Aggregated Travel Satisfaction

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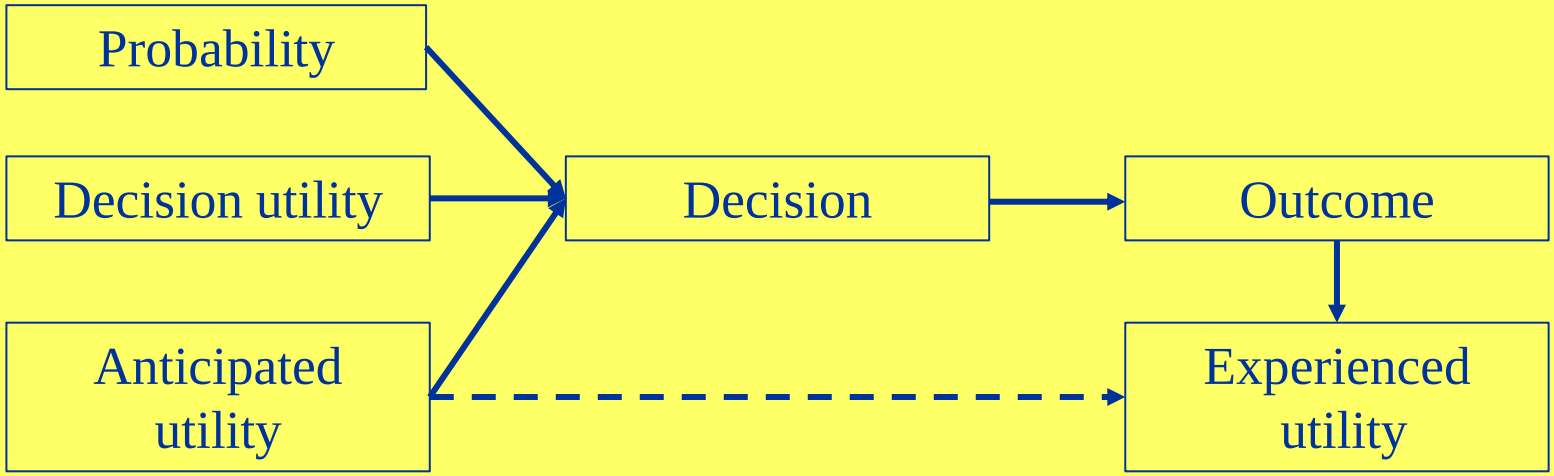
Varieties of Utility (Kahneman. Wakker, & Sarin, 1997)



If sequence of outcomes

Outcome *1* …. Outcome *i* …. Outcome *n*

Instant utility (IU_1) Instant utility (IU_i) Instant utility (IU_n)

How is experienced utility related to instant utilities?

$IU_{1 \ldots n}$ ⟶ Memory retrieval ⟶ Experienced utility

If memory retrieval is accurate

Summation rule: ΣIU_i

Averaging rule: $(1/n)\Sigma IU_i$

If memory retrieval is biased

Peak-end rule: $(\max(IU_{i<n})+IU_n)/2$

Previous research

Qualified evidence from lab studies supports the peak-end rule in aggregating sequences of negative events (e.g. pain stimuli) and positive events (e.g. pleasant film clips) (reviews by Fredrickson, 2000; Kahneman, 2000)

Other research has found evidence for the summing rule for sequences of equal-valenced events and the averaging rule for sequences of unequal-valenced events (Seta, Hairea, & Seta, 2008a,b)

Field studies (episodes during a day; days during an one-week vacation) fail to support the peak-end rule (Kemp, Burt, & Furneaux, 2008; Miron-Shatz, 2009)

Empirical Study

A work commute normally consists of several legs. How does satisfaction (experienced utility) with the work commute depend on satisfaction (instant utility) with each leg?

