Supplementary Material / Equations

Equation 1. Measurement of the framewise change of pixel luminance

(1)	$\Delta\ lum_{px} = lum_{px}\ (t_i) - lum_{px}\ (t_{i-1})$	*Image analysis of motion activity: defining pixel luminance change.* The term lum_{px} (Eq#1) defines the 24-bit RGB luminance (R: 0-255; G: 0-255; B: 0-255) of a single pixel area [*px*] in frame f_i at time t_i. The differential luminance value $\Delta\ lum_{px}$ describes the change in luminance of a pixel area in the time interval Δt between the two time points [t_{i-1}, t_i] corresponding with the interval between the two sequential frames [f_{i-1}, f_i]. Due to the frame rate of 60 Hz used, the time interval in which the differential luminance ($\Delta\ lum_{px}$) was analysed was 16.67 ms (further information, see [49]).

Equations 2. Definition of *motion-active* pixels

(2A) (2B)	$_{mot}a\ [px]\ = 1$ $_{mot}a\ [px]\ = 0$	*Image analysis of motion activity: Definition of the pixel status of motion activity.* *Motion-active state*: a selected pixel area [*px*] with $\Delta\ lum_{px} > lum_{th}$ (Eq#2A) *Motionless state:* for a selected pixel area [*px*] with $\Delta\ lum_{px} <= lum_{th}$ (Eq#2B) A single pixel is specified in this document as "px" for a length or as "[px]" for an area. The RGB luminance values ($\Delta\ lum_{px}$: Eq#1) form the basis for the distinction between *motion-active* and *motionless* state, which is determined for each individual pixel area [*px*]. *Motion* activity is detected at the pixel area [*px*] (Eq#2B) when the RGB luminance exceeded the threshold value $lum_{th} = 10$. For the 24-bit RGB luminance with the range of 0…255 for each of the three RGB domains this threshold results in lum_{th} [R] * lum_{th} [G]* lum_{th} [B] = 1 000, which corresponds to the share of 6.03086 E-05 in the total data space.

Equations 3. Measurement of the framewise change of pixel luminance and its normalization

(3A)	${}_{mot}A\ [mfa, sz_j, t_i] = \sum_{k=1}^{10000} ({}_{mot}a_{px}\ [k])$	*Definition of the motion activity in relation to the bee collective in a surveillance zone.* With ${}_{mot}A$, *motion* activity (Eq#3A); *mfa*, episode of the MFA activity; sz_j, the selected surveillance zone (j = 1-5) with the size of the square of 100 px * 100 px = 10 000 [px] in the originally recorded frame; a single pixel is denoted here as 'px' concerning a length, or denoted as '[px]' concerning an area; ${}_{mot}a_{px}$ [k], the value assigned in Eq#3A to the area k which is equivalent to the number k of the respective pixels confirming *motion* activity (${}_{mot}a_{px}$ [k_1] = 1) or *motionlessness* (${}_{mot}a_{px}$ [k_0] = 0) as defined in Eq#2 (with k_1 = 10 000 - k_0). For each frame f_i at the timepoint t_i, the *motion* activity ${}_{mot}A[t_i]$ is quantified for each surveillance zone sz_j by summing up the *motion-active* pixels [px] contained therein.
(3B)	$rel\ {}_{mot}S\ [mfa, sz_k] = \sum_{j=fstart}^{j=fend} ({}_{mot}A\ [j]\ ) / n_{ff}\,[sess_{exp}]$	*Normalisation of the motion activity in relation to the length of experimental session.* f_{start} , f_{end} are the frames at the starting and ending time (t_{start}, t_{end}) of the respective experimental session $sess_{exp}$; n_{ff} [$sess_{exp}$] is the number of frames of the respective session. Therefore, $rel\ {}_{mot}S$ (Eq#3B) is the relative expression of the sum of *motion* activity per frame throughout an entire experimental session ($sess_{exp}$). This normalization takes into account the fact that the *motion* activity in the test sessions can only be compared if the different lengths of the periods are considered.
(3C)	$max\ rel\ {}_{mot}S =$ $=MAX\,(rel\ {}_{mot}S\ [mfa, sz_{1\text{-}5}, sess_{exp} = 1..\ max_{sess}])$	*Assessment of the maximal motion activity in the entire episode.* The total maximum $max\ rel\ {}_{mot}S$ (Eq#3C) of the values $rel\ {}_{mot}S$ (Eq#3B) is determined from all surveillance zones ($sz_{1\text{-}5}$) and from all experimental sessions ($sess_{exp}$).
(3D)	$rel_2\ {}_{mot}S\ [mfa, sz_k, sess_{exp}] =$ $=rel\ {}_{mot}S\ [mfa, sz_k, sess_{exp}\ ] / max\ rel\ {}_{mot}S$	*Normalisation of the motion activity in the entire episode due to the maximal motion strength.* The value $rel_2\ {}_{mot}S$ is calculated by its normalization with the total maximum (Eq#3C) and thus provides the relative image-based *motion* activity per experimental session $sess_{exp}$ in one of the five surveillance zones (sz_k) between the limits of 0 and 1 (Eq#3D).
(3E) (3F) (3G)	$min\ {}_{mot}A\ = \text{MIN}\ ({}_{mot}A)$ $max\ {}_{mot}A\ = \text{MAX}\ ({}_{mot}A)$ ${}_{mot}A^* = 1 - (max\ {}_{mot}A\ - {}_{mot}A) / (max\ {}_{mot}A\ - min\ {}_{mot}A\ )$	*Normalisation of the motion activity in the entire episode due to the minimal and maximal motion strength.* The *motion* values ${}_{mot}A$ or the like are normalized with Eq#3G to the value ${}_{mot}A^*$ between 0 and 1 by considering the maximum and minimum *motion* values (Eq#3E,F) in the entire selected episode. Here, the minimum ${}_{mot}$A values (Eq#3A) are set to 0, and the maximum ${}_{mot}$A values (Eq#3A) are set to 1. This normalization is important in order to compare the range of motion in different episodes. For various reasons, this range is episode-specific, which could hardly be an attribute to be evaluated

