Decision processes underlying health state valuation: attention allocation in time trade-off and standard gamble

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Abstract: Time Trade-Off (TTO) and Standard Gamble (SG) are health state valuation methods used to elicit utilities for use in economic evaluation. However, TTO and SG often yield inconsistent results for the same health states. This study delves into the underlying factors behind these discrepancies by analyzing how individuals search for and gather information during TTO and SG tasks. We hypothesized that the distinct time and risk framings of these methods induce varying patterns of information search and processing. Our online experiment involved 167 participants from the United Kingdom, utilizing a process tracing paradigm adapted from MouseLab. Participants performed TTO and SG tasks for 4 different health states. The analysis centered on attention allocation patterns, focusing on the relative importance of duration, health states, and probability attributes (in SG). Our findings confirm that attention allocation differs between TTO and SG. In TTO, respondents tend to prioritize duration attributes, whereas in SG, attention gravitates towards health states and probability attributes. These attentional allocation patterns correlate with and influence (the differences observed between) TTO and SG utilities. This study highlights the significance of attention allocation in shaping preferences during health utility measurement. Future research can further investigate how manipulating attention affects preference formation in health utility assessment.

1. Introduction

Many countries use quality-adjusted life years (QALYs) as a measure of treatment effects in cost-effectiveness analysis and reimbursement decision-making (e.g. ZIN, 2018, NICE, 2018). QALYs are calculated by multiplying life duration by 'utilities' that represent the value of health-related quality of life, scaled such that life in full health has a value of 1 and being dead has a value of 0. Time trade-off (TTO) and standard gamble (SG) are among the most used methods for obtaining these utilities (Drummond et al., 2015), underlying widely used instruments to measure and value health-related quality of life in practice (Stolk et al., 2019, Wang and Poder, 2023). Yet, TTO and SG typically yield different utilities for the same health state (Lipman et al., 2019b, Bleichrodt and Johannesson, 1997). This has an undesirable consequence, cost-effectiveness analyses or reimbursement decisions that rely on health utilities obtained with (preference-accompanied instruments based on) these valuation methods may lead to different conclusions (Lipman et al., 2019a).

TTO and SG are typically applied under the linear QALY model (Pliskin et al., 1980), in which health profiles (T, Q), denoting a health profile comprised of T years in health state Q, are evaluated as:

$$U(T, Q) = T \times H(Q) \tag{1}$$

In TTO tasks we typically elicit indifferences (denoted by ~) between 10 years in Q and a full-health equivalent of T years in full health (FH), i.e.:

$$(10, Q) \sim (T, FH). \tag{2}$$

Applying the linear QALY model, which assumes $H(FH) = 1$, yields:

$$10 \times H(Q) = T, \tag{3}$$

and as such, the TTO utility of health state Q is obtained as $H(Q) = T/10$.

In SG tasks we typically elicit indifferences between (T,FH),p,(D), denoting a gamble offering (T,Q) with probability *p*, and immediate death otherwise, and (T,Q), i.e. certain impaired health for the same duration. Setting T=10, e.g.:

$$(10, Q) \sim (10, FH), p, (D). \tag{4}$$

Applying expected utility theory, which is assumed to hold in the linear QALY model, and normalizing such that $U(D) = 0$, yields:

$$10 \times H(Q) = p \times 10\,. \tag{5}$$

Hence, the SG utility for health state Q by the indifference probability $H(Q) = p$.

Most work comparing TTO and SG tends to find that $T/10$ in a TTO task is typically smaller than *p* in SG tasks for the same health state Q. These differences between TTO and SG utilities violates the linear QALY model. Previous work (Bleichrodt, 2002) has explained the different utilities obtained with TTO and SG by the restrictions applied in the (linear) QALY model. That is, it assumes i) zero time preferences for T and ii) linear weighting of probabilities, which both are empirically violated. First, positive time preferences are found for health (van der Pol and Roux, 2005, Attema and Brouwer, 2010): the value of life duration decreases as it is experienced farther in the future. This deprecation of time exerts a downwards pressure on TTO (but not SG) utilities (Bleichrodt, 2002), as individuals with stronger time preference are more inclined to trade off future lifetime for health improvement (experienced sooner) and SG involves no trade-offs in lifetime. Second, rather than linear weighting of probabilities, non-linear weighting of probabilities is often found for health (van Osch et al., 2004, Lipman et al., 2019b). This implies that small chances are typically overweighted and large chances overweighted, which will impact risk preferences. This probabilistic insensitivity exerts upward pressure on SG (but not TTO) utilities (Bleichrodt, 2002), as overweighting the typically small chances of death in SG will yield more conservative risk preferences and TTO is riskless.

Empirical evidence supports Bleichrodt's (2002) predictions, differences between the methods reduce or disappear when time and risk preferences are measured and corrected for (van Osch et al., 2004, Lipman et al., 2019b). This is perhaps unsurprising, as earlier work in psychology suggests that time and risk preferences as understood in economics are associated with different decision-making processes (Pachur et al., 2018, Reeck et al., 2017). That is, individuals with different preferences for risk and time seem to search for and process information differently. Several methods have been developed to study these processes (Schulte-Mecklenbeck et al., 2011), e.g. eye-tracking or process tracing. In the context of health utility measurement, some studies have explored information search and processing in discrete choice experiments (Selivanova and Krabbe, 2018), but no such studies have been conducted for TTO and SG to our knowledge. Such insight into information search and processing in these tasks may help design preference elicitation task, as well as provide a better understanding of differences and similarities in time and risk preferences. Hence, in this study, we fill that research gap by studying how individuals search for information in TTO and SG tasks in detail, and explore support for two hypotheses. First, we expect that in line with the different framings (i.e. time and risk) under which individuals are making trade-offs in TTO and SG, patterns of information search and processing differ between the two methods. Second, earlier work suggests that TTO and SG utilities diverge *because* of different preferences for time and risk within-individuals (van Osch et al., 2004, Lipman et al., 2019b). As such we expect that within-subject differences between TTO and SG utilities are correlated with patterns in information search and processing.

2. Methods

This study was part of a larger program of work focused on exploring decision processes in health state valuation (extending the work reported in: Lipman et al., 2019b), and their association with risk and time preferences modelled with cumulative prospect theory (CPT, Tversky and Kahneman, 1992). In this paper, we focus the reporting on information search in TTO and SG exclusively, but briefly present the full design which also included the tasks for estimating CPT (referred to as CPT gamble tasks) in Appendix A.

