2 (23.9)	70 (50; 80)	0	100
Walking				
Almost never	19.4 (21.8)	10 (6; 21)	0	100
Sometimes	37.7 (19.4)	40 (24; 50)	0	100
Often	63 (26.2)	71 (50; 80)	0	100
Sports				
Almost never	16.6 (21)	10 (5; 20)	0	100
Sometimes	29.5 (22)	25 (10; 45)	0	100
Often	49.8 (29.6)	50.5 (24.5; 75)	0	100
Concentration				
Almost never	21.4 (22.1)	14 (7; 25)	0	100
Sometimes	41.6 (20.1)	40 (25.8; 53.2)	0	100
Often	64.5 (26.2)	73 (50; 80.2)	0	100
Embarrassment				
Almost never	16.6 (22.3)	10 (4; 20)	0	100
Sometimes	29.4 (21.6)	25 (10; 50)	0	100
Often	47.9 (30.4)	50 (20; 75)	0	100
Unhappiness				
Almost never	21.1 (22.2)	13 (6; 25)	0	100
Sometimes	41.4 (22.1)	41.5 (25; 56)	0	100
Often	63.6 (28.2)	75 (50; 85)	0	100
Treated differently				
Almost never	20.9 (24.4)	11 (5; 25)	0	100
Sometimes	35.5 (22.8)	34.5 (19.8; 50)	0	100
Often	55.9 (30.6)	60.5 (31; 80)	0	100

[α] Levels *Never* and *Always* were fixed at 0 and 100 respectively

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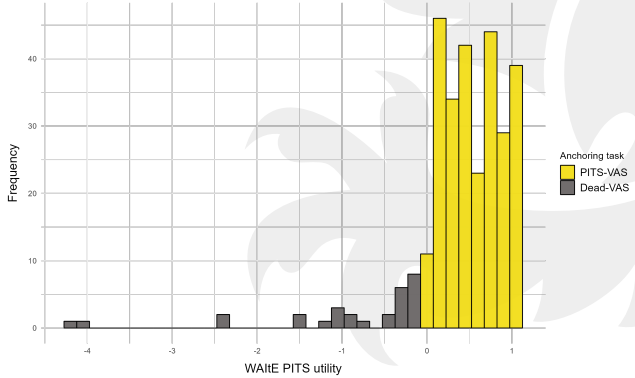
Attribute weighting and anchoring

OPUF Section	Mean (SD)	Median (Q1; Q3)	Min	Max
Domain weighting				
Tired	76.5 (28.4)	90 (60; 100)	1	100
Walking	65.5 (32.5)	75 (40; 100)	0	100
Sports	42.3 (32.8)	35 (11; 70)	0	100
Concentration	67.9 (30.9)	80 (44; 99.2)	0	100
Embarrassment	40.1 (34.3)	30 (9; 70)	0	100
Unhappiness	70 (31.9)	80 (50; 100)	0	100
Treated differently	52.1 (35.6)	50 (15.8; 86)	0	100
Anchoring				
PITS preferred to death	87.9% (32.7%)	1 (1; 1)	0	1
PITS-VAS	56.1 (31.3)	54 (30; 85)	0	100
Dead-VAS	42.5 (31.6)	38.5 (13.2; 63.5)	1	100
PITS VAS uncensored	-0.025 (5.95)	0.5 (0.2; 0.8)	-99	1
PITS VAS censored	0.431 (0.485)	0.5 (0.2; 0.8)	-1	1
PITS Utility Value (winsorized & imputed)	0.282 (1.456)	0.5 (0.2; 0.8)	-14.3	1

Anchoring distribution

- The distribution of PITS utility values were significantly left skewed (illustrated in the figure below). To mitigate this winsorization of values which lay in the outer 0.1% of the distribution was conducted. Missing values were imputed using multiple imputation by chained equations.