Equations 4. Assessment of the histogram-based *motion* spectrum

(4A)	$Increment_{50} =$ $= (\mathrm{LOG}_{10}\ (max\ {}_{mot}A\ [mfa] - min\ {}_{mot}A\ [mfa]))\ /\ 50$	*Definition of 50 steps in motion strength in histogram-based motion spectra.* The *motion* values ${}_{mot}A$ or the like are normalized with Eq#3G to the value ${}_{mot}A^*$ between 0 and 1 by considering the maximum and minimum *motion* values (Eq#3E,F) in the entire selected episode. Here, the minimum ${}_{mot}$A values (Eq#3A,E) are set to 0, and the maximum ${}_{mot}$A values (Eq#3A,F) are set to 1.
(4B) (4C)	${}_{LL}\mathrm{LOG}_{mot}\ [I_h] =$ $= \mathrm{LOG}_{10}\ (min\ {}_{mot}A\ [mfa]) + Increment_{50} * (I_h\text{-}1)$ ${}_{UL}\mathrm{LOG}_{mot}\ [I_h] = {}_{LL}\mathrm{LOG}_{mot}\ [I_h] + Increment_{50}$	*Definition of each interval of motion strength for the motion spectrum.* Therefore, in any case the general lower limit [*LL*] of the entire distribution of the *motion* activity of the selected episode is set in the paper mathematically as 0 [*px*], equal to zero *motion* activity (according to Eq#3A,E) per surveillance zone ($sz_{1\text{-}5}$); the general upper limit [*UL*] of the range of *motion* strength is assessed as the maximal value of *motion* activity (according to Eq#3F) determined in all five surveillance zones [$sz_{1\text{-}5}$] per *mfa* episode (Eq#4A). The respective lower and upper limits of the 50 histogram intervals I_h are calculated according to the Eq#4B,C.
(4D)	${}_{LL}\mathrm{LOG}_{mot}\ [I_h] < \mathrm{LOG}_{10}\ ({}_{mot}A\ [f_i,\ mfa]) < {}_{UL}\mathrm{LOG}\ [I_h]$	*Sorting algorithm for motion strength values in relation to the motion spectrum.* A single case of *motion* event ${}_{mot}A$ (Eq#3A) at the time t_i concerning the captured image f_i refers to the number of *motion*-active pixels per surveillance zone and this value is then as its logarithmic value LOG_{10} (${}_{mot}A$) sorted according to Eq#4D into the *motion* strength category I_h.
(4E)	$rel_1\ {}_{mot}A\ [I_h] = n_{ff}\ [I_h]\ /\ N_{ff}\ [sess_{exp}]$	*Normalizing the motion strength intervals in relation to the number of frames per experimental session.* For each histogram interval I_h, this sorting process yields a value indicating the number of cases concerning this *motion* strength interval (n_{ff} [I_h]), each of these cases referring to a single image. This number must be normalized to the length of the corresponding experimental session for comparability with other sessions (Eq#4C). This length of session is quantified with the number of frames involved N_{ff}. The result $rel_1\ {}_{mot}A$ (Eq#4E) presents itself as a value for the *motion* strength in a relative term.
(4F) (4G)	$max\ rel_1\ {}_{mot}A =$ $= \mathrm{MAX}\ (rel_1\ {}_{mot}A\ [I_h = 1\ ..\ 50;\ sess_{exp} = 1\ ..\ max\_session;\ sz_{1\text{-}5}])$ $rel_2\ {}_{mot}A\ [I_h] = rel_1\ {}_{mot}A\ [I_h]\ /\ max\ rel_1\ {}_{mot}A$	*Normalisation of the motion strength intervals in relation to the maximum motion strength value of the episode.* Lastly the maximum $rel_1\ {}_{mot}A$ value (Eq#4F) was assessed regarding all experimental sessions (e.g. $sess_{exp}$ = 1..17 for mfa_1), and for all nest areas ($sz_{1\text{-}5}$), but separately for each of the episodes $mfa_{1\text{-}3}$. This value was used to normalize the $rel_1\ {}_{mot}A$ data (Eq#4E) to range between 0 and 1 ($rel_2\ {}_{mot}A$ [I_h]: Eq#4G) for easier comparison.

