Employing psychological distance to explain perspective-specific EQ-5D-Y-3L health state valuation

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Employing psychological distance to explain perspective-specific EQ-5D-Y-3L health state valuation

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Abstract

Background

EQ-5D-Y-3L is an instrument used for health state valuation in pediatric populations. Previous studies have shown that composite time trade-off (cTTO) utilities obtained for this instrument are typically higher when adults value health states on behalf of a 10-year-old child (child perspective) than when they value them for themselves (adult perspective). In this study we adopted construal level theory (CLT) to explore if these differences between child and adult perspectives can be understood through variations in psychological distance.

Methods

We conducted online cTTO interviews with 150 adults in the UK, valuing 4 health states using perspectives that experimentally combine high and low psychological distance across all four dimensions of psychological distance defined in CLT (social, temporal, spatial, and hypothetical). We investigated how each dimension influences the mean, variance, and data quality of EQ-5D-Y-3L utilities.

Results

Our results indicate a trend of higher mean utilities and lower variance in perspectives with higher psychological distance. Each dimension of psychological distance has a unique effect on cTTO utilities, with hypothetical distance having the strongest effect and spatial distance being the only one with a negative association. In none of the dimensions, data quality is affected when psychological distance increases.

Conclusions

Overall, the utility difference between adult and child perspectives in EQ-5D-Y-3L valuation may partially be explained by psychological distance. Future research could explore ways to minimize or account for psychological distance effects, such as refining the wording of perspective descriptions in valuation tasks, to ensure greater clarity and consistency in responses.

1. Introduction

The quality-adjusted life year (QALY) is a metric used in health economic evaluations to measure the health gains (or losses) of healthcare interventions. It is calculated by multiplying the duration in which health gains (or losses) are experienced with a utility weight, i.e., the value of the health state, which reflects the health-related quality of life (HRQoL) associated with the health gains (or losses) (1). Several preference-accompanied instruments are used to estimate these utilities, among which EQ-5D, developed by the EuroQol Group, is one of the most widely used tools for this purpose in adult populations (2). With the attention to measuring HRQOL among pediatric patients growing (3), the EuroQol Group developed a new instrument, EQ-5D-Y-3L, based on the adult version EQ-5D-3L, by adjusting the wording to be more suitable for children (4).

The use of EQ-5D-Y-3L in economic evaluation is enabled by country-specific value sets derived from preferences for EQ-5D-Y-3L health states (5,6). In line with the EQ-5D-Y-3L valuation protocol used to generate these value sets (7), the composite time trade-off (cTTO) method is one of the methods that is used to elicit these preferences for EQ-5D-Y-3L health states. cTTO involves trade-offs between lives of different lengths, and is comprised of two methods, the conventional time trade-off (TTO) for health states considered better than dead (BTD); and the lead-time trade-off (LTTO) when death is preferred to an ill health state (implying that the state is considered worse than dead, WTD) (8). The conventional TTO was demonstrated as a simple and reliable way to measure health state preference in adults (9), where respondents are asked to make trade-offs between living in impaired health for a time frame of 10 years and a shorter time (X) less than 10 years in full health until an indifference point is found. LTTO, on the other hand, entails making decisions between X years in full health, and 10 years in full health followed by 10 years in the impaired health state. The values obtained from this combination of methods, cTTO utilities, range between -1 and 1, where -1 results from trading off all years of the lead time and 1 results from not giving up any years in the impaired health state.

Unlike adults who traditionally value health states for themselves in valuation studies for adult EQ-5D instruments (10), referred as the *adult perspective*, children do not participate in this valuation process due to concerns about ethics and their limited ability to understand complex preference elicitation tasks (11). Adults, instead, are asked to take the perspective of a 10-year-old child to value health states for EQ-5D-Y-3L, referred as the *child perspective*. Researchers have shown increasing interest in the question of how a shift from the adult to the child perspective may impact the derived health utilities and have explored this topic both qualitatively (12,13) and quantitively (14-18). Collectively, these studies suggest that valuing health for a child is different from valuing health for adults and there is a wide array of contextual factors that play a role in the child perspective (12,13,19). However, the direction in which this change in perspective influences cTTO utilities is not completely clear as current evidence is mixed. Some quantitative work found higher utilities in the child perspective (18,20), while others found little difference between the two perspectives (12,21). Besides, lower data quality and lower variance of utilities derived from EQ-5D-Y-3L health states valued with a child perspective were reported in another study (16). Overall, the evidence suggests that the use of child (rather than adult) perspectives, to some extent, affects EQ-5D-Y utilities, as well as their variance and data quality.

Most of these aforementioned studies aimed to compare these two perspectives or to investigate different reasons why they could affect EQ-5D-Y valuations, but did not use particular theoretical frameworks. In our view, the next step is to explore if the observed effects in those studies can be further explained by an existing theoretical framework. Following the suggestion from a previous study (16), we apply construal level theory (CLT) in this study to investigate why and how the change of perspective could affect EQ-5D-Y valuation.

CLT is a theory developed in social psychology, which explains individuals' thinking and reasoning (i.e., their construal) as a function of psychological distance (22). Psychological distance is decomposed into four dimensions: social, temporal, spatial and hypothetical distance (23). First, being socially distant or close refers to the distance between one self and other people (e.g., yourself vs. a stranger) (24); second, experiences or events in the past or future generate temporal distance, compared with the present (e.g. the time in primary school versus the time at university); third, the spatial remoteness between a location and the current whereabouts creates spatial distance (e.g. Netherlands vs. United Kingdom); finally, hypothetical distance describes how distant the hypothetical scenarios are compared to reality, for example, having had a disease oneself or having a close family member experiencing it vs. having only heard about it in the media. In CLT, the higher the psychological distance between the respondents and the concepts they are asked to consider, the more abstract their reasoning can be, and vice versa, a lower distance results in more concrete and detailed reasoning (22). Therefore, when distance increases, reasoning at higher levels of abstractness may lead people to agree more when they make decisions on a commonly imagined subject. For example, when individuals are asked to imagine spending this weekend at their parents' place, people will have a concrete while heterogeneous construal, as opposed to spending a weekend next year in a place that they have never been to. Compared with the low distance (a weekend at your parents' house), where the concrete benefits and barriers (e.g. Mom's cooking, conflicting plans, traffic jams, family tensions) come to mind easily and vary between individuals, subjects considering a weekend away next year may have a more homogenous construal (e.g. exploring a new place, getting away from daily stress).

In this study, we extend this theoretical framework to study EQ-5D-Y-3L valuations. Several studies have applied CLT in different domains. One study found that framing climate communications in a way that reduces psychological distance was effective for enhancing public engagement upon climate change (25). Construal levels are also considered significant for marketing strategies that are recommended to be tailored for consumers with low and high construal levels (26). In a study on consumer behaviors, people were found to make different choices for themselves than for others when social and temporal distance were involved (27). In the health domain, previous research focused on health behaviors, such as eating behavior that was suggested to be indirectly affected by construal levels

(28). Little is known about the role of CLT in health state valuation, except for a study (16) that found lower variance of utilities from cTTO tasks when health states are valued for someone else (a 10-year-old child) than for themselves. The latter may be explained in the context of CLT because the rather abstract construal level resulting from imagining other people experiencing a health state would lead to homogenous decision making among respondents compared to imagining themselves in those health states. That is, respondents have more varied views for their own health than for a 10-year-old child, who they represent abstractly due to psychological distance. Our research extends this and incorporates psychological distances more explicitly in the study of health valuation.