Our aim is to test different rules according to which memory of satisfaction with the legs of the work commute is aggregated to an overall satisfaction with the work commute

Sample and Procedure

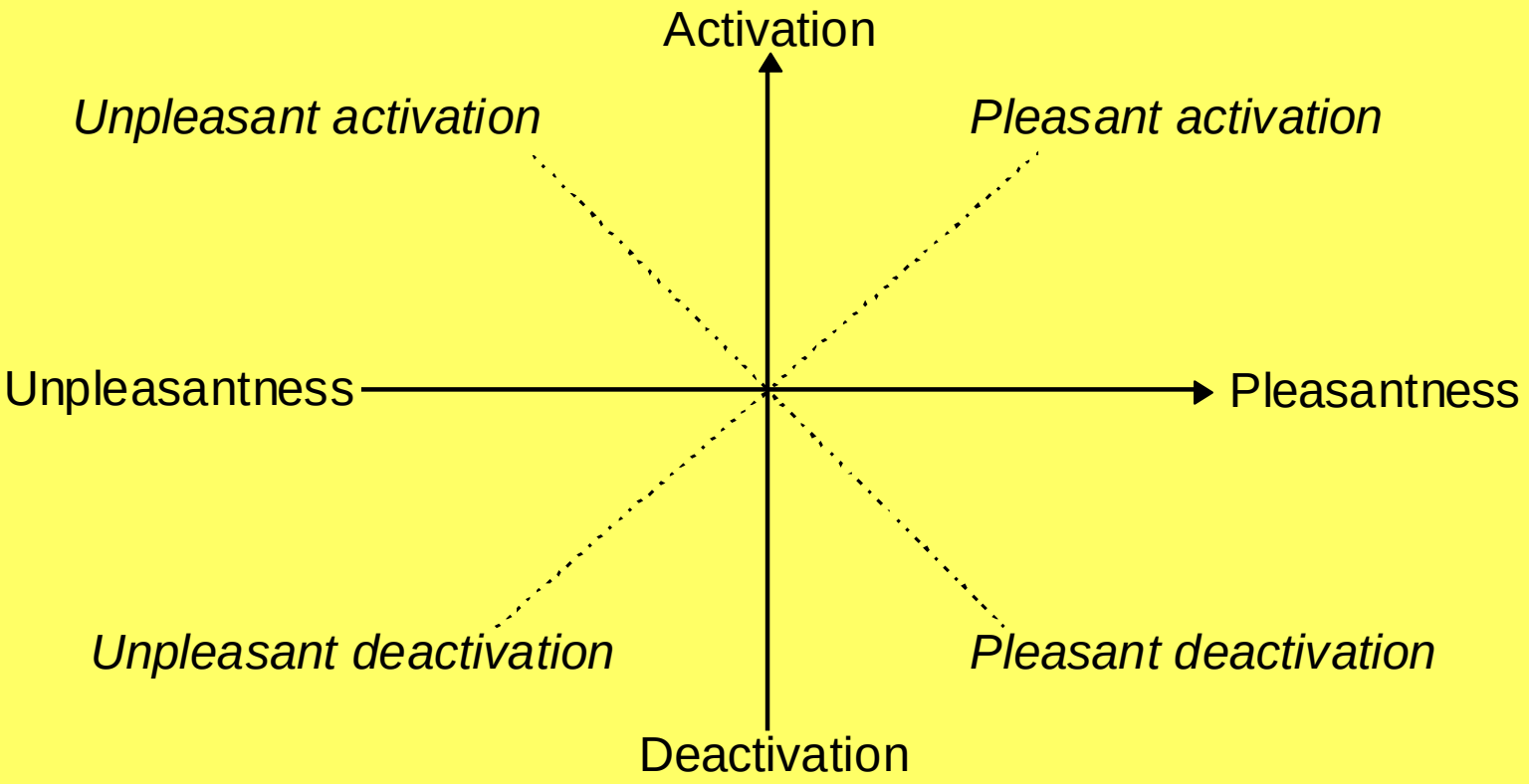
A mail questionnaire was answered by 996 (22.5% response rate) randomly sampled residents of the three largest urban areas of Sweden. 58.3% were women with age ranging from 20 to 65 for a mean of 41.2 years.

Questions were asked about the latest normal commute to work and from work, respectively. The data reported here are self-report ratings of satisfaction with the work commutes as a whole and satisfaction with each leg of the commutes.

The number of legs reported varied from 1 to 5. Only data from commutes with 3 and 4 legs are analyzed.