Equations 5. Assessment of the size of the tail areas of the histogram-based *motion* spectrum

(5A) (5B)	$n_i = rel_{2\ mot}A\ [I_h = i]$ $n_k = \text{MAX}\ (n_i)$ (for $n_1, \ldots, n_k, \ldots, n_{50}$)	*Determination of the position of the max motion strength in the 50 intervals of the histogram-based motion spectrum.* In each histogram-based *motion* spectrum created with the normalized data (Eq#4G), the interval k was determined which has the maximum of the cases (Eq#5A,B). This is repeated for all the *motion* spectra of the entire series of sessions (j = 1 to $max\ sess_{exp}$) of each episode ($mfa_{1\text{-}3}$) selected, and separately for all five surveillance zones ($sz_{1\text{-}5}$).
(5C)	$k\ [P_d]_j = (k\ [nP_d]_{j\text{-}1} + k\ [nP_d]_{j+1}) / 2$	*The pragmatic way to decide about the position of the max motion strength in a bimodal histogram-based motion spectrum.* The P_d -sessions in the semi-quiescent state clearly show bimodal distributions due to the initiated shimmering activity. Therefore, a possible maximum of the motion-profile (as suggested in Eq#5B) for a given $[P_d]$j session can only be determined pragmatically. For this purpose, the mean value of those positions was used for which the two nP_d sessions before and after the selected P_d session ($[nP_d]$ j-1, $[nP_d]$ j+1; Eq#5C) showed their maxima (Eq#5B) in their *motion* spectra.
(5D) (5E) (5F)	$UL = k + 5;\ LL = k - 5$ $uTa = \sum_{i=UL}^{50} (rel_2\ motA\ [i])$ $lTa = \sum_{i=1}^{i=LL} (rel2\ motA\ [i])$	*Determination of the motion strength summed up in the left-sided and right-sided tails in the histogram-based motion spectrum.* On both sides of the maximum in the *motion* spectrum (at the position $I_h = k$), the tails of the *motion* spectra are set with the respective distance of five intervals of the *motion* strength (where the interval I_h is defined logarithmically according to Eq#4D). Thus the left tail of the spectrum contains the $rel_{2\ mot}A\ [I_h]$ values (Eq#4G) in the interval range [I_h = 1 ... LL], and the right tail in the interval range [I_h = UL ... 50] (Eq#5D-F, see also [49]). The characteristic values of both tail ranges are then determined by the respective sums according to Eq#5E,F.
(5G)	$q_s = uT_a / lT_a$	*Determination of the skewness of motion spectrum.* Finally, the index q_s (Eq#5G) is used as a measure of *skewness* of the *motion* spectrum. This relation does not require further normalization, but on the other hand it is also independent of the position of the distribution on the spectral scale of *motion* strength (see also [49]).