In the context of EQ-5D-Y-3L valuation, we explore how psychological distance, manipulated in a purposively designed experimental design, could contribute to valuation outcomes. Specifically, we examine whether psychological distance affects mean utilities, for each of the aforementioned dimensions. Additionally, we investigate whether an increase in psychological distance could lead to lower variance in utilities, as individuals may rely on more abstract thinking, potentially resulting in more consistent valuations (when compared across individuals). We also investigate if data quality is affected when CLT is involved in health state valuation. Finally, we seek to understand the separate effects of each dimension of psychological distance.

2. Experiment

2.1 Experimental design

2.1.1 Health states

EQ-5D-Y-3L health states are described using five dimensions, i.e., mobility, looking after myself, doing usual activities, having pain or discomfort, and feeling worried, sad, or unhappy; and three levels of description within each dimension: no problems (level 1), some problems (level 2), and a lot of problems (level 3). For brevity in reporting, 5-digit numbers are used to summarize a specific health state, for example, 32323 refers to the health state with a lot of problems with walking about, some problems with looking after myself, a lot of problems with doing usual activities, some pain or discomfort, very worried, sad, or unhappy. In this experiment, we selected four health states varying from mild to severe in our study: 11312, 22222, 32323, and 33333. These states were selected from previous studies using a similar software operationalization (16,21). Note that we included only four health states as this study relies on a within-subjects design (see section 2.2.3), i.e. each respondent valued all health states included *four times.*

2.1.2 The manipulation of psychological distances

In this study, we explore the effect of psychological distance by experimentally manipulating the four dimensions of distances identified in CLT: social, temporal, spatial and hypothetical. Key to our manipulation is to combine different selections of 'low' and 'high' distances across these dimensions in the context of EQ-5D-Y-3L valuation, i.e., integrate them in the questions asked in health state valuation, such that the effect of each dimension can be separately estimated.

Social distance, originally defined as the remoteness in the social environment (29), is here categorized as ‘low’ when individuals value health states for themselves and ‘high’ when valuing health states for another person. We also modified temporal distance in our study [1], which reflects the difference in the age of the person imagined to be in the health state and the individual valuing the health state (note: this could be the same person). It is categorized as low, when participants value health states for adults (e.g., themselves or another adult of their age), and as high when participants value health states for a 10-year-old child (e.g., themselves as a child or another child). Age serves as a proxy for temporal distance, with adults and children representing different points in the lifespan. For

[1] While CLT typically defines temporal distance as the psychological distance related to time, in this study, we interpret temporal distance as the psychological difference between valuing health states for adults and for 10-year-old children. This adjustment was made to align distance more closely with specific age-related context of this research.

simplification, when valuing for other adults, we explicitly stated they are of a similar age as the participant.

Spatial distance, reflecting physical separation, is 'low' for valuing the health of someone geographically close and 'high' for those further away (e.g., another place provided by the participant within the same country). This is achieved by contextualizing questions with information on where respondents live (or lived as a child), collected at the beginning of the interview. For instance, when asking participants to value health states for their 10-year-old selves, 'low' spatial distance is created by referencing the location where they grew up, while 'high' spatial distance could involve another location they provided within the same country.

Hypothetical distance reflects how real an imagined scenario feels, coded as 'low' for familiar health states and 'high' for unfamiliar ones. Familiarity was assessed by having participants rank four health states from 1 (most familiar) to 4 (least familiar) based on direct or indirect experience, which was then dichotomized into low (1–2) and high (3–4).

Note that because experience with illness is endogenous, only the other three dimensions of psychological distance could be experimentally manipulated. In our experiment, we dichotomized these three dimensions into 'low' or 'high', and combined this into eight distinct combinations of questions, with an example illustrated in Table 1. To simplify the task, we introduced a 'cubic walk' approach (Appendix A), with three dimensions representing social, temporal, and spatial distances and the eight vertices corresponding to the eight perspectives, in which psychological distance steadily increased from perspective 1 to perspective 8.

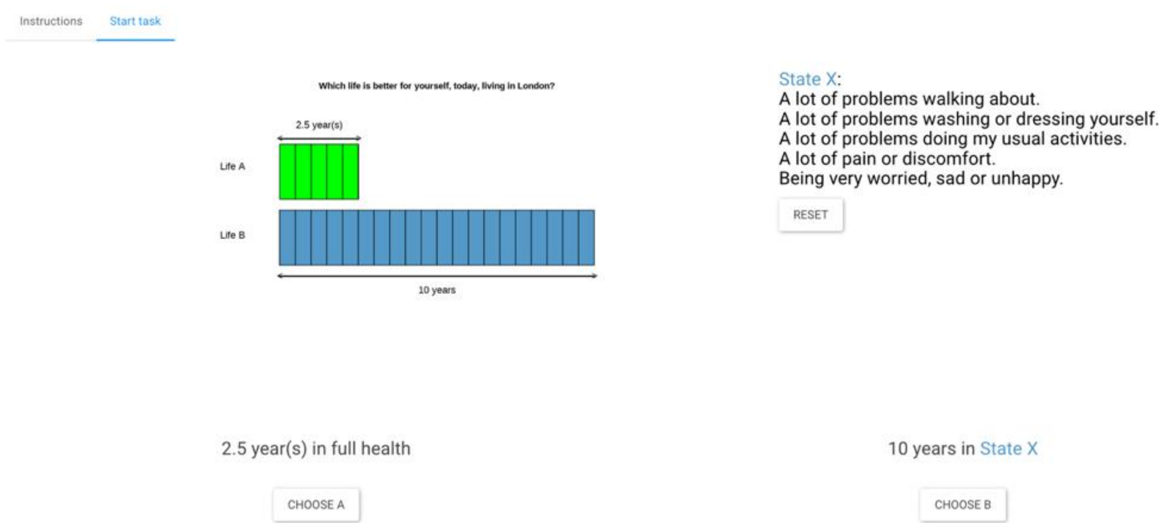
Table 1. Eight combinations of perspectives in operationalization.