”Affect Grid” (Russell, 1980; Russell et al., 1989)

[Swedish Core Affect Scale (SCAS) (Västfjäll et al., 2002; Västfjäll & Gärling, 2007)]



Satisfaction with Travel Scale (STS)

(Ettema et al., 2011; Friman et al., 2013)

Cognitive evaluation (STS_CE)

Worst I can think of (-3) – Best I can think of (3)

Very low standard (-3) – Very high standard (3)

Worked very poorly (-3) – Worked very well (3)

Positive activation-negative deactivation (STS_PA)

Very tired (-3) – Very alert (3)

Very bored (-3) – Very enthusiastic (3)

Very fed up(-3) – Very engaged (3)

Positive deactivation-negative activation (STS_PD)

Very hurried (-3) – Very relaxed (3)

Very worried (-3) – Very confident (3)

Very stressed (-3) – Very calm (3)

Results: Commute to work
ΔR^2 from hierarchical regression analyses

	Commute to work (n ≈ 170)		
Rule	STS_cognitive	STS_pos activation	STS_pos deactivation
Peak-end rule	**.34*** **	**.41*** **	**.49*** **
Summing rule	**.09*** **	**.08*** **	**.08*** **
Equal-weights averaging rule	**.02***	**.01**	**.01**
Duration-weighted averaging rule	**.04*** **	**.04*** **	**.03***
r	**.68**	**.73**	**.74**

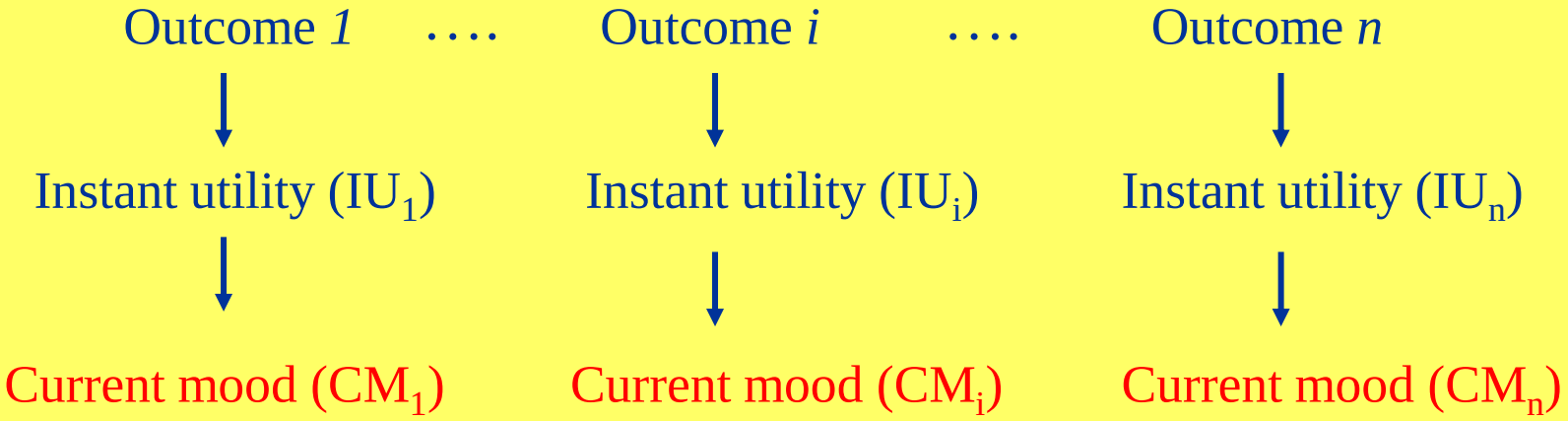
*p<.05; **p<.01; ***p<.001

Results: Commute from work
ΔR^2 from hierarchical regression analyses

	Commute from work (n ≈ 160)		
Rule	STS_cognitive	STS_pos activation	STS_pos deactivation
Peak-end rule	**.32*** **	**.41*** **	**.29*** **
Summing rule	**.23*** **	**.04*** **	**.23*** **
Equal-weights averaging rule	**.05*** **	**.01**	**.03*** **
Duration-weighted averaging rule	**.01***	**.00**	**.02***
r	**.77**	**.65**	**.76**