Equations 6. Temperature values of the individual pixels per surveillance zone

(6A)	$n_{[px]}\,(sz_i)$ defined as sz_1: 2 399 [px]; sz_2: 2 399 [px]; sz_3: 2 549 [px]; sz_4: 2 861 [px]; sz_5: 2 549 [px]	*Definition of the size of surveillance zones in the IR images.* The geometry and the associated number of individual pixel areas [px] for each of the seven surveillance zones defined for the IR images (sz_{1-7}; Eq#6A; see Fig. 3) were estimated according to the video images [49] and adapted to the resolution of the IR images (320 x 240 px).
(6B)	$_{heat}X\,[sz_i,\ t_{exp}] = \sum_{ipx=1}^{n\,[px]} \left(T_{ipx}\,[sz_i,\ t_{exp}] \,/\, n\,[px] \right)$	*Calculation of the relative heat per pixel area in a surveillance zone in an IR image.* The mean temperature ($_{heat}X$; Eq#6B) was calculated from the individual pixel values of the square areas defined in the IR image using Flir software; t_{exp}, experimental time defined for the selected image; $n[px]$, number of pixel areas [px] referring to the selected surveillance zone sz_i in the IR image; T_{ipx}, temperature of the individual pixel area $[px]_{ipx}$; $_{heat}X$, arithmetic mean of the temperature of all pixel areas of the selected surveillance zone.
(6cC)	$_{heat}X_{19}\,[sz_i, f\,[t_{exp}]] = \sum_{iff=-9}^{+9}\ {}_{heat}X\,[sz_i\,, f\,[t_{exp}],\ i_{ff}\,] \,/\, 19$	*Smoothing of the relative heat per pixel area in a surveillance zone in a sequence of IR images.* In the IR image sequence, the temperature of the selected surveillance zone was smoothed for each frame $f\,[t_{exp}]$ using a moving average (X_{19} with i_{ff} = 1..19). For this purpose, the mean value $_{heat}X_{19}$ was determined using the individual values (Eq#6B) of 9 leading and 9 trailing images (Eq#6cC).
(6D) (6E) (6F)	$min\ {}_{heat}X_{19}\ =\ \mathrm{MIN}\ ({}_{heat}X_{19})$, $max\ {}_{heat}X_{19}\ =\ \mathrm{MAX}\ ({}_{heat}X_{19})$ $_{heat}X_{19}^{*} = 1 - (max\ {}_{heat}X_{19} - {}_{heat}X_{19}) \,/\, (max\ {}_{heat}X_{19} - min\ {}_{heat}X_{19}\,)$	*Normalisation of the relative heat per pixel area in a surveillance zone in an IR image between min and max values.* The *heat* values $_{heat}X$ or the like are normalized with Eq#6F to the value $_{heat}X_{19}^{*}$ between 0 and 1 by taking into account the maximum and minimum *motion* values (Eq#6D,E) in the entire selected episode.

Equations 7. Determination of max *heat* and its time point in a pre-MFA *heat* pulse

(7A)	$H_{lth} = H_{max} - 0.001 * H_{max}$	*Defining the lower threshold value in the presumptive preMFA heat pulse.* To determine the two parameters of the preMFA *heat* pulse, the time value of its maximum height (Eq#7D) and the time value of its maximum initial rise (Eq#7I) to its maximum height, a measurement range between the absolute height (H_{max}) and a *lower threshold value* (H_{lth}) is defined within the first part of the bipolar shaped pulse according to Eq#7A (see also Fig. S2 A_{1-5}).
(7B) (7C)	For all T_{it} with $H_{lth} <= T_{it} <= H_{max}$ $t\ [T_{it}]$ is determined with $n_{all\_it} = n\ [t_{Tit}]$ $H'_{max} = \sum_{it=1}^{nall\_it} T_{it}\ [sz_j]\ /\ n_{all\_it}$	*Determination of the heat maximum in the presumptive preMFA heat pulse.* Subsequently, all *heat* values T_{it} in this selected time interval (with i_t as the number of the actual time value) were determined with their time values $t\ [T_{it}]$, corresponding to Eq#7B. This number of all respective time points (which conform to the selected frames) is determined with n_{all_it}. The mean value of those frames whose *heat* values lie within the upper (H_{max}) and lower (H_{lth}) threshold values is taken as the *heat* maximum (H'_{max} ; Eq#7B,C) in the first part of the bipolar pre-MFA impulse of the surveillance zone sz_j.
(7D)	$t\ [H'_{max}] = \sum_{it=1}^{nall\_it} (\ t\ [T_{it}]\ [sz_j]\ /\ n_{all\_it}\ )$	*Determination of the time value of the heat maximum in the presumptive preMFA heat pulse.* Similarly, the temporal value of this maximum H'_{max} is determined by taking all the time values of the *heat* data that lie within this amplitude range in the given time interval of the bipolar *heat* pulse according to Eq#7D.
(7E) (7F)	f_{start} = var (f [1.25 min] to f [2.0 min]) exp time with f [2.0 min] == 3*60 s *0.75 = ff 135 (for the rate of IR-frames = 3ff /s. Δff = var (ff 50-90); $dt = t\ (\Delta ff)$	*Definition of start and end frames in the presumptive preMFA heat pulse.* The start time of the analysis (f_{start}) ranges from the beginning of the pre-MFA pulse in experimental time to the first half of this bipolar pulse of 2 min exposure time, which corresponds in the episode mfa_1 to 135 frames (Eq#7E). *Definition of* Δff *as a probe for determination of max heat increase in the presumptive preMFA heat pulse.* The time step *dt*, in which later on the maximum slope $dH\ /\ dt$ (Eq#7I) is calculated for all surveillance zones in the episode mfa_1 (see abscissa in Fig. S2 B), ranges from f 50 to f 90, which corresponds to a time interval of 17 - 30 s (Eq#7F; Fig. S2 C).