Perspective	Operationalization	Social	Temporal	Spatial	Distance level
No. 1	Which is better for yourself, today, living in London?	Low	Low	Low	D1
No. 2	Which is better for another adult, today, living in London?	High	Low	Low	D2
No. 3	Which is better for yourself, today, living in Birmingham?	Low	Low	High	D2

No. 4	Which is better for another adult, today, living in Birmingham?	High	Low	High	D3
No. 5	Which is better for yourself, as a 10-year-old child, growing up in Birmingham?	Low	High	Low	D2
No. 6	Which is better for a 10-year-old child (not you), growing up in Birmingham?	High	High	Low	D3
No. 7	Which is better for yourself, as a 10-year-old child, growing up in London?	Low	High	High	D3
No. 8	Which is better for a 10-year-old child (not you), growing up in London?	High	High	High	D4

Instead of completing 32 valuations (eight perspectives × four health states), participants valued health states from four perspectives (D1–D4), progressing from minimal (similar to the adult perspective typically used) to maximal (similar to the child perspective typically used) psychological distance. Intermediate points (D2 with one "high" distance, D3 with two) were randomly selected, with paths across the cube (e.g., 1-5-6-8) randomized to ensure varied representation. This design reduced the task load to 16 valuations while still capturing the full progression of psychological distance. An example of how CLT was integrated into the EQ-5D-Y-3L cTTO task is shown in Figure 1.

Figure 1. Screenshot of cTTO task integrated with phycological distances.



2.2 Experimental procedure

2.2.1 Process

After obtaining ethics approval (ESHPM ETH2122-0416), we first piloted the study with three colleagues to test the design and Shiny software. In the main study, participants gave informed consent, answered demographic questions (age, employment, marital status, gender; Appendix B), and provided location details (current residence, childhood location, and two additional places) to enable spatial distance manipulations. They then self-reported health using EQ-5D-Y-3L (including a visual analog scale, EQ-VAS) before completing the main task: valuing 16 health states across four perspectives (Section 2.1). At the end, respondents reported religion, parenthood, and subjective life expectancy for themselves and a 10-year-old child. Full question wordings and screenshots are provided in Appendix C.

2.2.2 *Sample description and data collection*

A total of 150 participants were recruited from the UK general public through the online platform, Prolific. This sample size was selected to yield over 100 observations per health state in most perspectives, which is in line with the sample size used in most health state blocks in other EQ-5D valuation research (30,31). A larger sample size was desired but not feasible in our study due to budget constraints. All individual interviews were conducted digitally, with the assistance of a Shiny software package designed for this study (available on request) and tele-platform, Zoom, by an experienced interviewer (ZL) who instructed respondents throughout the entire process. Each participant was compensated 10 GBP upon the completion of the interview, lasting for approximately 45 minutes. Data collection lasted for two months, from March 2022 till May 2022.

2.2.3 cTTO operationalization

cTTO tasks were programmed in Shiny using a 6-step bisection procedure to reduce choices and speed up data collection. As is typical for cTTO, conventional TTO was applied for health states better than dead (BTD) and LTTO for worse than dead (WTD), with a 10-year duration for impaired health (8) and 10 years of full health for lead-time TTO, following common practice (30). To familiarize respondents, two warm-up tasks were included in the adult perspective: valuing life in a wheelchair and then a health state better or worse than wheelchair, allowing both BTD and WTD arms to be demonstrated. This is typically referred to as *the wheelchair example* and is a standard practice task included in EQ-5D valuation studies (10). Participants then valued preselected health states presented in random order.

2.3 Statistical analysis

We analyzed the effects of psychological distance on mean utilities, variance, and data quality in two stages. First, we compared utilities across aggregated distance levels (D1–D4, see also Table 1), using paired t-tests and mixed-effects regression for means and F-tests for variance; hypothetical distance was excluded since it was not experimentally manipulated. Low distance was coded as 0, and high distance as 1. The aggregated distance is calculated by summing the values across the four dimensions. For example, if hypothetical and spatial distances are low (0), and temporal and social distances are high (1), the total distance score would be 2. Second, we disaggregated each distance dimension, including hypothetical distance, testing for differences between low and high distance with mixed-effects regression for mean utilities and a Bayesian hierarchical model with heteroskedastic variance estimation to compare variance between distance dimensions. Building upon prior research using Just Another Gibbs Sampler (JAGS) approaches (32), we used the *brms* package in R which relies on Stan's Hamiltonian Monte Carlo (HMC) and the No-U-Turn Sampler (NUTS) for faster, more stable convergence and easier modeling of heteroskedasticity (i.e., modeling variance as a function of psychological distance). It is worth noting that data quality was examined by using a range of data quality indicators from a previous study (21), including non-trading, all-in-trading, dominance violations, and clustering of responses.

3. Results

3.1 Sample description

Table 2 displays the demographic characteristics of our study's participants alongside a comparison with UK population data in 2023 (33). Our sample predominantly consisted of individuals aged 40 to 64, comprising the majority, while those over 65 represent 12%, slightly lower than the census figure of 19.1%. Approximately 63% of our sample consisted of female participants, a figure that exceeded the census proportion where females made up 51% of the population. The anticipated life expectancy for children in our study's demographic was 86.3 years, surpassing the adult life expectancy of 82 years. Additionally, over half of the respondents had children, and fewer than one-third identify as religious.

Table 2. Summary of demographics collected in the sample.

Variables	Percentage	Mean	Standard deviation
Age		44.8	13.9
18-39	40		
40-64	48		
65+	12		
Gender			
% Male	37.3		
% Female	62.7		
% Other	0		
Health status: EQVAS		78.7	16.5
Expected age of own death		82	9.3
Expected age of death of child of 10 years		86.3	10.5
Having children	62		
Being religious	28.7		

3.2 Average effect of increasing psychological distance by health state

3.2.1 Mean utilities

We examined mean utilities across four levels of psychological distance (D1–D4). As shown in Figure 2, utilities generally increased with distance, with significant differences for severe health states (32323, 33333) in several comparisons (e.g., D1 vs. D4, D2 vs. D4, shown in Appendix E), but these did not remain significant after Bonferroni correction. This suggests a trend toward higher utilities with greater distance, but with weak statistical evidence. To test this further, we used mixed-effects regression, aggregating distance dimensions into a single score (0–4). Results showed a positive, significant association between psychological distance and cTTO utilities, which remained robust after adjusting for demographics (Table 3).

Figure 2. The effect of increasing psychological distance on mean utilities.

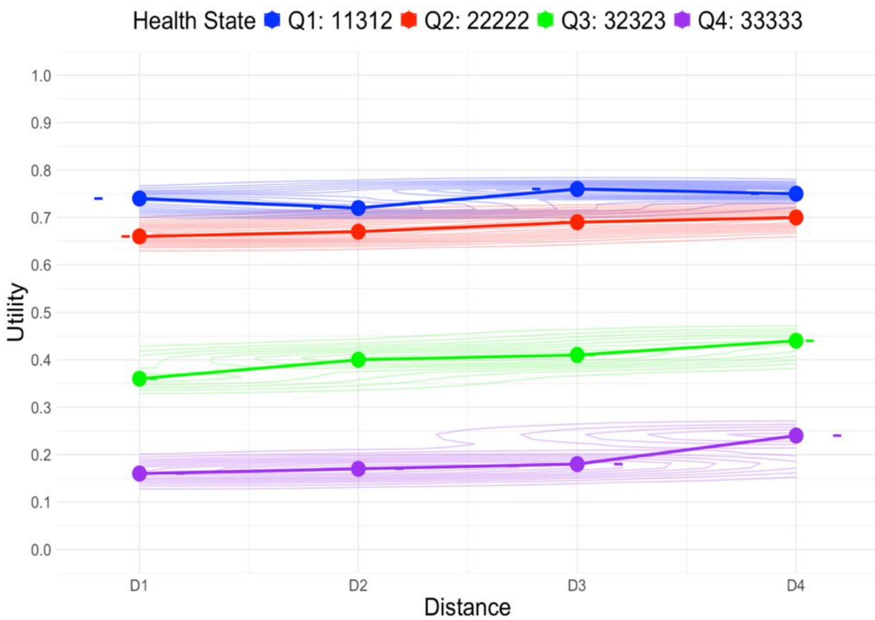


Table 3. Mixed effects regression for EQ-5D-Y utilities by distance, coefficients reported with standard errors in brackets.

