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Does the heart beat make us tick?

The impact of heart rate and arousal on time perception

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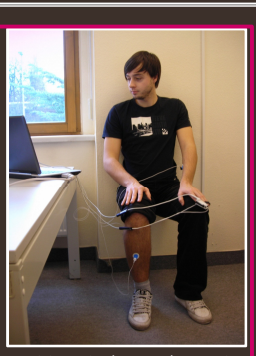
Introduction

Popular models of prospective time perception argue that human timing is effected by two factors: the pulse rate of an internal pacemaker (mainly affected by arousal) and the amount of attention directed to the passage of time (e.g., Zakay & Block, 1997). While results concerning the effect of attention on timing perception are conclusive: the more attention is directed to a time interval, the higher its estimated duration (e.g., Grondin, 2005); mechanisms of the pacemaker are still an unresolved issue. Attempts to locate an appropriate physiological manifestation of the pacemaker have not yet been successful nor has been the search for the underlying factors of arousal that affect time perception. A promising candidate appears to be the heart rate, because it produces regular paces. However, findings concerning the impact of heart rate on time perception are far from being conclusive (see for example, Carrasco, Redolat, & Simón, 1998, in contrast to Jamin et al., 2004). The current studies were intended to shed some light on the underlying mechanisms of prospective timing, by varying heart rate and arousal independently.



Participant in the muscle-exercise position equipped with ECG-electrodes

Study 1

Methods

N = 30 (20 female, mean age = 25.5, SD = 6.5)

Physical conditions (within subjects):
(1) Muscle exercise: increasing arousal and heart rate
(2) Breath-holding exercise: increasing arousal, decreasing heart rate
(3) Control condition: constant arousal and heart rate

Dependent Variables:
(1) Heart rate (ECG)
(2) Subjective arousal (ratings from 0 to 9)
(3) Time estimation (target interval of 8 sec)

Competing hypotheses

Heart-rate hypothesis: (heart rate influences the pace maker directly)
Higher time estimates in the **muscle-exercise condition** compared to the breath-holding and the control condition

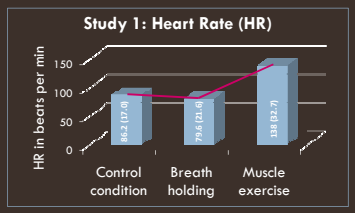
Subjective-arousal hypothesis: (subjective arousal determines time perception)
Higher time estimates in the **muscle-exercise and the breath-holding condition** compared to the control condition

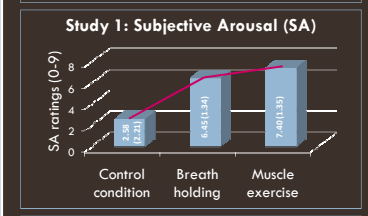
Results

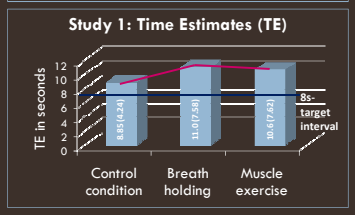
Contrast analysis for the 'heart-rate hypothesis'
$t(29) = 1.00$, $p = .323$, $g = 0.18$

Contrast analysis for the 'subjective-arousal hypothesis'
$t(29) = 2.41$, $p = .022$, $g = 0.41$

CONCLUSION: Heart rate is not a good predictor for time perception. Time estimates are consistent with the pattern of subjective arousal.







Study 2

Methods

N = 30 (23 female, mean age = 21.7, SD = 2.7)

A similar experimental design as in Study 1 was used with the same three physical conditions.

Differences to Study 1:

(1) A time production task (instead of verbal time estimation) was used in order to measure time perception (again with a target interval of 8 sec). Thus, testing the results of Study 1 with a different measurement of time perception to enhance the generality of the findings.

(2) Participants performed the time production task without and with a secondary memory task in each of the three physical conditions, thus, testing the results of Study 1 with distracted attention.

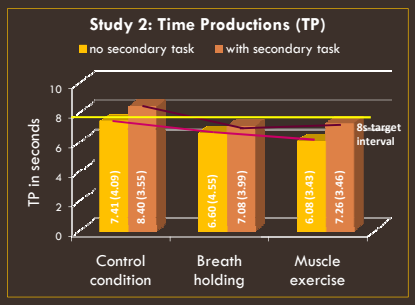
Results

Similar patterns as in Study 1 for heart rate and arousal were obtained, with and without a secondary task.

Contrast analysis for the 'heart-rate hypothesis'
No sec. task: $t(29) = 1.37$, $p = .180$, $g = 0.25$
With sec. task: $t(29) = 0.84$, $p = .408$, $g = 0.15$

Contrast analysis for the 'subjective-arousal hypothesis'
No sec. task: $t(29) = 2.69$, $p = .012$, $g = 0.49$
With sec. task: $t(29) = 3.71$, $p = .001$, $g = 0.68$

CONCLUSION: As in Study 1, subjective arousal is a better predictor of time perception than heart rate.



Note: The opposite pattern of time production compared to time estimation is to be expected. Whenever high verbal estimates of an interval are predicted, time productions should be low (see e.g., Zakay & Block, 1997).

Discussion

The results indicate that increased arousal leads to higher time estimates, whereas heart rate has no relevant impact on time perception. Thus, it is not the heart beat that makes us tick, but rather some kind of arousal that needs to be topic of further research.

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References

Carrasco, M. C., Redolat, R., & Simón, V. M. (1998). Effects of cigarette smoking on time estimation. *Human Psychopharmacology: Clinical and Experimental, 13*, 565-573.

Grondin, S. (2005). Current issues related to psychological time. In S. P. Shohov (Ed.), *Advances in psychology research* (Vol. 33, pp. 65-88). Hauppauge, NY: Nova Science.

Jamin, T., Joulia, F., Fontanari, P., Bonnon, M., Ulmer, C., & Crémieux, J. (2004). Effect of a static apnea exposure on time estimation ability. *Aviation, Space, and Environmental Medicine, 75*, 876-880.

Zakay, D., & Block, R. A. (1997). Temporal Cognition. *Current Directions in Psychological Science, 6(1),* 12-16.