(7G)	$dH = H_1 - H_0$ with $H_1 = H\,[f_{start} + \Delta ff]$; $H_0 = H\,[\Delta ff]$	*Scanning of heat values with the* Δff *probe to determine the max heat increase in the presumptive preMFA heat pulse.* The *heat* difference (dH) is defined on the reference *heat* (H_0) with the lower time value (Eq#7G) and the higher *heat* value (H_1) at the end of the selected time step dt. To do this, the entire selected period of 135 frames (Eq#7E) is scanned by increasing the respective start frame f_{start}.
(7H)	max dH / dt = MAX $dH / \Delta ff$	*Determination of the max heat increase in the presumptive preMFA heat pulse using the time interval* Δ*ff for scanning.* By selecting var (*ff* 50-85) which is var (*f* [1.25 min+17 s] to *f* [1.25 min+30 s]) exp time, the maximum inclination (MAX dH/dt) is determined (Eq#7H; Fig. S2 C).
(7I)	t [MAX dH/dt] = t (f_{start} (MAX dH/dt [Δff]))	*Determination of the time value of the max heat increase in the presumptive preMFA heat pulse.* The time value t [MAX dH/dt], which is linked to the maximum *heat* increase, is then equated with the time value of f_{start} at the selected time step of Δff (Eq#7I).

Equations 8. Derivation of the benchmarks for *heat-motion* coupling

(8A)	*heat* data: $_{heat}X_{19}$ (sz_i, f [t_i]) *motion data:* $_{mot}A$ (mfa_k, sz_j, f [t_i])	*Definition of the primary elements for calculating the magnitude of the heat-motion coupling.* The temperature values $_{heat}X_{19}$ (Eq#6C) and the *motion* data $_{mot}A$ (Eq#3A) (see Fig. 4 for survey of both parameters) are the primaries (Eq#8a) for calculation the magnitudes of *heat-motion* coupling. They are specified for the selected episode (mfa_{1-3}), for the respective surveillance zones ($sz_{j=1..5}$) at the relevant time of the experiment (f [t_i] with i = 1..> ff 4 000, and $\Delta t = t\,[f_i] - t\,[f_{i-1}] = 0.3$ s.
(8B)	lag$_{pos}$ condition: [$t_{heat} < t_{motion}$]; *lag*$_{pos}$ [*motion*] $\geqq 0$ *lag*$_{pos}$ [*motion*] = 0 *trial*$_0$ [*lag*$_{pos}$, *heat*]: $f_{start} = f_{100} = 100$; $f_{end} = f_{start} + 50 = f_{150}$ *trial*$_0$ [*lag*$_{pos}$, *motion*]: $f_{start} = f_{100} = 100$; $f_{end} = f_{start} + 50 = f_{150}$ *lag*$_{pos}$ [*motion*] = +1 *trial*$_1$ [*lag*$_{pos}$, *heat*]: $f_{start} = f_{100} - (+1) = f_{99}$; $f_{end} = f_{start} + 50 = f_{149}$ *trial*$_1$ [*lag*$_{pos}$, *motion*]: $f_{start} = f_{100} = 100$; f_{end}: $f_{start} + 50 = f_{150}$ … *lag*$_{pos}$ [*motion*] = +49 *trial*$_{49}$ [*lag*$_{pos}$, *heat*]: $f_{start} = f_{100} - 49 = f_{51}$; $f_{end} = f_{start} + 50 = f_{101}$ *trial*$_{49}$ [*lag*$_{pos}$, *motion*]: $f_{start} = f_{100}$; $f_{end} = f_{start} + 50 = f_{150}$	*Selection of the test sequence for the heat-motion coupling. Definition of data sets.* The lag condition [$t_{heat} < t_{motion}$] (Eq#8B) means, for the cross correlation of *heat* and *motion* data (Eq#8A) by the Pearson correlation coefficient (*pcc*), that the time point of *heat* measurement is before the time point of *motion* measurement (with the definition of *lag*$_{pos}$ [*motion*] $\geqq 0$). Here the *lag* of between *heat* and *motion* measurement is greater than zero. In Eq#8B, the single steps of the *lag*$_{pos}$ algorithm are detailed. First, for *lag*$_{pos}$ [*motion*] = 0 means that the start and end times for the calculation of the Pearson correlation coefficient (*pcc*) are the same for *heat* and *motion* domain. They range from f_{100} to f_{150} in each of the experimental sessions (P_d, nP_d). A single *trial* comprises therefore a single run to evaluate a *pcc* value. Second, for *lag*$_{pos}$[*motion*] = +1 means that the start and end times for the calculation of the Pearson correlation coefficient (*pcc*) are for the *heat* assessment by one frame earlier than for that of the *motion* domain. The *heat* domain ranges therefore from $f_{100-1} = f_{99}$ to $f_{150-1} = f_{149}$ in each of the experimental sessions (P_d, nP_d), while the *motion* domain remains frozen from f_{100} to f_{150}. Third, for *lag*$_{pos}$ [*motion*] = +49 means that the start and end times for the calculation of the Pearson correlation coefficient (*pcc*) are for the *heat* domain by 49 frames earlier than for the *motion* domain. The *heat* domain ranges therefore from $f_{100-49} = f_{51}$ to $f_{150-49} = f_{101}$ in each of the experimental sessions (P_d, nP_d), while the *motion* domain remains still frozen at f_{100} to f_{150}.