2.1. Sample and design

We recruited a sample of 167 respondents from the United Kingdom through Prolific to take part in an online experiment on information search in decisions about health. The online experiment was separated into two 45-minute sessions to respondent fatigue, that were completed with at least one day between, which also include the original instructions used. In the first session (demo: here), respondents provided informed consent as well as filling out a set of demographic questions, including age, sex, self-reported health (measured with EQ-5D-5L), and experience with ill health. Half of the sample completed the CPT gamble tasks first and the other half completed TTO and SG tasks first (in random order). After completing the first session, respondents received invitations for completing the second session a day later (demo: here). In this second session they completed the set of tasks they had not completed. The final sample (see Appendix A for data on exclusions) consisted of predominantly female respondents (70%) and had a mean age of 36.1 (SD=11.6).

2.2. Procedure

Throughout the online experiment, all tasks were operationalised in a process tracing paradigm adapted from MouseLab (Johnson et al., 1989). In this process tracing paradigm each attribute of the TTO and SG tasks was hidden behind a box containing part of the information. Each box could be individually revealed by moving the computer mouse to it and clicking on it. Note that respondents completed practice tasks at the start of the experiment in both sessions, in order for them to be familiarized with the process tracing paradigm. As is usual for applications of this type of paradigm, inspection duration is take as a measure attention allocation.

For TTO, for each of 4 health states respondents were offered a choice between living for 10 years in the health state under consideration or living in perfect health for a duration of X years, with X varying between 0 and 10 (in discrete yearly increments). This yields 44 TTO choices (4 times 11). The process tracing paradigm was operationalized by separating TTO tasks into four attributes (see Figure 1), two per option. For example, a choice between option A) 10 years in the Wheelchair state and Option B) 4 years in full health was operationalized as Duration A (10 years), Health state A (Wheelchair), Duration B (4 years), Health state B (Full health),

SG involved a similar procedure, that is, respondents were offered a choice between living for 10 years in each of 4 health states and a gamble offering 10 years in full health with a probability of X% and immediate death otherwise (i.e. 100-X%). Symmetrical to TTO, X varied from 0 to 100 in increments of 10%. The process tracing paradigm was operationalized by separating SG tasks into a total of 12 attributes. For example, a choice between 10 years in a wheelchair with certainty (Option A) and a risky gamble yielding 10 years in full health with 40% chance and immediate death otherwise (Option B) was presented as: Duration A1 (10 years), Health state A1 (Wheelchair), Probability A1 (100%), Duration A2 (now), Health state A2 (Dead), Probability A2 (0%) for the first option. The second option was described operationalized as Duration B1 (10 years), Health state B1 (Full health), Probability B1 (40%), Duration B2 (now), Health state B2 (Dead), Probability B2 (60%), see also Appendix C.

Respondents completed TTO and SG tasks for four health states based on common chronic diseases, which were introduced to them using vignettes (see Appendix B). This vignette-based approach was used such that short labels could be included in the process tracing task, i.e.: Depression, Diabetes, Wheelchair, and Arthritis. A minority of respondents (23-44% of the sample) indicated to have experience with living in these states (themselves or by experiencing them through family/friends). Typically, TTO and SG tasks are implemented with bisection or ping-pong procedures, in which all choices for a particular health state are completed in succession, with these procedures ending with the indifferences needed for health utility measurement (e.g. Eq. 2 and 4). In our study, we opted for a completely random elicitation procedure to study attention allocation in TTO and SG without the search procedure systematically biasing attention allocation. This random elicitation procedure meant respondents completed 46 TTO and 46 SG choices (see Appendix B). We also tried to eliminate bias in the choice presentation through left-right randomisation (per choice task), as well as randomising the horizontal/vertical presentation of the process tracing (per session). There were two voluntary breaks in between choice tasks to reduce fatigue.

Figure 1. Operationalisation of SG in the process tracing paradigm (horizontal).

2.3. Analysis

We used the following strategy for analysis.

2.3.1. Estimating TTO and SG utilities

The random elicitation used implies that we did not directly elicit the indifferences described by Eq. 2 and 4, which allow estimating utilities. Instead, we chose to apply a Bayesian hierarchical model to estimate TTO and SG utilities. This hierarchical strategy pools individually elicited parameters (in this case utilities) through group-level distributions, which yields more reliable estimations (Pachur et al., 2018). The prior distributions of TTO and SG utilities (defined separately per health state and method) were assumed to be normal distributions spanning a range from 0 to 1. Uniform priors were used for the standard deviation of the group-level distribution, ranging from 0 to 10. The model evaluates options in TTO and SG task under the linear QALY model as in Eq. 3 and Eq. 5. As such for both TTO and SG option A is represented as: $10 \times H(Q)$. Option B depends on the choice task, i.e. for TTO tasks it is the time T in full health and for SG tasks it is the chance $p \times 10$, where p refers to the chance that the gamble yields. For example, for TTO17 (see Appendix B) it is $T = 5$, and for SG21 it is 0.9. To model probabilistic choice, we used a logit function with a Luce choice-sensitivity parameter $0 < \phi \geq 5$. As such we can express the TTO and SG model in the following equations:

$$p_{TTO}(A,B) = \frac{1}{1+e^{-\phi((10H(Q_i)-T)}} \text{ and } p_{SG}(A,B) = \frac{1}{1+e^{-\phi((10H(Q_i)-p*10)}}, \tag{6}$$

where subscript i refers to Depression, Diabetes, Wheelchair, and Arthritis for which the model was estimated separately. Probit transformations were used to link individual-level distributions to the group-level distributions (which were also modelled as normal distributions), with a linear-linkage function used to scale the distribution for 0-1 to 0-5 for These joint individual and group-level parameter distributions were estimated using Monte Carlo Markov Chain methods implemented the R2JAGS package in R. The JAGS models can be downloaded here (TTO) and here (SG).

2.3.2. Information search and processing in TTO and SG

In line with Pachur et al. (2018), we identify patterns in information search and processing through opening durations across attributes and tasks, which as is convention in process tracing, assumes that longer opening times reflect stronger attention. In our exploration of information search and processing in TTO and SG analysis we defined a set of indices that describe (relative) attention allocation to the core components of each task, i.e.:

- **TTOattentionD** and **TTOattentionH,** which are the median opening time for all duration or health state attributes across TTO – divided by the combined median opening times for all attributes,
- **SGattentionD**, **SGattentionH**, and **SGattentionP** which are the median opening time for all duration, health state and probability attributes across SG items – divided by the combined median opening times for all SG attributes.