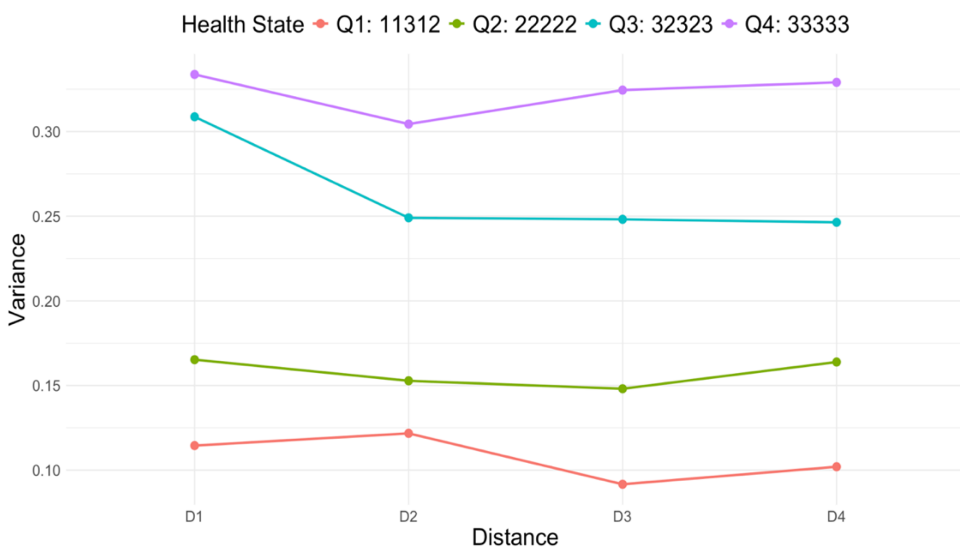
	Model 1	Model 2
Aggregated distance	0.02 (0.01) ***	0.02 (0.01) ***
11321	0.56 (0.02) ***	0.56 (0.02) ***
22222	0.50 (0.02) ***	0.50 (0.02) ***
32323	0.22 (0.02) ***	0.22 (0.02) ***
EQVAS		-0.00 (0.00)
Age		-0.00 (0.00)
Male (reference: female)		0.02 (0.06)
Being religious (reference: not religious)		0.08 (0.06)
Having kids		-0.00 (0.06)
Subjective life expectancy for yourself		-0.00 (0.00)
Subjective life expectancy for a 10-year-old child		0.01 (0.00) ***
Constant	0.13 (0.03) ***	-0.66 (0.29) **

Note: 1) HS 33333 was used as the reference category. Dummy variables (for states 11321, 22222, 32323) were included in the regression, representing differences in utility compared to 33333. 2)* indicates a significant difference at 10% level; ** indicates significant difference at 5% level; *** indicates significant difference at 1% level.

3.2.2 Variance in utilities

To examine how increasing distance could affect the variance in utilities, we conducted F-tests comparing variance across all distance pairs (D1 vs. D2, D1 vs. D3, etc.) and visualized the variance trends as shown in Figure 3, with additional figures on the spread of utilities presented in Appendix A (Figures A2 and A3). The results indicated that variance did not significantly differ in most comparisons, with the only significant pair being D2 vs D4 for HS 32323 and HS 33333, suggesting that increasing distance did not systematically lead to changes in variance of utilities. Across all distance pairs, four health states exhibited fluctuations with a relatively directional trend towards lower dispersion at longer distances. Overall, these findings suggest that some differences in response similarity across respondents may be observed across levels of distance; variance in utility responses remains overall unaffected by increasing distance.

Figure 3. The effect of increasing psychological distance on variance in utilities.



3.3 Average effects of increasing psychological distance per dimension

3.3.1 Mean utilities

We also used mixed effects regression to examine the effects of increasing psychological distance per dimension. Table 5 presents two mixed-effects regression models. Across all models, the three health states consistently showed higher utilities compared to the baseline health state 33333. Model 2 includes individual psychological distance dimensions but excludes demographic variables. Hypothetical distance emerged as the strongest predictor of utility, followed by social and temporal distance, both of which had small but significant positive effects on utilities. Spatial distance, in contrast, had a relatively weaker, negative, and marginally significant effect, suggesting some uncertainty about its impact. This result implies that cTTO utilities might decrease as spatial distance increases, but the evidence remains inconclusive. In Model 2, which incorporates demographic variables, the results for the psychological distance dimensions remain largely unchanged. Temporal distance still has a small but significant, positive effect on utilities, while hypothetical distance continues to have the strongest effect. Among demographic variables, only subjective life expectancy for children shows a significant and positive association with cTTO utilities, suggesting that those who expect children to become older tradeoff fewer life years in cTTO tasks.

Table 4. Mixed effects regression on EQ-5D-Y utilities by dimension.

cTTO utilities	Model 1	Model 2
HS 11321	0.57 (0.02) ***	0.57 (0.02) ***
HS 22222	0.50 (0.02) ***	0.50 (0.02) ***
HS 32323	0.22 (0.02) ***	0.22 (0.02) ***
Social distance	0.04 (0.02) **	0.04 (0.02) **
Temporal distance	0.04 (0.02) **	0.04 (0.02) ***
Spatial distance	-0.03 (0.02) *	-0.03 (0.02) *
Hypothetical distance	0.07 (0.01) ***	0.07 (0.01) ***
EQVAS		-0.00 (0.00)
Age		-0.00 (0.00)
Gender		0.02 (0.06)
Being religious		0.08 (0.06)
Having kids		-0.00 (0.06)
Subjective life expectancy for adults		-0.00 (0.00)
Subjective life expectancy for a 10-year-old child		0.01 (0.00) ***
Constant	0.12 (0.03) ***	-0.67 (0.28) **

Note: 1) 33333 was used as the reference category. Dummy variables (11321, 22222, 32323) were included in the regression, representing differences in utility compared to 33333. 2) * indicates significant difference at 10% level; ** indicates significant difference at 5% level; *** indicates significant difference at 1% level.