(8C)	$k = lag_{pos}$ [*motion*] $trial_k$ [*k*, *heat*]: f_{start} [*k*, *heat*] = $f_{100} - k$; f_{end} [*k*, *heat*] = f_{start} [*k*, *heat*] + 50 $trial_k$ [*k*, *motion*]: f_{start} [*k*, *motion*] = f_{100}; f_{end} [*k*, *motion*] = f_{start} [*k*, *motion*] + 50 *pcc* ($trial_k$ [*k*, *heat*], $trial_k$ [*k*, *motion*])	*Setting the Pearson correlation coefficient for the heat-motion coupling. Algorithm of cross correlation between heat and motion for* lag_{pos} *[motion]* The general algorithm of the assessment of the *pcc* value for the lag_{pos} [*motion*] condition is here (Eq#8cC) summarized.
(8D)	lag_{neg} condition: [$t_{heat} > t_{motion}$]; lag_{neg} [*motion*] $\leqq 0$ lag_{neg} [*motion*] = 0 $trial_0$ [lag_{neg}, *heat*]: $f_{start} = f_{100} = 100$; $f_{end} = f_{start} + 50 = f_{150}$ $trial_0$ [lag_{neg}, *motion*]: $f_{start} = f_{100} = 100$; $f_{end} = f_{start} + 50 = f_{150}$ lag_{neg} [*motion*] = -1 $trial_1$ [lag_{neg}, *heat*]: $f_{start} = f_{100} - (-1) = f_{101}$; $f_{end} = f_{start} + 50 = f_{151}$ $trial_1$ [lag_{neg}, *motion*]: $f_{start} = f_{100} = 100$; f_{end}: $f_{start} + 50 = f_{150}$ … lag_{neg} [*motion*] = -49 $trial_1$ [lag_{neg}, *heat*]: $f_{start} = f_{100} - (-49) = f_{149}$; $f_{end} = f_{start} + 50 = f_{199}$ $trial_1$ [lag_{neg}, *motion*]: $f_{start} = f_{100} = 100$; f_{end}: $f_{start} + 50 = f_{150}$	*Selection of the test sequence for the motion-heat coupling. Definition of data sets.* Similarly (regarding to Eq#8B), the lag condition [$t_{heat} > t_{motion}$] (Eq#8D) means for the cross correlation of *heat* and *motion* data (Eq#8A) by the Pearson correlation coefficient (*pcc*) that the time point of *heat* measurement is after the time point of *motion* measurement (with the definition of lag_{neg} [*motion*] $\leqq 0$). Here, the lag between *heat* and *motion* measurement is less than zero. In Eq#8D, the single steps of the lag_{pos} algorithm are detailed. First, for lag_{neg} [*motion*] = 0 means that the start and end times for the calculation of the Pearson correlation coefficient (*pcc*) are the same for *heat* and *motion* domain. They range from f_{100} to f_{150} in each of the experimental sessions (P_d, nP_d). A single *trial* comprises therefore a single run to evaluate a *pcc* value. Second, for lag_{neg} [*motion*] = -1 means that the start and end times for the calculation of the Pearson correlation coefficient (*pcc*) are for the *heat* assessment by one frame later than for that of the *motion* domain. The *heat* domain ranges therefore from $f_{100-(-1)} = f_{101}$ to $f_{150-(-1)} = f_{151}$ in each of the experimental sessions (P_d, nP_d), while the *motion* domain remains frozen from f_{100} to f_{150}. Third, for lag_{neg} [*motion*] = -49 means that the start and end times for the calculation of the Pearson correlation coefficient (*pcc*) are for the *heat* domain by 49 frames earlier than for the *motion* domain. The *heat* domain ranges therefore from $f_{100-(-49)} = f_{149}$ to $f_{150-(-49)} = f_{199}$ in each of the experimental sessions (P_d, nP_d), while the *motion* domain remains still frozen at f_{100} to f_{150}.