To compare relative strength of attention between TTO and SG we multiply each attention parameter by the number of attribute types (i.e. 2 for TTO and 3 for SG). These relative attention allocation patterns characterize the relative strength of attention allocated towards a single attribute compared to the other attributes in a task. For example, TTOattentionD < 1, TTOattentionD = 1 and TTOattentionD > 1 represent cases where less, equal or more attention is allocated to duration vis-à-vis health state attributes. Finally, we include a set of ratios that reflect the degree to which relative attention to duration or health states in TTO and SG tasks are affected by the introduction of the probability attribute in SG, i.e.:

- **TTOvsSGattentionD =** TTOattentionD - SGattentionD
- **TTOvsSGattentionH** = TTOattentionH - SGattentionH

Note that we subtract rather than divide here to avoid non-tractable results related to attention indices of 0 (indicating that an attribute was ignored). These attention indices can be seen as a proxy for the shift in attention 'caused' by the introduction of risk in SG. That is, if the introduction of probabilities in SG implies that attention is shifted away from duration or health state attributes these attention parameters are positive (e.g. TTOattentionD =1.2 and SGattentionD=1.0), and negative when attention to those attributes increases.

3. Results

In Appendix C we provide a visualization of overall attention allocation in TTO and SG, suggesting that respondents complete tasks faster and with fewer information over time. Table 1 reports descriptive statistics for TTO and SG utilities for the four health states, as well as the (relative) attention allocation indices. Across all four states TTO utilities were lower than SG utilities (paired Wilcoxon tests, all p's <0.006). The attention allocation indices suggest that in TTO respondents' relative attention is biased towards duration attributes, as TTOattentionD is larger than TTOattentionH (paired Wilcoxon test, p=0.06). SG, on the other, relative attention is biased towards health state and probability attributes (paired Wilcoxon tests compared to SGattentionD, both p's

<0.001). The signs for TTOattentionD and TTOattentionH indicate that focus on duration elements decreases when probabilities are introduced in SG and relative focus to health states increases.

Table 1. Descriptive statistics for TTO and SG utilities estimated and attention allocation indices

	TTO						SG				
Condition	***M***	***SD***	***Median***	**Q1**	**Q3**		***M***	***SD***	***Median***	**Q1**	**Q3**
Wheelchair	0.68	0.23	0.76	0.56	0.86		0.72	0.23	0.76	0.61	0.89
Depression	0.51	0.27	0.55	0.35	0.75		0.56	0.32	0.65	0.28	0.85
Arthritis	0.61	0.25	0.65	0.46	0.76		0.66	0.26	0.75	0.55	0.87
Diabetes	0.78	0.17	0.86	0.70	0.89		0.8	0.17	0.86	0.74	0.94
AttentionD	1.01	0.16	1.01	0.98	1.04		0.78	0.38	0.94	0.82	0.98
AttentionH	0.99	0.16	0.99	0.96	1.02		1.16	0.43	1.02	0.99	1.10
AttenionP							1.07	0.31	1.04	1.00	1.11
TTOSGattentionD	0.24	0.41	0.07	0.02							
TTOSGattentionH	-0.17	0.45	-0.04	-0.18							

To further substantiate which attributes received significantly more attention we ran mixed effects models on opening times, with subject random effects and fixed effects for Option A ($10\times H(Q)$) vs. B Furthermore, fixed effects were included to capture information type (Health State and Probability for the SG model), with Duration as reference. Finally, we include health state dummies to test if opening times differed between states, where the Arthritis state was taken as reference. Table 2 shows that for both TTO and SG attention allocation was biased towards option B (Option A was always 10 years in some health state). For TTO respondents allocated more attention to duration than health state information, whereas for SG the opposite was true. Furthermore, respondents allocated more attention to probability information. For TTO we find some evidence that respondents allocated more time overall to the Depression health state.

In Table 3, we report Spearman correlations for attention allocation indices and utilities elicited with both methods (compiled across all 4 health states), as well as the difference between them (SG-TTO). Note that a full inter-correlation matrix can be found in Appendix C. A weak but significant positive correlation is observed between TTOattentionD and TTO utilities, which suggests that those whose attention is biased towards duration (relative to health states) thave higher utilities. Note that the exact opposite correlation is observed between the perfectly symmetrical TTOattentionH and TTO utilities. For SG, we find weak but significant associations between utilities and both SGattentionH and SGattentionP. Allocating more attention to health states is associated with lower utilities, whilst allocating more attention to probability is associated with higher utilities. Interestingly, attention allocation is also associated with the difference between TTO and SG utilities. That is SG-TTO is positively associated with TTOattentionD and TTOSGattentionH. These associations suggest that individuals allocating more attention to duration (relative to health states) in the TTO and individuals whose attention is shifted away from health state attributes *less* when probability information is introduced in SG have larger difference in utilities. We also illustrate these significant associations in Figure 2.

Table 2. Fixed effects estimates (standard errors in brackets) for mixed effects models predicting box opening time (in seconds).

	TTO	SG
Constant	0.89 (0.03) ***	0.69 (0.04) ***
A vs. B: B	0.03 (0.01) *	0.06 (0.01) ***
Domain: P		0.14 (0.01) ***
Domain: H	-0.03 (0.01) **	0.13 (0.01) ***
State: Depression	-0.03 (0.01)*	-0.01 (0.01)
State: Diabetes	-0.03 (0.01)	-0.01 (0.01)
State: Wheelchair	-0.04 (0.02)	-0.01 (0.02)

Notes: *, **, *** signify that the fixed effect were significant with p's <0.05, 0.01, 0.001

Table 3. Spearman correlation coefficients for utilities and relevant attention indices

Variable 1	Variable 2	Spearman correlation coefficient
TTOattentionD	TTO utilities	0.14***
TTOattentionH	TTO utilities	-0.14***
SGattentionD	SG utilities	0.04
SGattentionH	SG utilities	-0.10**
SGattentionP	SG utilities	0.08*
TTOattentionD	(SG-TTO)	-0.15***
TTOattentionH	(SG-TTO)	0.15***
SGattentionD	(SG-TTO)	-0.04
SGattentionH	(SG-TTO)	0.03
SGattentionP	(SG-TTO)	0.06
TTOSGattentionD	(SG-TTO)	-0.06
TTOSGattentionH	(SG-TTO)	0.11**

Notes: *, **, *** signify that the correlation coefficients were significant different from 0 with p's <0.05, 0.01, 0.001.