*p<.05; **p<.01; ***p<.001

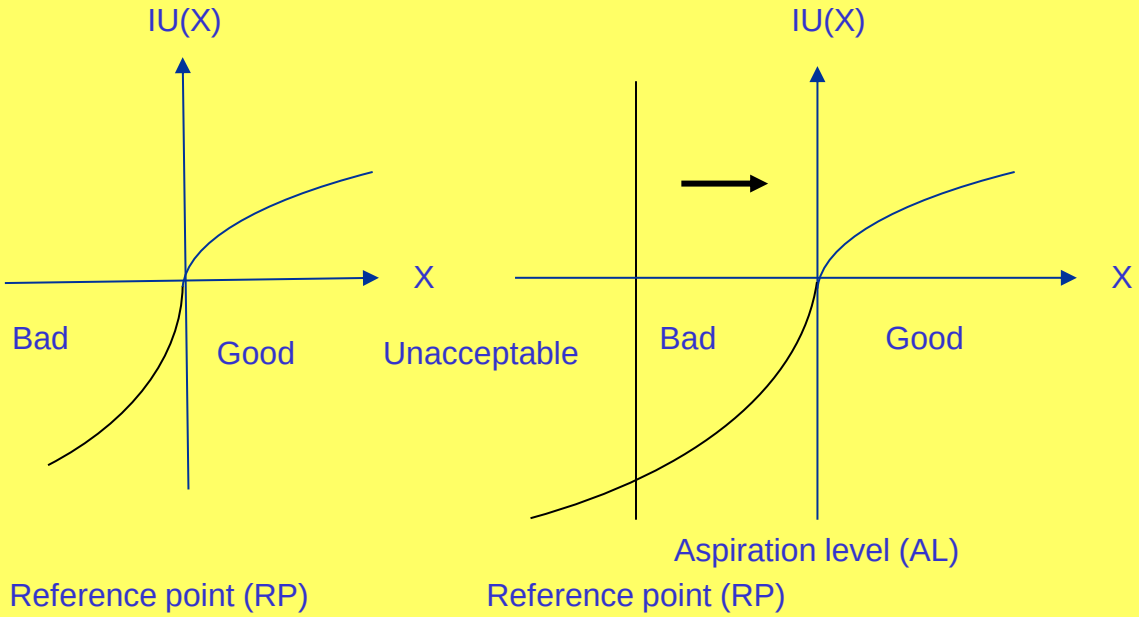
An alternative conceptualization



Propositions

- The total outcome of a choice is segmented in separate independent outcomes forming a sequence ranging from a single to many separate outcomes
- The separate outcomes are evaluated as good or bad relative to a changing aspiration level and fixed reference point (according to a modified Prospect Theory value function)
- Evaluations have an emotional impact if and only if they are personally relevant
- An emotional impact changes current mood
- Current mood is temporarily represented in working/short-term memory
- Memory for previous current moods may be reconstructed from episodic memory of the evaluations of the separate outcomes and their emotional impacts.
- The reconstruction of current moods is prone to dampening due to the serial position and response contraction biases

Evaluation of outcomes varying in *X*



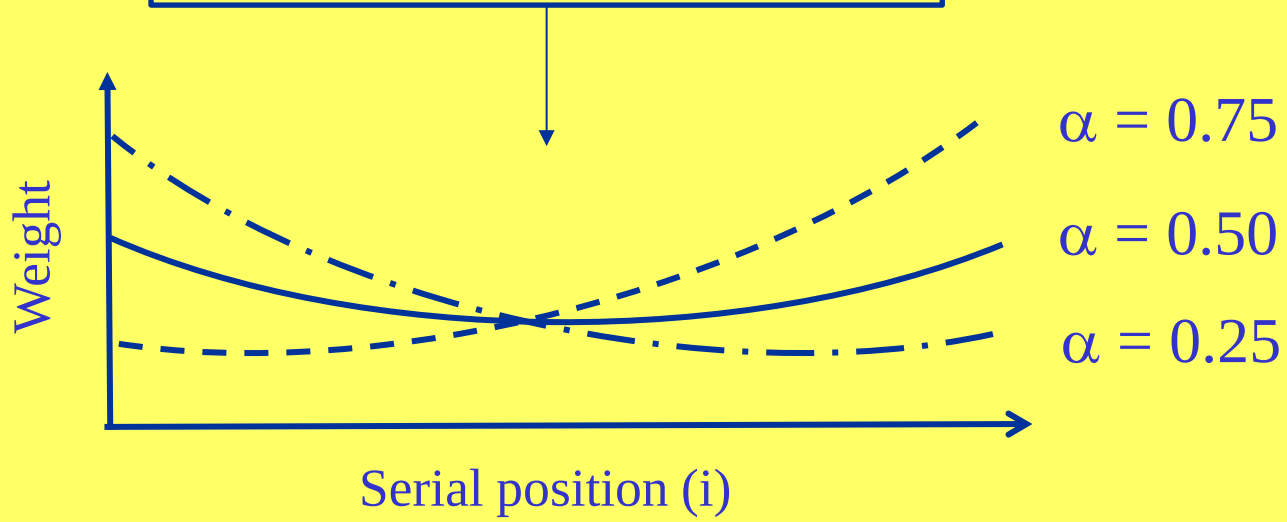
$$IU = \begin{cases} -a_L|X - RP|^b & 0 < X \leq RP; \quad 0 < a_L; \quad 0 < b \leq 1 \\ -a_L|X - RP - (AL\text{-}RP)|^b & RP < X < AL; \quad 0 < a_L; \quad 0 < b \leq 1 \\ a_G(X - RP - (AL\text{-}RP))^b & RP \leq AL \leq X; \quad 0 < a_L < a_G; \quad 0 < b \leq 1 \end{cases} \qquad (1)$$