(8E)	l = lag_{neg} [*motion*] trial$_l$ [l, *heat*]: f_{start} [l, *heat*] = f_{100} - l ; f_{end} [l, *heat*] = f_{start} [l, *heat*] + 50 trial$_l$ [l, *motion*]: f_{start} [l, *motion*] = f_{100}; f_{end} [l, *motion*] = f_{start} [l, *motion*] + 50 *pcc (trial$_l$* [l, *heat*], *trial$_l$* [l, *motion*])	*Setting the Pearson correlation coefficient for the motion-heat coupling. Algorithm of cross correlation between heat and motion for lag_{neg} [motion].* The general algorithm for the lag_{neg} [*motion*] condition is here (Eq#8E) summarized. For every run (*trial*) of each lag [*motion*] condition the Pearson correlation coefficient (*pcc*) is calculated according to the definition of the start and end frames in Eq#8C,E. These *pcc* values for both *lag* conditions are plotted against the *lag* values, as shown in Fig. S3 C. Only one of the lines in the diagram in Fig. S3 C serves as an example for this calculation step, e.g. the one in the red area with the parameter f_{100}.
(8F)	*For both lag* conditions: lag_{neg} [*motion*] ≦ 0; lag_{pos} [*motion*] ≧ 0 *pcc* [step, *trial*] = (step [*heat*, *trial*, *lag*], step [*motion*, *trial*, *lag*]) with step$_1$ comprises trials$_{1\text{-}50}$ (*lag* $_{neg,pos}$) *heat* | step$_1$: f_{start} [*trial*$_0$] = f_{100}+1= f_{101}; f_{end} [*trial*$_0$] = f_{start} [*trial*$_0$] + 50 = f_{151} …… f_{start} [*trial*$_k$] = f_{start} [k, *heat*] +1= f_{100} - k +1; f_{end} [*trial*$_k$] = f_{start} [*trial*$_k$] + 50 *motion* | step$_1$: f_{start} [*trial*$_0$] = f_{100}+1= f_{101}; f_{end} [*trial*$_0$] = f_{start} [*trial*$_0$] + 50 = f_{151} … f_{start} [*trial*$_k$] = f_{100}+1= f_{101}; f_{end} [*trial*$_k$] = f_{start} [*trial*$_k$] + 50 = f_{151}	*Definition of data sets for superimposing pcc values.* In the next round, the *pcc* values are merged along several time *steps*. Here too, the number of 50 was chosen for the number of time steps in the sequence of frames. In Fig. S3 C, this type of evaluation of the *pcc* values (Eq#8F,G) is shown for 20 such time steps (the curves for these 20 time steps are colored from red to green). The point here is that the sequences of *pcc* values of a series of such 'steps*, as shown in Fig. S3 C, can be averaged over fixed delays, as carried out in Fig. S3 D. These sequences begin on the abscissa with lag = 0 for the two conditions lag_{neg} ≦ 0 & lag_{pos} ≧ 0, and then include all further 'steps' that begin with incrementally (+*i*) increased start frames (f_{start} = f_{100}….= f_{100+i}). In this way, mean values and mean errors of the *pcc* values at fixed lag values can be determined for each lag unit (Fig. S3 D). This enables a statistical statement to be made about the coupling conditions between *heat* and *motion* (Eq#8H).