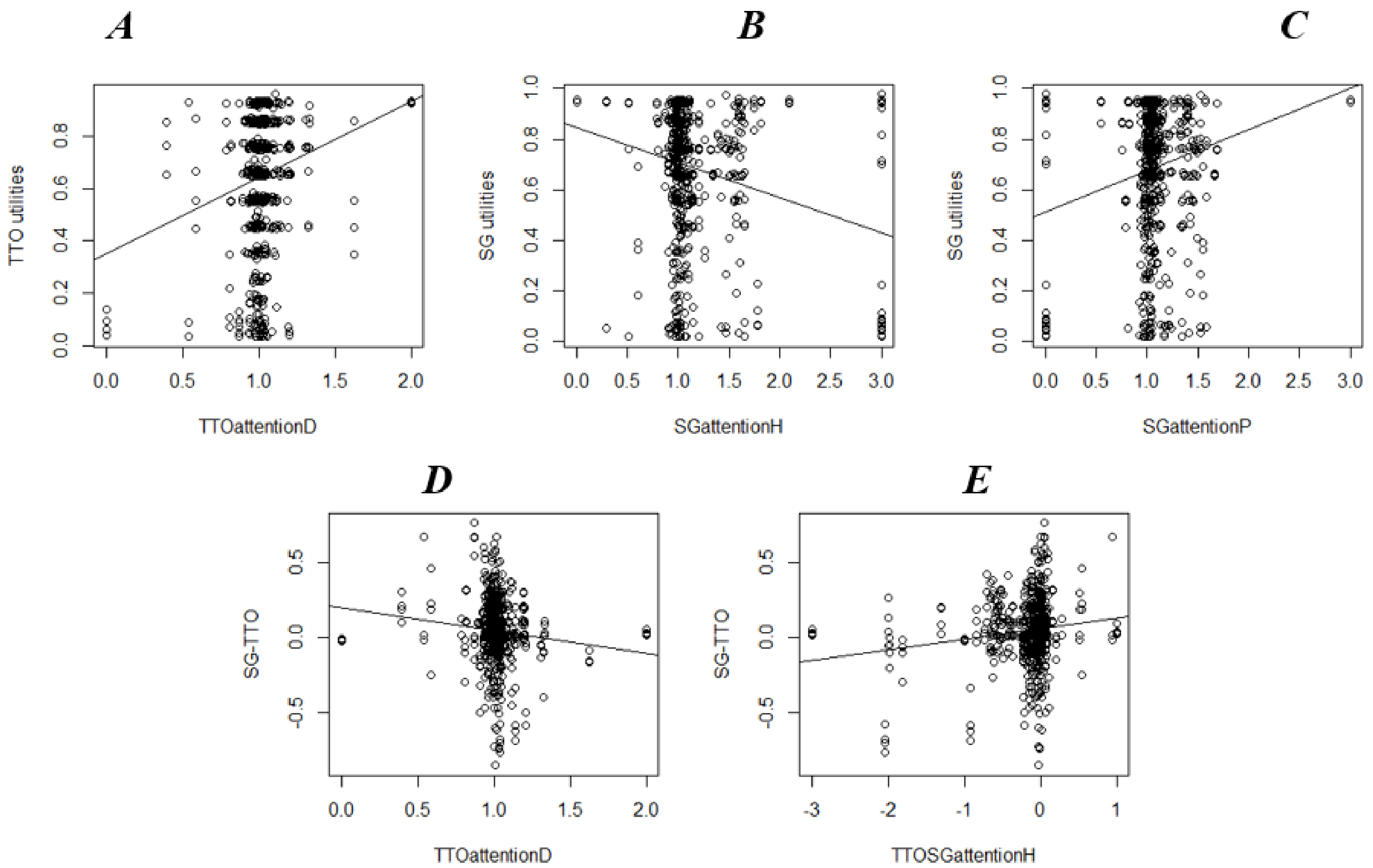

Figure 2. Significant association between attention allocation indices and (the difference) between TTO and SG utilities. Note that we only show associations for TTOattentionD and not TTOattentionH as the two attention indices are perfectly correlated.

4. Discussion

This study investigated differences in information search and processing in TTO and SG, using methods adapted from the psychological literature (Pachur et al. 2018). As in previous work (Bleichrodt and Johannesson, 1997, Lipman et al., 2020), we find higher utilities for TTO and SG. Hence, the typical difference in utilities replicates to the process tracing setting, which required decomposing the tasks into different attributes. As such, even though the 'look and feel' of the health utility measurement tasks was not at all comparable to that used in other studies using these tasks for generating value sets using extensive valuation protocols (Stolk et al., 2019, Dewitt et al., 2018), the oft-observed difference in their utilities replicated.

Our data enables an in-depth study of attention allocation in TTO and SG, and tests our hypothesis that the different framings (i.e. time and risk) under which individuals are making trade-offs in TTO and SG yield unique patterns of information search and processing. For both TTO and SG, respondents required fewer time and information to state a preference as the task progresses, suggesting some form of learning occurs, in line with findings by Augestad et al. (2012). As expected, some differences appear to exist in how respondents allocate their attention in these two tasks. That is, we found that in TTO, attention is biased towards durations (rather than health states) and to the full health equivalent (rather than the time spent in impaired health). For SG, attention is biased towards probabilities and health states (rather than durations) and to the gamble option (rather than the certain outcome). To our knowledge ours is the first study identifying patterns of attention allocation in these methods, making comparisons to earlier work complicated. However, our results are in line with think-out-loud work reported in van Osch (2007), who identified that the (certain) time spent in impaired health in TTO and SG is most likely to be taken as a reference-point with focus being on how the other outcome compares to it (meaning that the reference-point receives less attention).