3.3.2 Variance of EQ-5D-Y utility

We used a Bayesian model to examine how psychological distance affects variance in TTO utilities. Details on the modelling approach are provided in Appendix D, but essentially the model estimates utilities drawn from a posterior distribution in which both the mean and the standard deviation can be affected by psychological distance. For every dimension, a scaling parameter γ is estimated that captures if variance increases going from low to high distance on the dimension. Higher temporal distance reduced variance (γ=−0.13, 95% Credible Interval: [-0.20, -0.07]), indicating more similar valuations across respondents, while higher spatial distance increased variance (γ=0.11, 95% CI: [0.04, 0.17]), suggesting less similarity. Social distance (γ=−0.02, 95% CI: [-0.09, 0.04]) and hypothetical distance (γ=−0.03, 95% CI: [-0.10, 0.04]) had a negative but negligible impact on variance, indicating that response consistency was similar whether respondents were evaluating health for themselves or others. Overall, temporal distance improved response similarity, spatial distance reduced it, and the other dimensions did not substantially alter valuation patterns.

3.3.3 Data quality in utilities

A summary of statistics regarding data quality is presented in Table 6. The first row shows that non-trading responses are more frequently observed for high distances. Chi-square tests for proportions were conducted for all pairs across each level. None were found to be significant. The total number of utilities equal to 1, -1, and 0 were 362 (15%), 104 (4.3%) and 81 (3.4%), respectively, with 2400 observations in the whole dataset. All-in trading (U=-1) and zero responses (U=0) were similarly distributed across all levels. Overall, the data quality is sufficient, with a low number of strict violations of dominance ranging between 6% and 7%, and weak dominance between 24.8% and 29.1%. These figures are comparable to another study using a similar approach (31), in which strict violation occurred at a rate between 6.4% and 7.5% and weak violation between 25.2% and 30.9%.

Table 5. Data quality across all perspectives of low and high psychological distance in each dimension.

	Sample size	Non-trading responses U=1	All-in trading responses U=-1	Zero responses U=0	Sample size	All states valued same (within the perspective)	Sample size	Weak dominance violation (e.g., U (32323) <= U (33333))	Strict dominance violation (e.g., U (32323) < U (33333))
Social low	1232	167 (13.6%)	60 (4.9%)	46 (3.7%)	308	16 (5.2%)	308*3=924	229 (24.80%)	55 (6.00%)
Social high	1168	195 (16.7%)	44 (3.8%)	35 (3.0%)	292	21 (7.2%)	292*3=876	255 (29.10%)	61 (7.00%)
Temporal low	1212	176 (14.5%)	56 (4.6%)	38 (3.1%)	303	16 (5.3%)	303*3=909	233 (25.60%)	59 (6.50%)
Temporal high	1188	186 (15.7%)	48 (4%)	43 (3.6%)	297	21 (7.1%)	297*3=891	251 (28.20%)	57 (6.40%)
Spatial low	1156	167 (14.4%)	47 (4.0%)	35 (3.0%)	289	18 (6.2%)	289*3=867	239 (27.60%)	57 (6.60%)
Spatial high	1244	195 (15.7%)	57 (4.6%)	46 (3.7%)	311	19 (6.1%)	311*3=933	245 (26.30%)	59 (6.30%)
Hypothetical low	1040	151 (14.5%)	48 (4.6%)	45 (4.3%)	-[a]	-[a]	-[a]	-[a]	-[a]
Hypothetical high	1360	211 (15.5%)	56 (4.1%)	36 (2.6%)	-[a]	-[a]	-[a]	-[a]	-[a]

Note: Analyses in columns -[a] were not reported as it is not possible to compare utilities of health states in hypothetical distance since it was defined differently than the other 3 dimensions, as explained in the method section.

4. Discussion

Our exploratory study set out to develop a new approach to understand how (child and adult) perspective with different psychological distances, as conceptualized by CLT, influence the mean, variance, and data quality of EQ-5D-Y-3L utilities.

Our results suggest that mean utilities increase with psychological distance, particularly for severe health states (32323, 33333). Aggregated across dimensions, greater distance was positively associated with utilities, suggesting less willingness to trade off life years. However, the effects on mean utilities were not uniform when each dimension was examined separately, highlighting the complexity of this relationship. First, hypothetical distance had the strongest positive effect: less familiar states were valued higher even after controlling for severity. Second, temporal and social distances also raised utilities, consistent with CLT, as abstract thinking about distant states may reduce perceived severity and willingness to trade. Third, spatial distance showed a small negative effect, with more distant locations linked to lower utilities, though only marginally significant.

These findings contribute to the previous evidence on utility differences between child and adult perspective (12,18,20) and align with the broader arguments that decision making is shaped by psychological distance (34). In line with previous research suggesting that a higher-level construal is associated with a preference for desirable outcomes (35), our findings suggest that when valuing health states for a psychologically distant child, respondents may exhibit an enhanced sensitivity towards the child’s imaginary life, i.e., they may focus more on the abstract ideal of preserving life itself, rather than weighing specific health impairments. This sensitivity and shift in focus might reduce their willingness to trade off years, thereby resulting in higher utilities. While it remains an open question whether the “desirable outcome” in this context is longer life or better health, our findings suggest that for distant others such as children, the emphasis may lean more toward life preservation. In addition, we explored whether variance of health utilities might decrease with greater psychological distance, based on the intuition that respondents could converge on more similar valuations when assessing health states from more distant perspectives (22). Previous studies suggested that respondents may have a more concrete construal level for their own health, allowing them to consider specific external factors that might potentially affect their valuation, such as subjective life expectancy (36). Indeed, think-out-loud interviews (13) also revealed that when adults took the child perspective in health valuation, such factors became less concrete, for example, life events and goals. However, our findings present a more nuanced picture, as different dimensions of psychological distance appeared to influence variance in distinct ways. Temporal distance reduced variance, consistent with more abstract, generalized judgments across age groups. In contrast, spatial distance increased variance, possibly because respondents struggled to relate to unfamiliar locations. Social and hypothetical distances had little impact, suggesting that evaluating for oneself versus others, or familiar versus unfamiliar states, does not systematically change response consistency. These mixed results indicate that CLT alone cannot fully explain variance patterns, and other mechanisms such as uncertainty, cognitive effort, or contextual familiarity may also be influential. Further research should test whether spatial familiarity may moderate variance and whether temporal effects persist across valuation methods.

Taken together, these findings suggest that at least part of the well-documented gap between child and adult perspective valuations may be attributable to differences in psychological distance. In other words, higher utilities observed in child perspective valuations do not necessarily reflect differences in how respondents value children's health per se but may partially result from the more distant construal involved.

Our findings do not suggest a systematic decline in data quality with increasing psychological distance. Non-trading responses ranged between 13% and 16%, lower than those reported in previous research (21,31). All-in trading responses (U = -1) and zero responses (U = 0) each accounted for less than 5% of responses, indicating that extreme response behaviors were relatively uncommon. Formatting... Our strict violation rate is comparable to a previous study that used four health states (31), while slightly higher than the range reported in another related study (21). This difference may be attributed to the larger sample size in the latter study, which likely smoothed out inconsistencies, and the presence of more intermediate health states, which facilitated a more gradual and logical progression in health state valuations, thereby reducing the likelihood of strict violations.