(8G)	$k = lag_{\text{pos or neg}}$ $n_{step} = 1$ to 50 *heat* | $step_n$: f_{start} [$trial_0$, $step_n$] = $f_{100} + n = f_{100+n}$; f_{end} [$trial_0$] = = f_{start} [$trial_0$, $step_n$] + 50 = f_{150+n} …… f_{start} [$trial_k$, $step_n$] = f_{start} [k, *heat*] + n = $f_{100} - k + n$; f_{end} [$trial_k$, $step_n$] = f_{start} [$trial_k$, $step_n$] + 50 *motion* | $step_1$: f_{start} [$trial_0$, $step_n$] = $f_{100} + n = f_{100+n}$; f_{end} [$trial_0$, $step_n$] = f_{start} [$trial_0$, $step_n$] + 50 = f_{150+n} … f_{start} [$trial_k$] = $f_{100} + n = f_{100+n}$; f_{end} [$trial_k$] = f_{start} [$trial_k$] + 50 = f_{150+n}	*Algorithm of cross correlation between heat and motion for repetitions of pcc assessments in the number n of steps for both conditions of lags.* The equations Eq#8G combine the 'step' algorithm with the 'trial' algorithm in Eq#8B-E for both lag conditions (pos or neg).
(8H) (8I)	mean (*pcc* [*step*, *trial*], I_i) mean error (*pcc* [*step*, *trial*], I_i) with two *bundles*: $I_1 = step_{1\text{-}10}$; $I_2 = step_{10\text{-}25}$	*Condensing algorithm* To condense the *pcc* data, basic statistics (mean values and mean errors; Eq#8H) are assessed for every fixed lag (see Fig. S3 C,D) in two *bundles* (Eq#8I), from step 1 to step 10 (I_1), or from step 10 to step 25 (I_2). The version with I_1 is displayed in the Fig. S3 D for both *lag* conditions.

(8J) (8K)	*lag*$_{neg}$ (*motion*) ≦ 0 *cum pcc* (*lag*, *I*$_i$) = = *cum pcc* (*lag*$_{neg}$ – 1, *I*$_i$) + mean (*pcc* [*step*, *trial*], *lag*$_{neg}$, *I*$_i$) *lag*$_{pos}$ (*motion*) ≧ 0 *cum pcc* (*lag*$_{pos}$, I$_i$) = = *cum pcc* (*lag*$_{pos}$ + 1, I$_i$) + mean (*pcc* [step, trial], *lag*$_{pos}$ *+1*; *I*$_i$)	*Cumulation algorithm* In order to simplify the condensed data, the mean values of *pcc* [*step*, *trial*]; *I*$_i$) (Eq#8H,I) are cumulated (Eq#8J,L), for each of the *lag* conditions and separated for the two *bundles* of *pcc* values (I_1 and I_2) each from the *lag* [*motion*] = 0 onwards.
(8L) (8M)	*max cum pcc* = MAX (ABS(*cum pcc* (*lags*, *I*$_j$)) for *lags* = from 0 to ±49 and for both bundles j = 1-2 *rel cum pcc* (*lag*, *I*$_j$) = *cum pcc* (*lag*, *I*$_i$) / *max cum pcc*	*Normalising the cumulated pcc data for all lags.* In a next step, the cumulated data (*cum pcc* (*lag*, *I*$_i$); Eq#8J,K) are normalized by the maximal absolute value (Eq#8L) forming relative cumulated data (*rel cum pcc*) according to Eq#8M in the range of ±1.
(8N) (8O) (8P)	*for lag* condition: [t_{heat} < t_{motion}]; *lag*$_{pos}$ [*motion*] ≧ 0 *lag*$_{pos}$ [i_t =1-4] = +3s, +6s, +9s and +12 s *for lag* condition: [t_{heat} > t_{motion}]; *lag*$_{neg}$ [*motion*] ≦ 0 *lag*$_{neg}$ [i_t =1-4] = -3s, -6s, -9s and -12 s e.g. P [*lag* [i$_t$], I$_1$] = *rel cum pcc* (*lag* [i$_t$], *I*$_1$)	*Defining four discrete values of the cumulated pcc data.* The last step was to select the data from these *pcc* curves at four discrete time delays for each of the positive and negative ranges (±3 s, ±6 s, ±9 s and ±12 s) for both *lag* conditions (Eq#8B-E,N-P) according to Fig. S3 E and offer them as reference values to characterize the coupling between *heat* and *motion*. In Fig. S3 E only the *bundle* of *pcc* values I_1 was applied.