Attention allocation was also associated with utilities in both tasks, and as such, with the trade-offs individuals made in these time and risk framings. For TTO, respondents with more relative attention for duration (relative to health states) had higher utilities. This result appears in line with earlier work suggesting that those self-reporting to find living a long life important have higher utilities (Kirsch et al., 2000), with our work suggesting that this importance of duration of life may also be identified from information search and processing. For SG, respondents with more relative attention to probabilities had higher utilities, and more attention to health states was associated with lower utilities. These results are in line with Pachur et al. (2018), who find that risk preferences for monetary gambles are associated with attention to probability information. Interestingly, our results also provide evidence in favour of our expectation that attention allocation was also associated with *differences* between TTO and SG utilities. That is, more attention to duration attributes in TTO tasks was associated with smaller differences between utilities in both tasks. Furthermore, individuals whose attention more strongly shifts away from health state information when probability information is introduced in SG have smaller difference in utilities. These findings may be tentatively interpreted as follows: differences between TTO and SG are smaller for individuals who are more sensitive to the unique framing under which these methods are applied (i.e. duration for TTO and probabilities for SG).

Collectively, these findings suggest that the time and risk framing of TTO and SG affect the attributes individuals allocate attention to and corresponding trade-offs occur. Individuals for whom this attenuated focus is more pronounced appear to be less willing to make those trade-offs, yielding higher utilities and smaller differences between TTO and SG. Although the strength of the associations observed in this study are small and no correction for multiple testing is applied, this result may have a few implications. First, our results underline the importance of understanding scale compatibility. Bleichrodt (2002) suggested that this phenomenon predicts that the attribute traded off in TTO and SG carries more importance, which may bias utilities. Our results provide evidence in favour of that hypothesis at a process-level, respondents allocate more attention and more reluctantly sacrifice these scale-compatible attributes. Second, although our study only tests the *association* between attention allocation in health valuation and utilities, earlier work has also shown that changes in attention allocation can *cause* changes in preferences. That is, Pachur et al. (2018) find that deliberately increasing attention to attributes led to changes in trade-offs. Extending this approach to health state valuation, this could, for example, mean that increasing individuals' focus on durations in TTO, would yield higher utilities. Future work may explore how different visualizations, e.g. those used in existing valuation protocols (Stolk et al., 2019, Dewitt et al., 2018), are directing attention to specific attributes of the task and as a consequence potentially shaping utilities that these tasks produce.

The primary limitations of this study were its' online nature and ex-post issues detected with the process-tracing paradigm. First, our experiment used online data collection (without interviewer supervision), which is well-known to lead to noisier data and/or data of poorer quality (von Gaudecker et al., 2008, Norman et al., 2010). Although we increased our sample size compared to other process tracing studies (Pachur et al., 2014, Pachur et al., 2018), subsequent studies aiming to explore the role of attention allocation in TTO and SG could incorporate personal interviews, as is usual for EQ-5D valuation (Stolk et al., 2019). Second, the process tracing paradigm was implemented in R Shiny by the first author and, even after extensive pre-testing, several issues with the data storage were observed. Ex-post, determining how these issues arose was difficult and we decided to exclude most data for these respondents. Future work may consider using existing process tracing tools such as MouseLabWeb (Willemsen and Johnson, 2011).

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Appendix A: Fully study design

A full flowchart depicting the experimental structure can also be found in Figure 1.
A total of 226 respondents finished the first session (113 completed CPT first and 113 completed TTO/SG first), of which 218 respondents remained after exclusions (107 and 111 respectively, session 2 was completed by 195 respondents (~11% dropout). We excluded 7 respondents who failed attention checks, and 21 due to technical issues with the task identified after data collection was finished. The final included sample was made-up of 167 respondents. Complete data is obtained for 152 and 145 respondents for TTO and SG respectively.

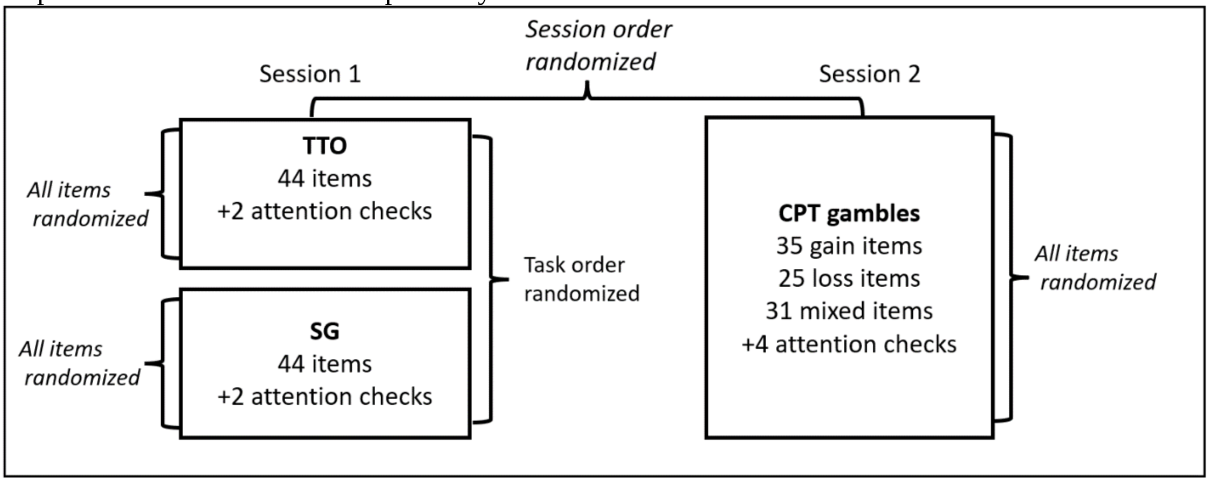

Figure A1. Flowchart showing experimental set-up

Appendix B: Vignettes used to describe health states

Wheelchair

The health state 'Wheelchair' refers to a health state in which you should imagine not being able to walk about without assistance. As a result, you require a wheelchair to move around. Your need for the wheelchair leads to moderate limitations in your daily activities as activities such as grocery shopping and cleaning are more difficult (but absolutely possible) from the wheelchair. Imagine your mobility problems are the result of local paralysis just above the knee. This means you are not in pain. Life in wheelchair comes with difficulties, but you are not anxious or depressed and able to care for yourself (e.g. wash and go to the toilet). As such, we can summarize the state 'Wheelchair' as:

You are unable to walk
You have moderate problems with usual activities
You have no problems with self-care
You have no pain
You are not anxious or depressed

Depression

The health state 'Depression' refers to state characterised by major depressive symptoms. This means that on most days you wake up and don't want to get out of bed, or leave the house. ou just don't have the energy, no matter how many hours of sleep you had. You think negatively about yourself and expect the worst from the people around you. Physically, you are healthy. Technically, you could go for a run whenever you wanted, if only you weren't so tired all day. Similarly, you can't get yourself to do things you would normally enjoy or find important, such as going to work, grocery shopping or maintaining personal hygiene. As such, we can summarize the state 'Depression' as:

You have no problems with mobility
You have severe problems with usual activities
You have moderate problems with self-care
You have no pain
You are severely anxious or depressed

Arthritis

The health state 'Arthritis' refers to a health state in which you have rheumatoid arthritis. This chronic disease is characterized by very stiff and painful joints, in your case it is predominantly the joints of the legs and your fingers. Rheumatoid arthritis typically involves moderate to severe pain with movement, as a result some people suffering from this disease quit work or reduce their hours.