A key consideration arising from our findings is whether the observed effect of psychological distance on utilities is desirable or problematic. On the one hand, if the difference in utilities between child and adult perspectives is primarily driven by psychological distance rather than genuine differences in how respondents perceive health states, this may introduce bias into valuation tasks. Higher psychological distance may inflate utility scores, potentially underestimating the true burden of childhood health conditions. This could have implications for health economic evaluations (15), where the underestimated disutility for child health states may lead to lower QALY gains and, consequently, less prioritization of pediatric health interventions. Furthermore, if utility scores fluctuate depending on how psychologically distant the respondent perceives the child to be, this introduces instability in valuation outcomes, raising concerns about the consistency and comparability of child health valuations across studies. On the other hand, psychological distance effects may not necessarily be distortions but rather a reflection of how individuals naturally approach child health valuations. In public health decision-making, policymakers often evaluate health states from a socially distant perspective, considering long-term benefits and broader population-level outcomes rather than immediate personal suffering. In this context, increased psychological distance may align with how societal decisions about healthcare resources are made. Additionally, since adults cannot directly experience childhood health states, abstraction is an unavoidable part of the valuation process. If psychological distance helps structure this reasoning in a more systematic and generalized way, its effect on utility scores may not be entirely undesirable. Ultimately, whether the effect of psychological distance should be controlled for or incorporated into health state valuation frameworks depends on the intended use of utilities—whether as a measure of individual subjective experience or as a tool for societal decision-making.

There are several limitations of our study. First, online video interviews were conducted instead of in-person interviews, although it is not evident that online data collection leads to less credibility (16,37,38). Second, the within-subject data collection design may have introduced anchoring or order effects as individuals tend to rely on the anchoring heuristic that could lead them to base subsequent decisions on their previous responses (39). This anchoring effect could distort the distribution of responses and reduce the variability in valuations. Further research is encouraged to apply psychological distance in a between-subject experiment design, where each respondent only evaluates one health state (or every health state once). Third, only four health states were included in this study, impeding the comparison of results with other studies using more health states (5,40-42). In addition, our goal was to estimate the effect of each dimension of psychological distance, so the included perspectives may seem to be unnecessarily burdensome for health state valuation in practice. For example, in practice, individuals' spatial location is hardly relevant for real-life health state valuation. We encourage further research to investigate the effects of psychological distance by using perspectives with more practical relevance. Fourth, while the bisection approach improved efficiency in cTTO tasks, it may have increased cognitive burden, potentially reducing accuracy. Furthermore, most EQ-5D valuation studies employ titration-based elicitation procedures instead, restricting generalizability. Finally, our evidence is indirect, in the sense that we observed a utility difference between different perspectives but did not directly test our theory and measure psychological distance. Therefore, these interpretations should be approached with caution, and we encourage further research to directly examine the effects of psychological distance on health state valuation.

5. Conclusion

Our findings indicate that higher psychological distance is generally associated with increasing utilities, especially for severe health states, though effects differ by dimension. Temporal distance reduced variance, and data quality was unaffected. As CLT alone cannot fully explain these patterns, further research should experimentally test psychological distance across contexts to ensure utility estimates better reflect health preferences and support healthcare investments.

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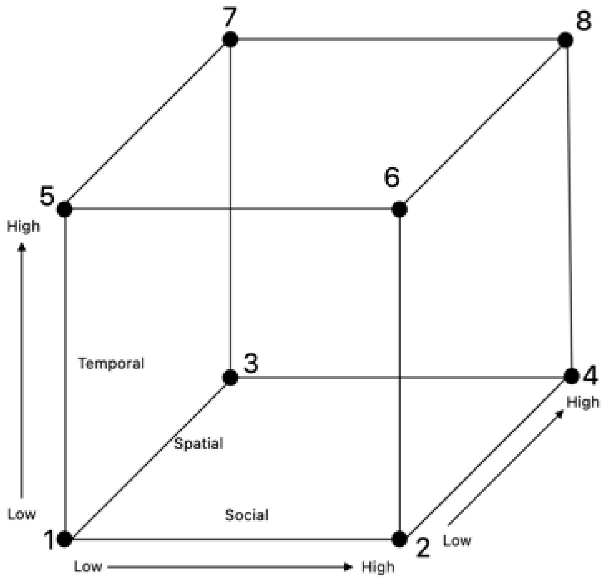
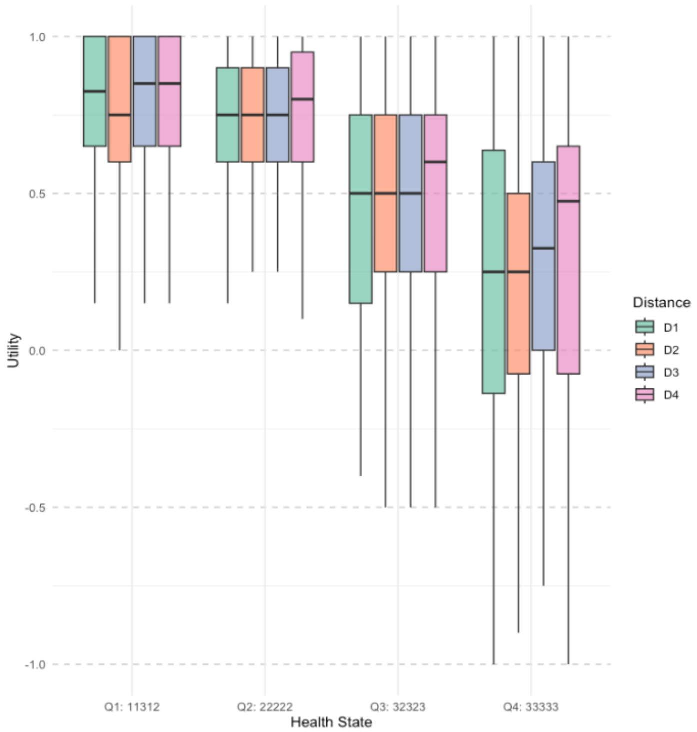
Appendix A. Supplementary figures

Figure A1. The cubic walk experimental design.



Note: in this cube, the three dimensions represent three psychological distances: temporal, spatial and social. Each participant values from four perspectives, the bottom left starting point of the cube (D1) — the minimum psychological distance comparable to adult EQ-5D evaluations — to the top right corner, representing the maximum psychological distance (D4). Along this journey, participants would also value health states at two intermediate points, namely D2 and D3 (where D2 means one distance is 'high', and D3 means two distances are 'high'), chosen randomly to ensure a varied representation of the intermediate psychological distances. Examples of potential paths include 1-5-6-8, 1-3-7-8, or 1-2-6-8. Regardless of the chosen path, the process covered a progression from the most concrete (D1) to the most abstract (D4) perspectives.

