

Cognitive views on time

'Time is the conscious experiential *product* of the processes that allow the (human) organism to adaptively organize itself so that its behaviour remains tuned to the sequential (i.e. order) relations in its environment'
(John Michon, 1985)

- philosophical discussions of time (Zeno ... McTaggart, philosophy of physics) concerned with reality of time or specific aspects thereof (becoming? block world?); also mathematical structure of time (points? intervals?)
- under the influence of Edmund Husserl (1928) and William James (1890) attention was redirected to human experience of time
- some overlap with previous sets of questions: construction of time out of events

Relevant questions in this area

- *what* characterizes human temporal experience? (order, duration, perspective)
- do humans perceive or construct the flow of time? (answer: construct)
- *when* have humans begun to construct time in this manner? (?)
- do animals have a sense of time? (unclear)
- *why* do humans construct time? (answer: better planning?)
- *how* do humans construct time?
- *where* does the human construction of time show up in language? (tense and aspect)

Features of human temporal experience

- order relations
(even when events 'arrive' successively, our judgment of succession may be wrong!)
- duration (how reliable, influence of emotional states and disturbances)
- temporal perspective (indexical *now* (= present), adequate positioning of past and future relative to *now*; in an experience of *déjà vu* this goes awry)
- in all cases resist the temptation to assume that human mind simply reads data present in the environment!

Prehistory of temporal experience: preview

- animals probably don't have much in the way of temporal experience; more precisely:
- Bischof–Köhler hypothesis: 'Animals other than humans cannot anticipate future needs or drive states and are therefore bound to a present that is defined by their current motivational state.'
- there is some very recent evidence for the existence of episodic memory in food-caching birds (e.g. scrub jays) – so some idea of the past although not of the future
- when did it evolve in humans? two stages: *Homo erectus* – *Homo neanderthalensis*?
- e.g. burial of the dead, tools to make tools, symbolic representations

Human temporal experience: William James

(Principles of Psychology 1890)

- we have no sense for empty time: no internal clock which is consciously accessible
- the present is intimately related to consciousness, which is not a discrete 'string of beads' of successive 'nows'
- consciousness is the 'specious present', which is responsible for e.g. judgment of difference of events
- apart from the 'specious present', there is no time *intuition*, only symbolization (contra Kant)

The 'specious present'

[T]he practically cognized present [i.e. the specious present] is no knife-edge, but a saddle-back, with a certain breadth of its own on which we sit perched, and from which we look in two directions of time. The unit of composition of our perception of time is a *duration*, with a bow and a stern, as it were – a rearward- and a forward-looking end. It is only as parts of this *duration-block* that the relation of *succession* of one end to the other is perceived. We do not first feel one end and then feel the other after it, and from the perception of the succession infer an interval of time between, but we seem to feel the interval of time as a whole, with its two ends embedded in it. The experience is from the outset a synthetic datum, not a simple one; and to sensible perception its elements are inseparable, although attention looking back may easily decompose the experience, and distinguish its beginning from its end. (William James, Principles of Psychology, p. 574)

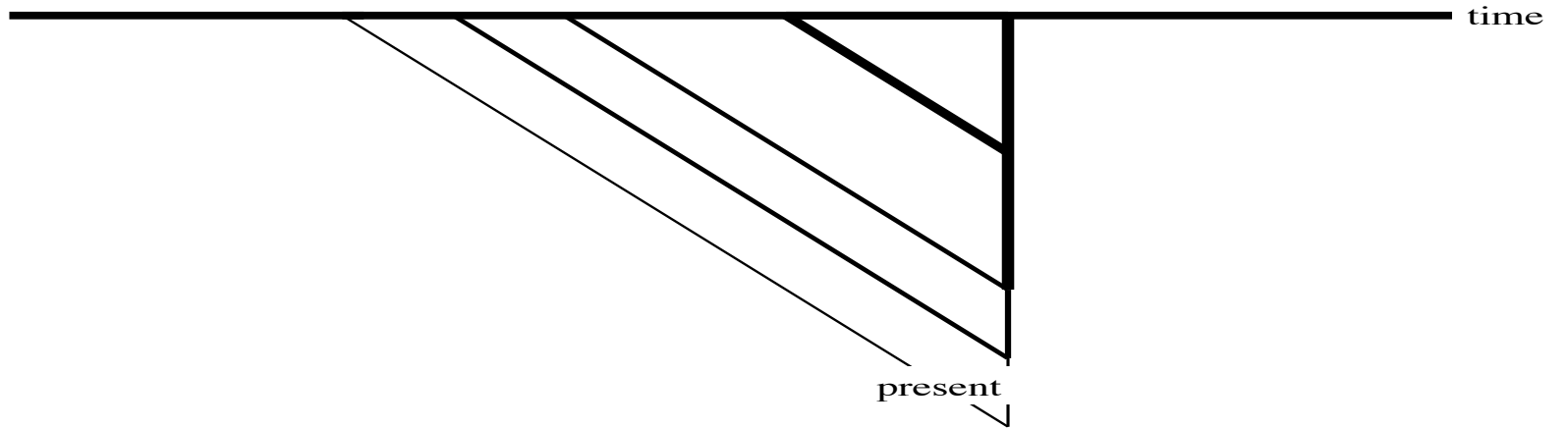
Judgments of duration

- 'a time filled with varied and interesting experiences seems short in passing, but long as we look back'
- 'a tract of time empty of experiences seems long in passing, but in retrospect short'
- attending to time makes it last longer, especially when 'nothing' happens
- memories crowded with events seem to refer to longer period
- relational theory of time with a twist: shows the role of *mental* events in construction of time