Furthermore, the pain and problems with movement affect many aspect of your life, because you have to live with it every day. As such, some days you are in a bad mood and worried that the pain will flare up. As such, we can summarize the state 'Arthritis' as:

You have moderate problems with mobility
You have moderate problems with usual activities
You have no problems with self-care
You have severe pain
You are slightly anxious or depressed

Diabetes

The health state 'Diabetes' refers to a health state in which you have diabetes. Diabetes refers to a chronic lack of insulin, which carries several risks. Now, in principle, diabetes does not have a large effect on your health, but it requires constant insulin monitoring. Furthermore, diabetes patients typically have to change their diets to include less saturated fats and as little alcohol as possible. The constant monitoring and dieting do affect your usual activities somewhat, and at times you find this depressing. As such, we can summarize the state 'Diabetes' as:

You have no problems with mobility
You have moderate problems with usual activities
You have no problems with self-care
You have no pain
You are slightly anxious or depressed

Appendix B: All choice tasks completed by respondents

This appendix reprints the choice tasks used to estimate TTO and SG utilities, as well as attention checks used to exclude respondents (TTOAC1, TTOAC2, SGAC1, and SGAC2). The 46 items per method were presented in random order to respondents.

Table B1. Items used for TTO utility elicitation.

ID	Adur	AQ	Bdur	BQ	ID	Adur	AQ	Bdur	BQ
TTO1	10 years	Wheelchair	now	Dead	**TTO23**	10 years	Arthritis	now	Dead
TTO2	10 years	Wheelchair	1 year	Full health	**TTO24**	10 years	Arthritis	1 year	Full health
TTO3	10 years	Wheelchair	2 years	Full health	**TTO25**	10 years	Arthritis	2 years	Full health
TTO4	10 years	Wheelchair	3 years	Full health	**TTO26**	10 years	Arthritis	3 years	Full health
TTO5	10 years	Wheelchair	4 years	Full health	**TTO27**	10 years	Arthritis	4 years	Full health
TTO6	10 years	Wheelchair	5 years	Full health	**TTO28**	10 years	Arthritis	5 years	Full health
TTO7	10 years	Wheelchair	6 years	Full health	**TTO29**	10 years	Arthritis	6 years	Full health
TTO8	10 years	Wheelchair	7 years	Full health	**TTO30**	10 years	Arthritis	7 years	Full health
TTO9	10 years	Wheelchair	8 years	Full health	**TTO31**	10 years	Arthritis	8 years	Full health
TTO10	10 years	Wheelchair	9 years	Full health	**TTO32**	10 years	Arthritis	9 years	Full health
TTO11	10 years	Wheelchair	10 years	Full health	**TTO33**	10 years	Arthritis	10 years	Full health
TTO12	10 years	Depression	now	Dead	**TTO34**	10 years	Diabetes	now	Dead
TTO13	10 years	Depression	1 year	Full health	**TTO35**	10 years	Diabetes	1 year	Full health
TTO14	10 years	Depression	2 years	Full health	**TTO36**	10 years	Diabetes	2 years	Full health
TTO15	10 years	Depression	3 years	Full health	**TTO37**	10 years	Diabetes	3 years	Full health
TTO16	10 years	Depression	4 years	Full health	**TTO38**	10 years	Diabetes	4 years	Full health
TTO17	10 years	Depression	5 years	Full health	**TTO39**	10 years	Diabetes	5 years	Full health
TTO18	10 years	Depression	6 years	Full health	**TTO40**	10 years	Diabetes	6 years	Full health
TTO19	10 years	Depression	7 years	Full health	**TTO41**	10 years	Diabetes	7 years	Full health
TTO20	10 years	Depression	8 years	Full health	**TTO42**	10 years	Diabetes	8 years	Full health
TTO21	10 years	Depression	9 years	Full health	**TTO43**	10 years	Diabetes	9 years	Full health
TTO22	10 years	Depression	10 years	Full health	**TTO44**	10 years	Diabetes	10 years	Full health
TTOAC1	10 years	Diabetes	11 years	Full health	**TTOAC2**	10 years	Wheelchair	11 years	Full health

Table C2. Items used for SG utility elicitation.