Figure A2. The effect of increasing psychological distance on the spread of utilities.



Appendix B. Demographic questions asked in the interview

1. What is your sex?

Male

Female

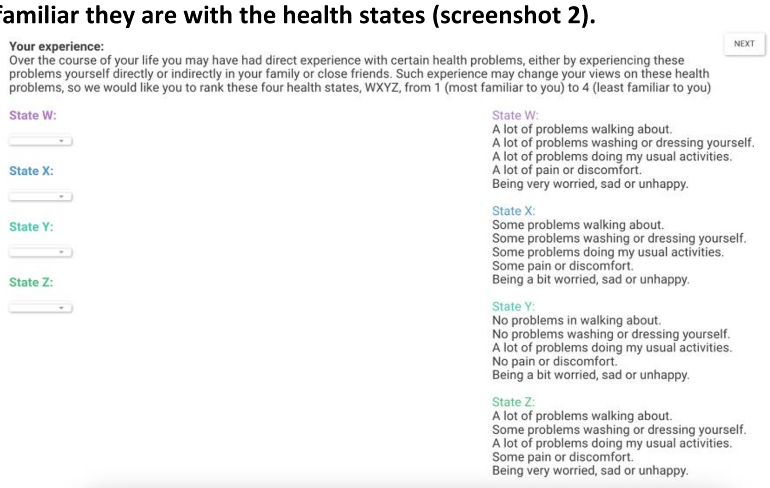
Other

2. What is your age?
3. What is your employment status?
4. What is your marital status?

5. Do you have children?
Yes
No
6. Are you religious?
Yes
No
7. What is your life expectancy for an adult?
8. What is your life expectancy for a 10-year-old child?

Appendix C. Screenshots of psychological distance manipulation in the interview

Figure C1. Hypothetical distance manipulation: we ask respondents to rank (screenshot 1) and choose how familiar they are with the health states (screenshot 2).



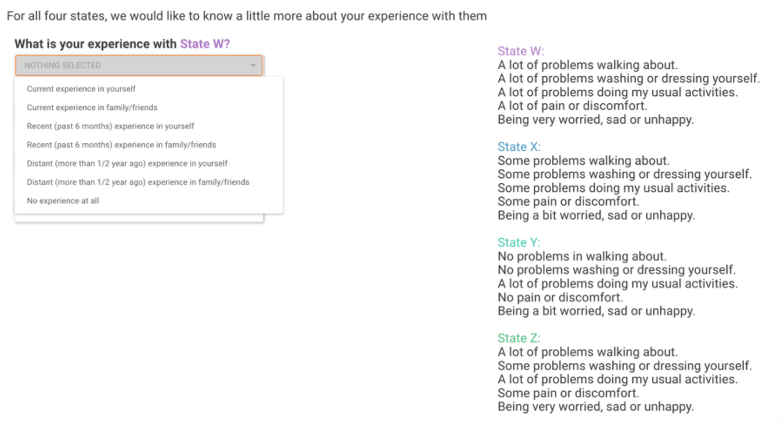


Figure C2. Spatial distance manipulation: we ask respondents about their location information before moving to the main task.

In which city do you live?

london

Please name another city in the same country:

oxford

In which city did you grow up?

manchester

Please name another city in the same country:

cambridge

In the main cTTO questions, respondents would then be asked to choose between two health states by considering additional conditions (spatial, temporal and social factors), compared to the traditional questions asked in cTTO tasks. Example questions are as follows:

1. Please choose between these two health states, considering yourself, as a 10-year-old, growing up in Cambridge, which one do you think is better?
2. Please choose between these two health states, considering a 10-year-old child, growing up in Manchester, which one do you think is better?
3. Please choose between these two health states, considering yourself, today, living in London, which one do you think is better?
4. Please choose between these two health states, considering a 10-year-old, , growing up in Oxford, which one do you think is better?

Appendix D. Bayesian modelling description and R code

Our model consisted of two key components:

1. Mean Model (TTO Valuations as a Function of Psychological Distance):

$$y_i \sim N(\mu_i, \sigma_i^2)$$

where the mean utility (μi\mu_iμi) for respondent iii is modeled as:

$$\mu_i = \beta_0 + \beta_1 \cdot social_i + \beta_2 \cdot temporal_i + \beta_3 \cdot spatial_i + \beta_4 \cdot hypothetiocal_i + u_{ID}$$

with a random intercept (u_{ID}) to account for individual differences in TTO preferences.

2. Variance Model (Heteroskedastic Variance as a Function of Psychological Distance):

$$\log(\sigma_i^2) = \gamma_0 + \gamma_1 \cdot social_i + \gamma_2 \cdot temporal_i + \gamma_3 \cdot spatial_i + \gamma_4 \cdot hypothetical_i$$

This specification allows psychological distance factors to influence not only the mean, but also the variability of TTO responses.

Priors for regression coefficients were set as weakly informative normal priors (N(0,1), and a Student-t prior ($\nu=3, \mu=0, \sigma=2.5$) was used for the variance of random effects. The model was estimated using four Markov Chain Monte Carlo (MCMC) chains, each with 4,000 iterations (2,000 warm-up, 2,000 post-warmup), ensuring convergence (R^=1.00 for all parameters).

Specific R code:

```
# bayesian variance on each distance
install.packages("brms")
install.packages("dplyr")
install.packages("readr")
install.packages("Matrix")
install.packages("brms", dependencies = TRUE)
update.packages(ask = FALSE, checkBuilt = TRUE)
install.packages("rstan", dependencies = TRUE)
install.packages("brms", type = "source")
library(brms)
library(dplyr)
library(rstan)
library(Matrix)
install.packages("Matrix", type = "binary")
library(Matrix)
install.packages("brms", type = "source")
library(brms)
install.packages("lmerTest")
library(brms)

df <- MGfixfinal
```

```
# Bayesian variance model (heteroskedastic model)
bayesian_model <- brm(
    bf(value ~ social + temporal + spatial + Hyp + (1 | ID),  # Mean model
    sigma ~ social + temporal + spatial + Hyp),
# Variance model
  data = df,
  family = gaussian(),
  prior = c(
    prior(normal(0, 1), class = "b"),         # Priors for fixed effects
    prior(normal(0, 1), class = "b", dpar = "sigma"),  # Priors for variance effects
    prior(student_t(3, 0, 2.5), class = "sd") # Prior for random effects
  ),
  chains = 4, iter = 4000, warmup = 2000, cores = 4, control = list(adapt_delta = 0.95)
)
# Model summary
summary(bayesian_model)
# Plot posterior distributions
plot(bayesian_model)
plot(bayesian_model, pars = c("b_social", "b_temporal", "b_spatial", "b_Hyp",
                        "b_sigma_social", "b_sigma_temporal", "b_sigma_spatial", "b_sigma_Hyp"))
# Extract variance parameter estimates
posterior_samples(bayesian_model, pars = "b_sigma_")
# check the effect size
0.01/sd(df$value)
```

Figure D1. Psychological distances in posterior distribution in terms of variance in utilities.