Current mood: How do you feel now?

$$CM_i = CM_{i-1} + eIU_i \qquad i = 1,\ldots.,n; \quad e \geq 0 \qquad (2)$$

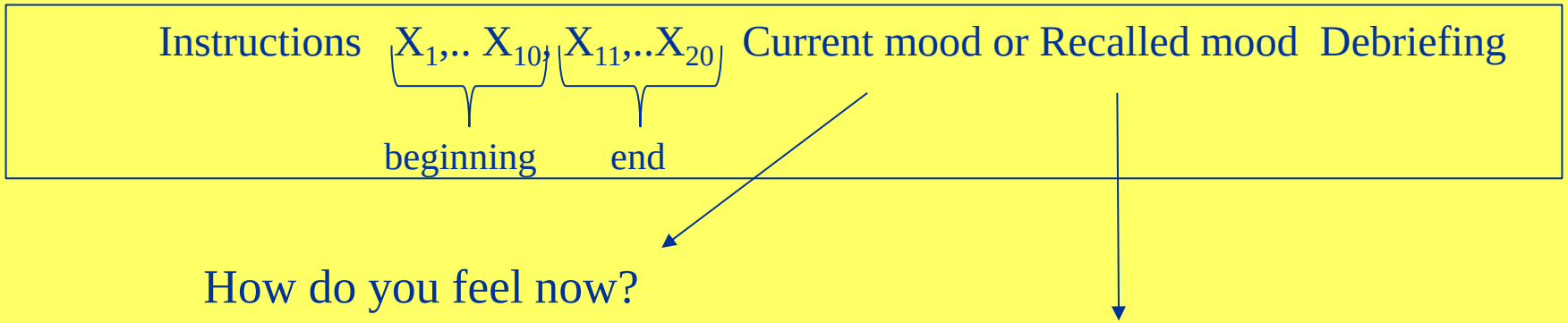
Recalled current mood: How did you feel during the sequence?

$$RCM_{n+1} = c\ {}_1\Sigma^n \boxed{(\alpha((i-1)/(n-1))^2 + (1-\alpha)((n-i)/(n-1))^2)}\ CM_i \quad 0 \leq \alpha, c \leq 1 \qquad (3)$$



Experiment

Sequence of potential lottery outcomes {(SEK) X_i: 1-49, 51-99} and AL = (SEK) 50 (endownment) with one randomly selected lottery outcome played after completed sequence



How do you feel now?

Glad
0 1 2 3 4 5 6
Sad
0 1 2 3 4 5 6
Active
0 1 2 3 4 5 6
Passive
0 1 2 3 4 5 6

How did you feel during the sequence?

Glad
0 1 2 3 4 5 6
Sad
0 1 2 3 4 5 6
Active
0 1 2 3 4 5 6
Passive
0 1 2 3 4 5 6

You have SEK 50 to start with

+ SEK 37

- SEK 15

Results for affect balance ((glad+active-sad-passive)/4)
2 X 2 X 2 between-groups factorial design with 163 undergraduates

	Negative beginning				Positive beginning			
	Negative end		Positive end		Negative end		Positive end	
	M	Sd	M	Sd	M	Sd	M	Sd
Current mood	0.0	(2.6)	0.6	(2.2)	0.7	(2.0)	1.8	(1.9)
Recalled mood	-0.5	(2.0)	0.7	(1.4)	0.1	(1.9)	0.8	(2.6)