ID	AXdur	AXQ	AXP	AYdur	AYQ	AYIP	BXdur	BXQ	BXP	BYdur	BYQ	BYIP
SG1	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	0%	now	Dead	100%
SG2	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	10%	now	Dead	90%
SG3	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	20%	now	Dead	80%
SG4	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	30%	now	Dead	70%
SG5	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	40%	now	Dead	60%
SG6	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	50%	now	Dead	50%
SG7	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	60%	now	Dead	40%
SG8	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	70%	now	Dead	30%
SG9	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	80%	now	Dead	20%
SG10	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	90%	now	Dead	10%
SG11	10 years	Wheelchair	100%	now	Dead	0%	10 years	Full health	100%	now	Dead	0%
SG12	10 years	Depression	100%	now	Dead	0%	10 years	Full health	0%	now	Dead	100%
SG13	10 years	Depression	100%	now	Dead	0%	10 years	Full health	10%	now	Dead	90%
SG14	10 years	Depression	100%	now	Dead	0%	10 years	Full health	20%	now	Dead	80%
SG15	10 years	Depression	100%	now	Dead	0%	10 years	Full health	30%	now	Dead	70%
SG16	10 years	Depression	100%	now	Dead	0%	10 years	Full health	40%	now	Dead	60%
SG17	10 years	Depression	100%	now	Dead	0%	10 years	Full health	50%	now	Dead	50%
SG18	10 years	Depression	100%	now	Dead	0%	10 years	Full health	60%	now	Dead	40%
SG19	10 years	Depression	100%	now	Dead	0%	10 years	Full health	70%	now	Dead	30%
SG20	10 years	Depression	100%	now	Dead	0%	10 years	Full health	80%	now	Dead	20%
SG21	10 years	Depression	100%	now	Dead	0%	10 years	Full health	90%	now	Dead	10%
SG22	10 years	Depression	100%	now	Dead	0%	10 years	Full health	100%	now	Dead	0%
SG23	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	0%	now	Dead	100%
SG24	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	10%	now	Dead	90%
SG25	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	20%	now	Dead	80%
SG26	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	30%	now	Dead	70%
SG27	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	40%	now	Dead	60%
SG28	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	50%	now	Dead	50%
SG29	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	60%	now	Dead	40%
SG30	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	70%	now	Dead	30%
SG31	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	80%	now	Dead	20%
SG32	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	90%	now	Dead	10%
SG33	10 years	Arthritis	100%	now	Dead	0%	10 years	Full health	100%	now	Dead	0%
SG34	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	0%	now	Dead	100%
SG35	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	10%	now	Dead	90%
SG36	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	20%	now	Dead	80%
SG37	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	30%	now	Dead	70%
SG38	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	40%	now	Dead	60%
SG39	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	50%	now	Dead	50%
SG40	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	60%	now	Dead	40%
SG41	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	70%	now	Dead	30%
SG42	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	80%	now	Dead	20%
SG43	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	90%	now	Dead	10%
SG44	10 years	Diabetes	100%	now	Dead	0%	10 years	Full health	100%	now	Dead	0%
SGAC1	10 years	Diabetes	100%	now	Dead	0%	11 years	Full health	100%	now	Dead	0%
SGAC2	10 years	Wheelchair	100%	now	Dead	0%	11 years	Full health	100%	now	Dead	0%

Appendix C. Additional results visualising attention allocation in TTO and SG

Figure C1 shows that individuals make fewer acquisitions and spend fewer time on TTO and SG tasks as they complete more choice tasks. The figure also reports significant and negative correlation coefficients between the task number and acquisitions, suggesting that later tasks were associated with fewer acquisitions. Visual inspection suggests that breaks do not significantly increase task completion time or box openings, suggesting that the decrease in acquisition time and frequency reflects learning effects. Figure C2 shows the mean opening time for each of the attributes for TTO and SG tasks in seconds, and Figure C3 shows the full inter-correlation matrix between TTO/SG utilities, their difference and the attention allocation indices

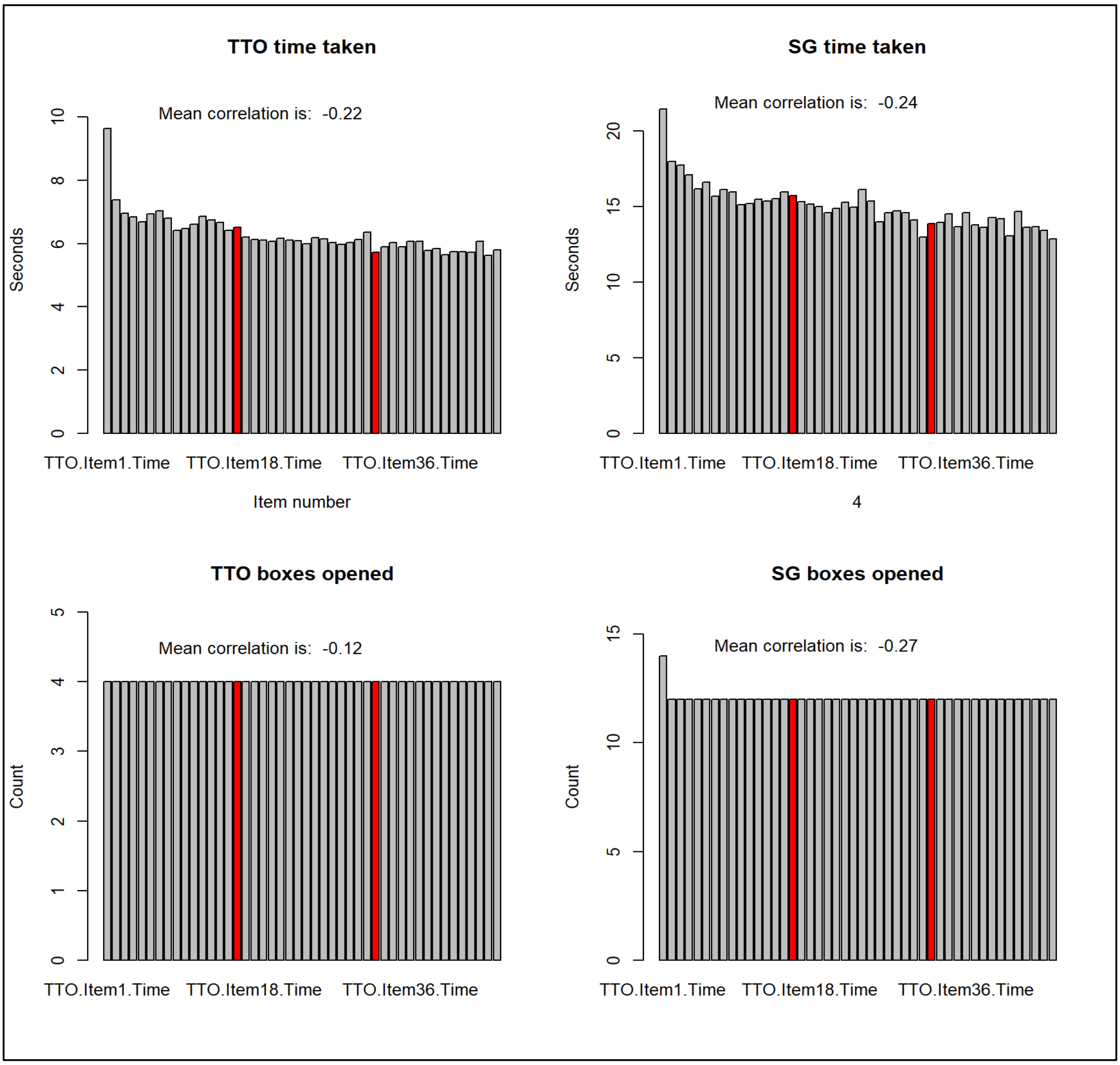

Figure C1. Acquisition time and frequency for TTO and SG: time taken per task and amount of boxes opened. Red bars indicate first task completed directly after the break.