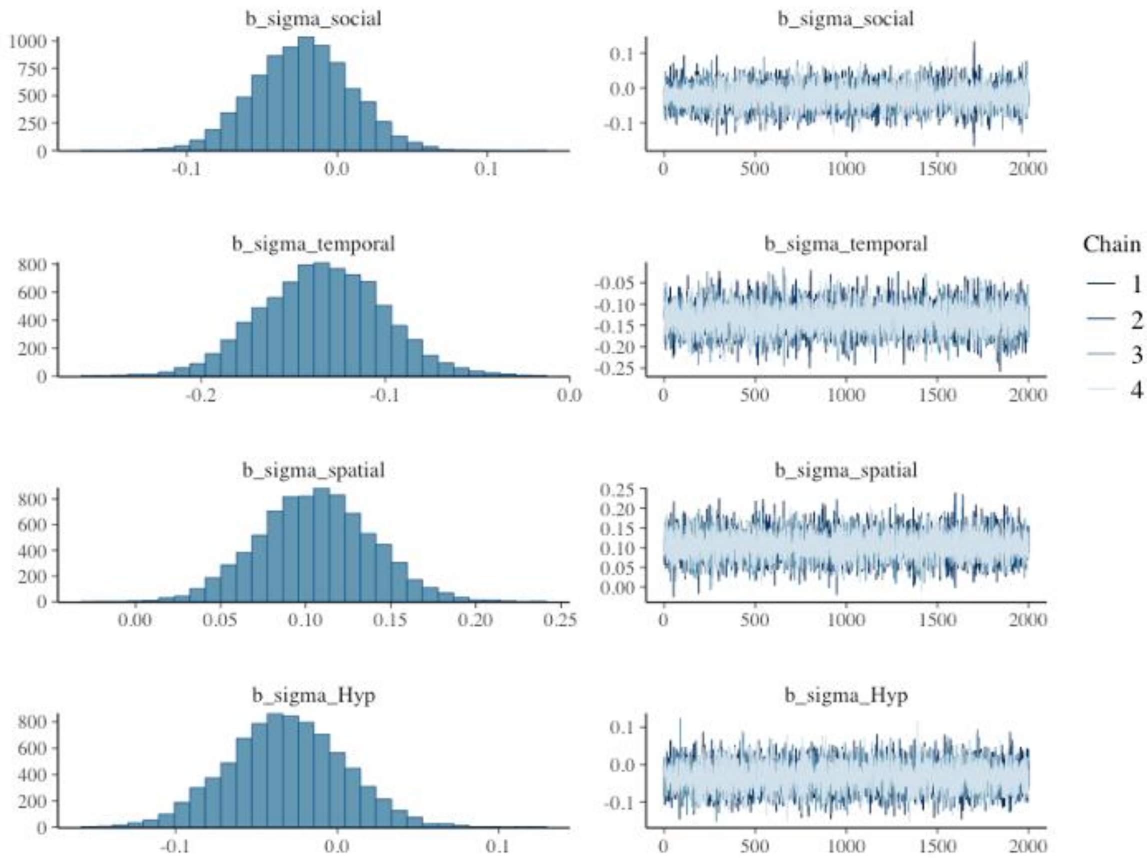
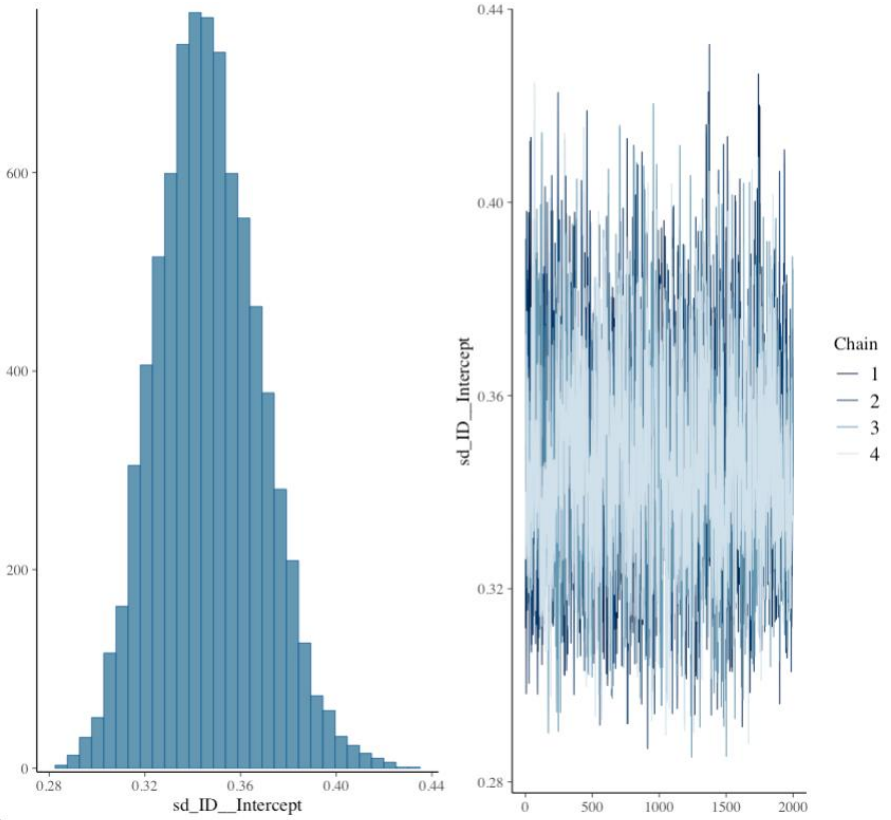

b_sigma_social
b_sigma_temporal
b_sigma_spatial
b_sigma_Hyp
Chain
1
2
3
4

Figure D2. Sampled valued across psychological distances in trace plot.



Note: the histogram in the left panel is bell-shaped, indicating this posterior distribution is well-defined; the right panel shows the mixing-colored lines that represent independent chain. They are well mixed without major divergence, indicating that the sampling process explored the posterior distribution efficiently.

Appendix E. Pair t-test on mean utilities across pairs of distance and health states

Table E1. Mean utilities of paired health states and distance, with SD in parentheses.

	Q1-11312	Q2-22222	Q3-32323	Q4-33333
D1	0.74 (0.34)	0.66 (0.41)	0.36 (0.56) **	0.16 (0.58) **
D2	0.72 (0.35)	0.67 (0.39)	0.4 (0.5)	0.17 (0.55)
D3	0.76 (0.3)	0.69 (0.38)	0.41 (0.5)	0.18 (0.57) **
D4	0.75 (0.32)	0.7 (0.4)	0.44 (0.5) **	0.24 (0.57) **

Note: * indicates significant difference at 10% level; ** indicates significant difference at 5% level; *** indicates significant difference at 1% level.

We only found significant difference from three pairs of health state and distance: health state 32323 between D1 and D4; health state 33333 between D1 and D4, and between D3 and D4.

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