Current (0.8) > Recalled current mood (0.3), $F(1, 155) = 1.98$, $p = .161$

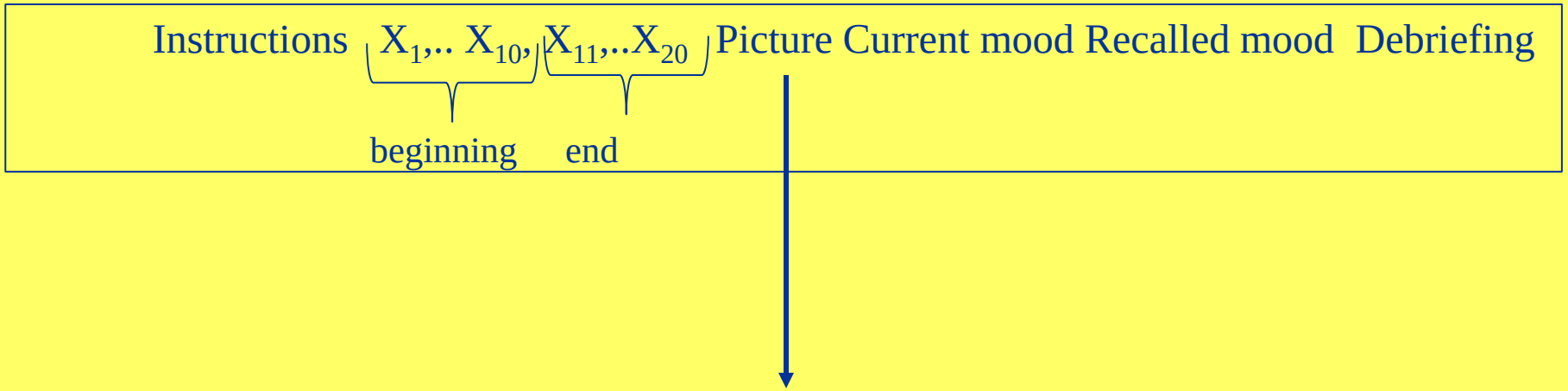
Positive (0.8) > Negative beginning (0.2), $F(1, 155) = 3.58$, $p = .060$

Positive (1.0) > Negative end (0.1), $F(1, 155) = 7.46$, $p = .007$

No significant interaction effects, $F < 1$

Control experiment

Sequence of potential lottery outcomes (X_i) with one randomly selected lottery outcome played after the sequence was completed



Test of incidental effect on current mood:
Participants led to believe they evaluated current mood for neutral landscape picture (presented for 8 sec)
Then they were asked to report how they felt during the sequence

Results for affect balance ((glad+active-sad-passive)/4)
(2 X 2) X 2 mixed factorial design with another 87 undergraduates

	Negative beginning				Positive beginning			
	Negative end		Positive end		Negative end		Positive end	
	M	Sd	M	Sd	M	Sd	M	Sd
Current mood	0.5	(2.7)	1.9	(1.6)	0.8	(2.0)	2.0	(2.0)
Recalled mood	0.4	(1.4)	1.1	(1.2)	0.2	(1.5)	0.9	(1.0)

Current (1.3) > Recalled current mood (0.7), $F(1, 155) = 11.93$, $p = .001$

Positive (1.0) = Negative beginning (1.0), $F(1, 155) < 1$

Positive (1.5) > Negative end (0.5), $F(1, 155) = 9.57$, $p = .003$

Current/recalled mood X Positive/negative end, $F(1, 83) = 2.97$. $p = .089$

No other interaction effects, $F < 1$

Simulations

Evaluation of each outcome in the sequence

$$IU_i = -a_L|X_i - RP + (AL-RP)|^b$$

$$IU_i = a_G(X_i - RP + (AL-RP))^b$$

$$RP=0/AL = 50$$

$$a_G=1/a_L= 2/b=0.90$$

Current mood at the end of the sequence

$$CM_n = CM_{n-1} + eIU_n$$

$$e = 0.05$$

Recalled current mood after the sequence

$$RCM_{n+1} = c\ {}_1\Sigma^n(\alpha((i-1)/(n-1))^2 + (1-\alpha)((n-i)/(n-1))^2)CM_i$$

