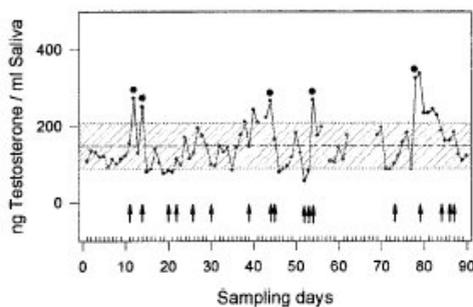


### TESTOSTERONE AND SEXUAL ACTIVITY

“Testosterone levels surge when men are trying for a baby” BBC News reported after Katharina Hirschenhauser and her colleagues published the results of their study on time patterns of testosterone and self-reported sexual behavior in healthy, adult men.

The scientists of the Institute of Applied Psychology in Lisbon, Portugal, asked twenty-seven volunteers to collect daily morning saliva over a period of 90 days and measured their testosterone levels. Subjects were given a questionnaire to be completed every evening about the day’s eventual sexual activity. They also received a general questionnaire to collect information about their family status (pair bond and its duration, whether they were fathers already and whether they wished to have children with their current partner (“prospective fathers”).

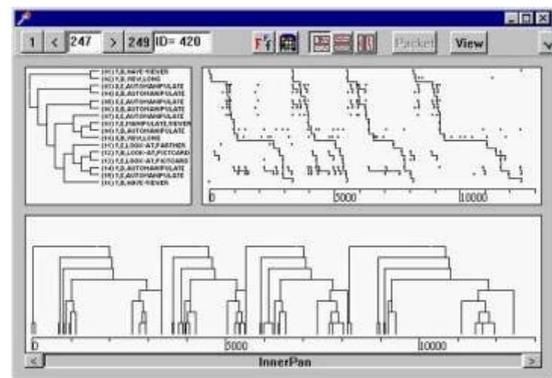


**Figure 1.** Example of an individual testosterone pattern over the 90-day sampling period. The shaded area represents the individual mean  $\pm$  standard deviation. Testosterone levels beyond the upper limit of this area are considered to be peaks in testosterone. Arrows indicate peak days in sexual activity. Circles above peaks indicate a co-occurrence of testosterone peaks and sexual activity.

### PATTERN ANALYSIS BY THEME

The combined hormone-behavior data were analyzed using the software package Theme. Theme is a professional system for detecting and analyzing hidden patterns in data records.

Numerous non-random time patterns were found in all individuals. From the patterns detected, all patterns that contained testosterone peaks and peaks in sexual activity were selected. A co-occurrence of testosterone peaks and sexual activity was found in 75% of the time patterns that involved testosterone.



**Figure 2.** Theme screenshot showing a pattern diagram. Upper left box: event types included in the pattern and their connections. Upper right box: real-time distribution of events and patterns. The dots represent event occurrences and the zig-zag lines connecting the dots represent pattern occurrences. Bottom box: real-time structure of the pattern. The lines display the connections between event occurrences

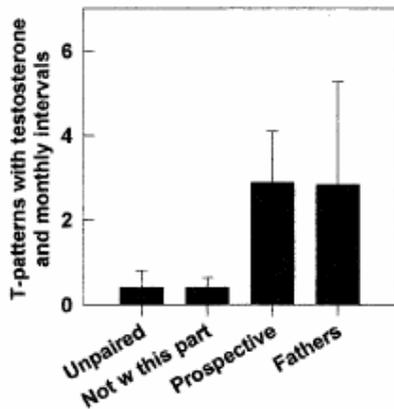
The temporal sequence of the interaction between testosterone and sexual activity was studied by selecting patterns in which a peak in testosterone preceded sexual activity and patterns in which sexual activity was followed by a testosterone peak. No prevalent sequence was found.

Subsequently, all patterns with testosterone peaks were selected and the interval between peaks was analyzed. In 24 of the 27 males testosterone peaks occurred with weekly intervals. Fifteen subjects had monthly peaks of testosterone (peaks occurring with a 28-day full-moon interval).

### COMPARISON BETWEEN SOCIAL GROUPS

The proportion of time patterns that involved testosterone and sexual activity were not different

between men with a partner and unpaired men and also not different between fathers and non-fathers.



**Figure 3.** The number of detected time patterns with monthly testosterone peaks in the four social groups..

However, a co-occurrence of testosterone peaks and sexual activity was observed more often in

#### THEME: A UNIQUE TOOL

The present example is one of numerous possible applications of Theme in behavioral research. The study highlights Theme as a unique tool to detect and analyze 'hidden' patterns. Patterns of this kind are hard or impossible to detect using other methods.

prospective fathers than in men who had no partner or did not want to have children with their current partner. Prospective fathers were also different from the other social groups in that they had a higher frequency of patterns with monthly testosterone peaks (Figure 3).

#### CONCLUSION

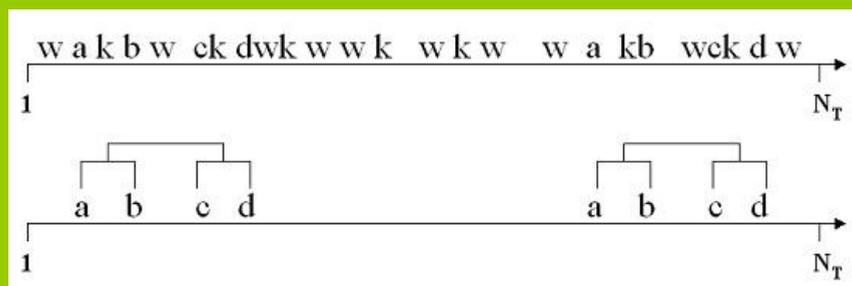
The authors suggest that rather than representing a direct regular pattern of testosterone per se, the observed patterns in prospective fathers suggest that men have the ability to respond hormonally to their partner's menstrual cycle.

#### REFERENCE

Hirschenhauser K.; Frigerio D.; Grammer K.; Magnusson M. (2002) Monthly patterns of testosterone and behavior in prospective fathers. *Hormones and behavior*, **42**, 172-181.

#### How does Theme work?

Theme uses a unique algorithm that searches for relationships between events by taking into account both the order and relative timing of these events, and their hierarchical structure. Statistics such as the number of different patterns detected in a behavioral record, their length, abundance and number of actors involved can be used as objective measures of the level of organization or complexity of the behavior.



**Figure 4.** Upper part: A record containing six types of events (a, b, c, d, k and w). Lower part: The same record after removing all occurrences of k and w. Two simple pattern (ab) and (cd) appear that were difficult to find when the other events were present. The patterns (ab) and (cd) are part of a larger pattern ((ab)(cd)) which may then become part of an even more complex pattern.

#### Reference

Magnusson MS (2000), Discovering hidden time patterns in behavior: T-patterns and their detection. *Behavior, Research Methods, Instruments & Computers* **32**, 93-110.