Utility value set

Dimension level	Mean[a] (95% CI)[b]	Median (Q1; Q3)	Min	Max
Tired				
Almost never	0.029 (0.025; 0.033)	0.029 (0.027; 0.030)	0.021	0.039
Sometimes	0.052 (0.047; 0.058)	0.052 (0.050; 0.054)	0.041	0.063
Often	0.088 (0.082; 0.094)	0.088 (0.085; 0.090)	0.077	0.103
Always	0.140 (0.133; 0.148)	0.140 (0.137; 0.143)	0.125	0.157
Walking				
Almost never	0.021 (0.018; 0.024)	0.021 (0.020; 0.022)	0.016	0.027
Sometimes	0.045 (0.041; 0.049)	0.045 (0.043; 0.046)	0.037	0.052
Often	0.075 (0.069; 0.082)	0.075 (0.073; 0.077)	0.064	0.087
Always	0.116 (0.108; 0.124)	0.115 (0.113; 0.118)	0.101	0.131
Sports				
Almost never	0.012 (0.010; 0.015)	0.012 (0.012; 0.013)	0.009	0.017
Sometimes	0.023 (0.020; 0.025)	0.023 (0.022; 0.024)	0.018	0.029
Often	0.038 (0.034; 0.044)	0.038 (0.037; 0.040)	0.029	0.052
Always	0.069 (0.063; 0.076)	0.069 (0.067; 0.071)	0.058	0.084
Concentration				
Almost never	0.026 (0.023; 0.030)	0.026 (0.025; 0.028)	0.019	0.034
Sometimes	0.051 (0.047; 0.055)	0.051 (0.049; 0.052)	0.044	0.060
Often	0.080 (0.074; 0.086)	0.080 (0.078; 0.082)	0.069	0.093
Always	0.121 (0.114; 0.128)	0.121 (0.118; 0.123)	0.107	0.138
Embarrassment				
Almost never	0.012 (0.010; 0.014)	0.012 (0.011; 0.013)	0.008	0.017
Sometimes	0.022 (0.019; 0.025)	0.022 (0.021; 0.023)	0.016	0.027
Often	0.034 (0.030; 0.038)	0.034 (0.032; 0.035)	0.025	0.043
Always	0.061 (0.056; 0.067)	0.061 (0.059; 0.063)	0.051	0.072
Unhappiness				
Almost never	0.025 (0.022; 0.029)	0.025 (0.024; 0.026)	0.019	0.033
Sometimes	0.054 (0.049; 0.059)	0.054 (0.052; 0.056)	0.045	0.064
Often	0.083 (0.076; 0.090)	0.083 (0.081; 0.086)	0.070	0.101
Always	0.124 (0.117; 0.133)	0.124 (0.122; 0.127)	0.110	0.142
Treated differently				
Almost never	0.019 (0.016; 0.022)	0.019 (0.017; 0.020)	0.013	0.025
Sometimes	0.035 (0.030; 0.039)	0.035 (0.033; 0.036)	0.026	0.043
Often	0.052 (0.048; 0.057)	0.052 (0.050; 0.054)	0.042	0.062
Always	0.087 (0.079; 0.095)	0.087 (0.084; 0.089)	0.071	0.101

[a] Coefficients were anchored using a PITS utility value of 0.282.

[b] Confidence intervals were estimated from bootstrap resampling with 10,000 iterations.

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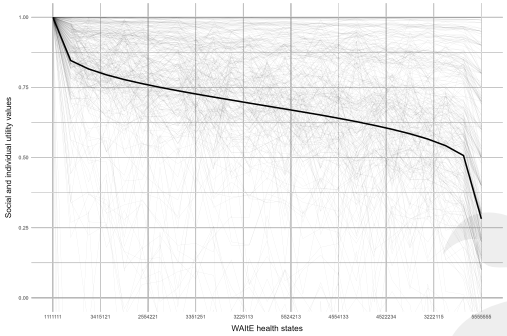
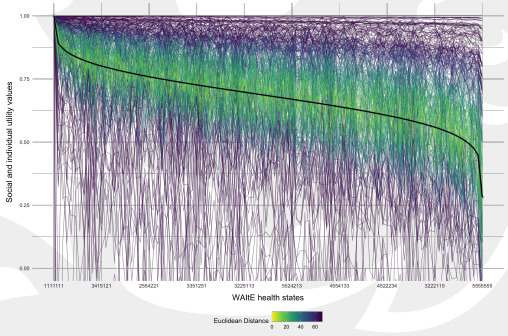
Preference heterogeneity





PERMANOVA

Group variable	Df	SS_W	R^2	F	p
Age	6	663590.648	0.057	3.018	0.030*
Gender	3	57313.577	0.005	0.521	0.362
Weight status	1	6892.412	0.001	0.188	0.727
Education	5	33542.464	0.003	0.183	0.967
Employment status	7	290563.598	0.025	1.133	0.269
Ethnicity	4	521334.829	0.045	3.557	0.056
Residual	273	10003165.515	0.864		
Total (SS_T)	299	11576403.042	1.000		

Abbreviations: df, degrees of freedom; F, pseudo F statistics; SS_T, total sum-of-squares; SS_W, within-group sum-of-squares.
p values based on 10,000 permutations; * = $p < 0.05$.

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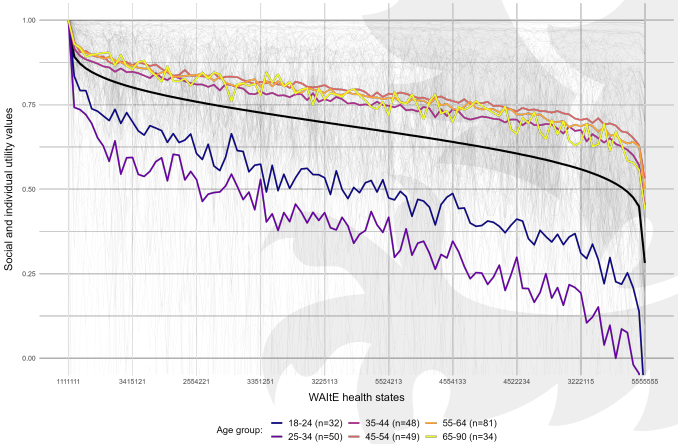
Preference heterogeneity



Discussion

- Winsorization of PITS utility values
- Tiredness and Unhappiness were considered the most important domains while Embarrassment and Sports the least.
  - This was consistent with prior valuation studies that have been completed with the WAItE.
- EUD and PERMANOVA were used to explore preference heterogeneity and age was shown to have a significant impact on preferences.
  - Younger participants generally had lower health state utility values for equivalent health states than older participants.

Conclusion

- Preferences varied significantly by age. This could indicate that adults and adolescents are likely to have systematically different preference values for the same health states.
- Another study in an adolescent population is ongoing to elicit an adolescent valueset for the WAItE using the OPUF.

Thank you for listening