$$c = 0.05$$

	Negative beginning		Positive beginning	
	Negative end	Positive end	Negative end	Positive end
$CM_0 = 0/\alpha=0.25$ (neutral initial current mood/retrieval of beginning)				
Current mood	-38	-9	-11	18
Recalled mood	-5	-3	1	2
$CM_0 = 0/\alpha=0.75$ (neutral initial current mood/retrieval of end)				
Current mood	-38	-9	-11	18
Recalled mood	-8	-4	0	4
$CM_0 = 50/\alpha=0.25$ (glad-active initial current mood/retrieval of beginning)				
Current mood	14	41	39	68
Recalled mood	12	14	18	20
$CM_0 = 50/\alpha=0.75$ (glad-active initial current mood/retrieval of end)				
Current mood	14	41	39	68
Recalled mood	9	13	16	21

Synthetic data adding errors sampled from normal distribution
2 X 2 X 2 between-groups factorial design with 160 participants

	Negative beginning				Positive beginning			
	Negative end		Positive end		Negative end		Positive end	
	M	Sd	M	Sd	M	Sd	M	Sd
Current mood	13.7	(12.4)	51.7	(17.8)	41.1	(16.5)	65.7	(21.2)
Recalled mood	15.4	(17.6)	18.7	(20.7)	18.0	(18.8)	23.1	(19.5)

Current (43.0) > Recalled current mood (18.8), $F(1, 152) = 65.62$, $p < .001$
Positive (36.9) > Negative beginning (24.8), $F(1, 152) = 16.36$, $p < .001$
Positive (39.8) > Negative end (22.0), $F(1, 152) = 35.20$, $p < .001$
Current/recalled mood x Positive/negative beginning, $F(1, 152) = 8.27$, $p = .005$
Current/recalled mood x Positive/negative end, $F(1, 152) = 20.58$, $p < .001$
No other significant interaction effects, $p > .15$

Synthetic data adding errors sampled from normal distribution
(2 X 2) X 2 mixed factorial design with 80 participants

	Negative beginning				Positive beginning			
	Negative end		Positive end		Negative end		Positive end	
	M	Sd	M	Sd	M	Sd	M	Sd
Current mood	16.0	(30.5)	43.1	(28.9)	41.2	(24.3)	71.9	(19.0)
Recalled mood	15.2	(26.9)	23.7	(24.8)	19.6	(28.6)	31.1	(21.7)

Current (42.8) > Recalled current mood (22.6), $F(1, 76) = 44.89$, $p < .001$

Positive (40.9) > Negative beginning (24.5), $F(1, 76) = 10.74$, $p = .002$

Positive (42.5) > Negative end (23.0), $F(1, 76) = 15.18$, $p < .001$

Current/recalled mood x Positive/negative beginning, $F(1, 76) = 14.23$, $p < .001$

Current/recalled mood x Positive/negative end, $F(1, 76) = 11.52$, $p < .001$

No other significant interaction effects, $F < 1$

$r_{\text{current mood, recalled current mood}} = .29 - .66$ (end effect mediated by current mood)

Conclusions

Our field study of work commuting shows (perhaps unsurprisingly) that a normative duration-weighted aggregation rule provides the best fit to the data. We think it is due to the routine character of work commutes and perhaps that measurements were made retrospectively. Follow-up research under way will target different types of trips asking questions on-line through smartphones.

Our theoretical conceptualizations of the relations between good-bad evaluations, current mood, and recalled current mood has met with some success but additional refinement remains. We also need to collect more data in experiments improving our measurement methods (e.g. using unobtrusive measures of current mood such as automatic processing of face pictures).

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Biographical sketch

Tommy Gärling is Emeritus Professor of Psychology affiliated with University of Gothenburg (Göteborg) and Karlstad University in Sweden. He has conducted research on travel behavior since the beginning 1980s, authored and co-authored close to 100 internationally published journal articles and book chapters, co-edited three books, is former board member of the International Association of Travel Behavior Research (IATBR), and is member of the editorial board of the journal *Transportation*. Economic psychology and environmental psychology are two other fields of research in which Tommy Gärling is active. He has contributed to more than 200 international publications in these fields, is former president of the environmental psychology division of the International Association of Applied Psychology (IAAP), member of the editorial boards of *Journal of Environmental Psychology* and *Journal of Socio-Economics*, and Associate Editor of *Journal of Economic Psychology.*

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