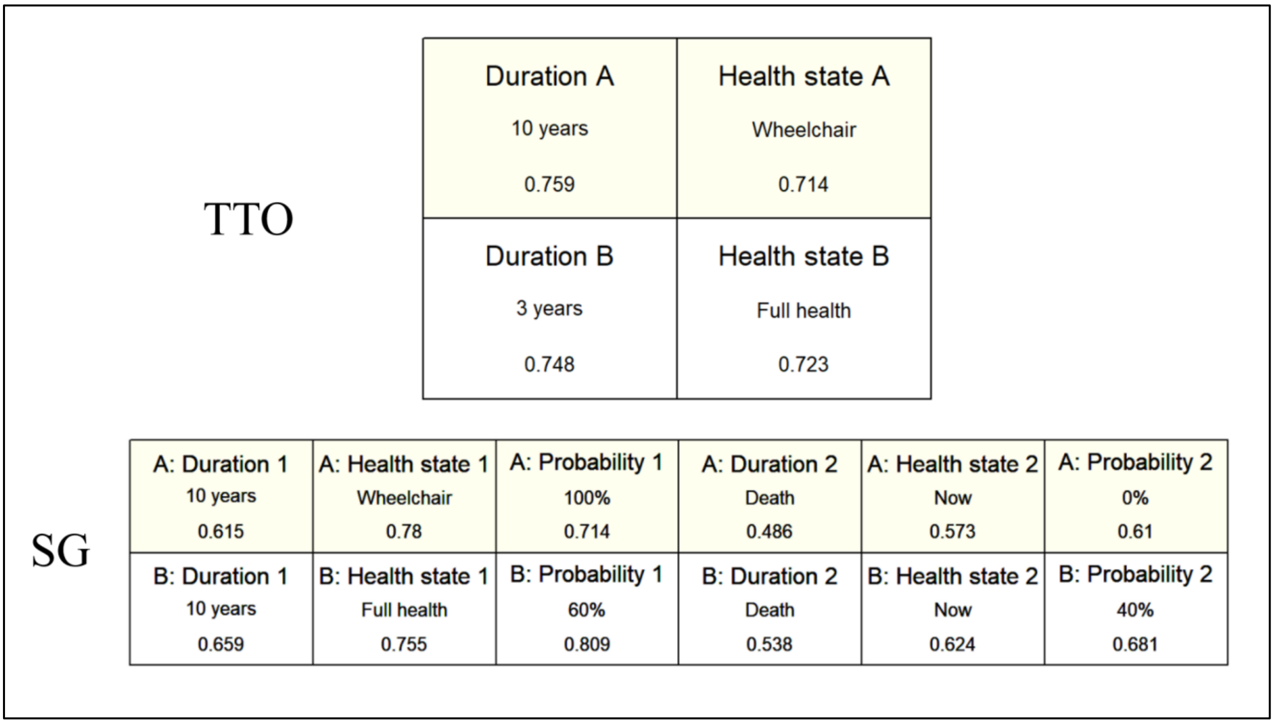

Figure C2. Average time looking at each attribute per TTO and SG task, with examples.

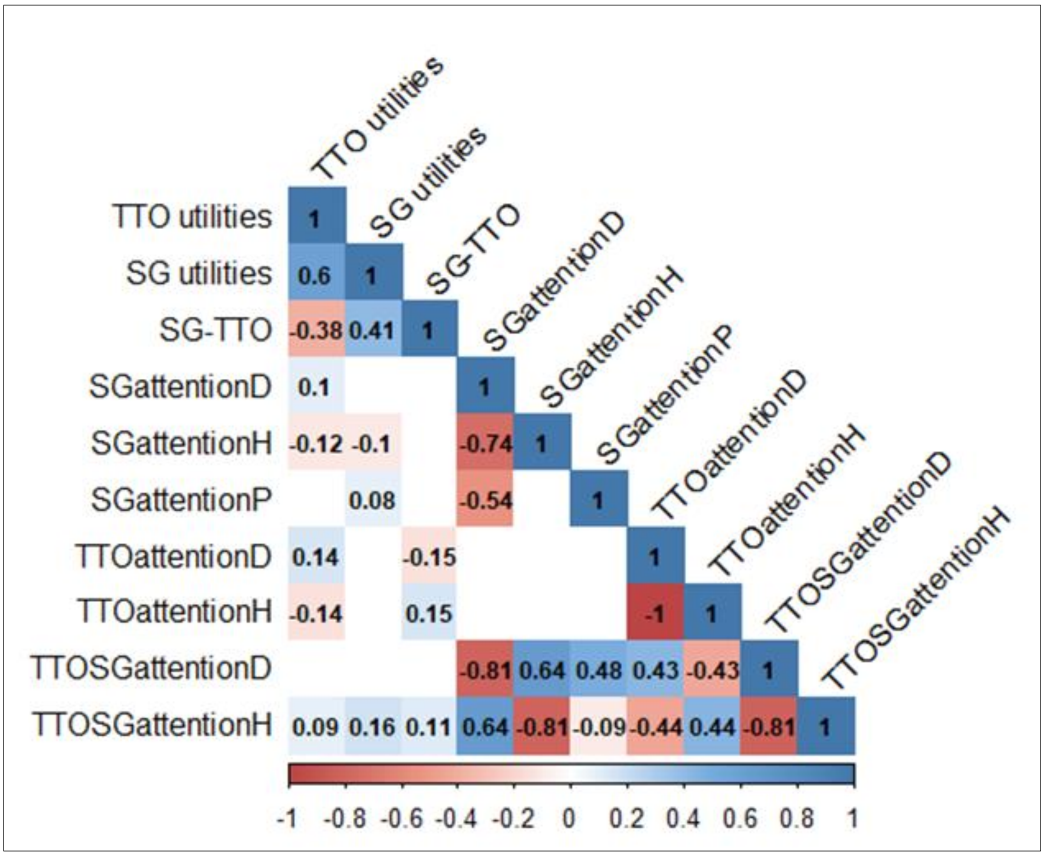

Figure C3. Intercorrelation matrix reporting significant correlations between utilities and attention parameter

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