The feeling of past time is a present experience

- ‘a succession of feelings is not a feeling of succession’
- ‘if A and B are to be represented as occurring in succession, they must be simultaneously represented’ – together with a judgement of succession
- time is in a sense *two-dimensional*: there is a ‘perspective projection of past objects upon present consciousness’ (we will encounter this idea also in Husserl)
- ‘fading’ and ‘dawning’ brain processes

The feeling of past time is a present experience



James' conclusion

- 'Kant's notion of an intuition of objective time as an infinite necessary continuum has nothing to support it'
- specious present lasts for a few seconds
- the rest is *symbolic* construction: calendar, representing time as the real line, ...
- our conclusion will be that many features of this construction are inherent in our cognition

The specious present: neurobiology

- 'slow' processing cycle: $3s$ (Pöppel)
- example: Necker cube
- example CUBACUBACUBACUBA ...
- within each window of $3s$, percepts are bound together (in working memory, by neural synchrony?)
- after $3s$ the brain asks: 'what's new?'
- some percepts are then transferred to long term memory; no discontinuity
- duration estimates for durations less than $3s$ are much more accurate than for those greater than $3s$

Time as succession

- stimuli with stimulus onset asynchrony (SOA) less than around $44ms$ which are projected on the same retinal area: perceived as simultaneous
- SOA around $50ms$: flicker, i.e. perceived as different without being able to determine order
- only at larger SOA's, in the order of $100ms$, can successiveness proper be perceived
- SOA around $50ms$, projected on different parts of the retina: perception of movement
- if stimulus is first red, then green, 'moving' point changes color in mid-trajectory!
- conscious attention required to encode succession; other relations ('ends before', 'overlap') not encoded at all!?

Time as duration

- distinguish between perceived duration and remembered duration
- the latter apparently influenced by *ease* with which events can be retrieved
- more events retrieved more easily thus means a longer estimated duration
- do we have an internal clock, *which can be used for duration estimates?*
- temporal aspects of behaviour usually cognitively impenetrable: duration not encoded?
- duration estimates without external stimuli practically impossible

Example: duration estimates and temporal perspective in depressives

- make subjects produce *what they think of* as e.g. 120s (future)
- and reproduce a duration determined by the experimenter as 120s (past)
- *time dilation* := time interval experienced as longer than it is
- observations show time dilation, both in retrospect (e.g. past hour) and in anticipation (e.g. coming hour)
- time dilation more marked with respect to the future
- does *time dilation* mean that subjective time 'races' or 'stands still'? probably the latter

Temporal perspective: past, present

How is temporal perspective constructed from the present (cf. Husserl on *inneres Zeitbewusstsein*)?

Past connected with memory, but there are different memories:

- short term/working memory
- long term memory
- procedural memory
- semantic memory
- episodic memory: biographical past
- (episode: 'who did what to whom, where, when and why; and what happened next' – as experienced, not learned, fact)
- among episodic memories one can further distinguish between 'hot' and 'cold' memories – hot memories are ones in which one relives the past (cf. Proust)

Temporal perspective: present, future

- future: poor in perceptual content, rich in cognitive content
- humans are goal-oriented: anticipation of a future state and planning toward that state
- planning $:=$: setting a goal and devising a *sequence* of actions that will achieve that goal, taking into account events in, and properties of the world
- does our sense of the future derive from being goal-oriented?

Aberrant temporal perspective

- lesions of the frontal cortex and 'utilization behaviour'
- schizophrenia: no stable 'I–here–now' perspective (from J. Wrobel, *Language and schizophrenia*):

I: Are your uncles alive?

P: One died in France.

I: And which ones are still alive?

P: After the father from the mother's family, only Jasiiek from France is still alive; he died already, he was killed in some kind of accident.

Aberrant temporal perspective: schizophrenics

- poor at the *goal-directed serial-alternation* task: start from 104, arrive at 51 by repeatedly doing
 1. subtract 7
 2. add 1,2 or 3
- correlates with loss of temporal perspective, as formulated in
- ‘my past, present and future seem all muddled up and mixed together’
- ‘my past and future seem to have collapsed into the present, and it is difficult for me to tell them apart’
- ‘my past, present and future seem like separate islands of experience with little relation to each other’
- ‘my short-term goals do not fit my long term goals’
- same observations after use of marihuana

Why do we have the experience of time at all?

- with Kant, one probably has to say that time is subjective
- in a sense it is a necessary condition of experience 'as we know it' – it is hard to imagine experience ordered otherwise than in linear continuous time
- but at the same time derivative of experience
- for many motor skills, conscious (explicit) coding of time not necessary
- e.g. handwriting controlled by interaction with environment, adjusted by varying force, *not* duration
- coding of temporal information needs attention
- sometimes attention to duration necessary in learning phase (cf. cooking)
- order relations important to plan in new situation
- but much is unknown here