A detailed description of the ANY-maze measures

ANY-maze
www.anymaze.com

ANY-maze measures

1 Information measures

1.1 Test number

Description	A sequential number assigned to each test when it's completed.
Independent variable	No
Dependent variable	No
Notes	None

1.2 Animal number

Description	The animal number of the animal this test was performed on.
Independent variable	No
Dependent variable	No
Notes	Animal numbers are assigned sequentially to animals as they're added to an experiment. These numbers are never reissued, even if an animal is removed from the experiment. For example, if you create an experiment with 10 animals in it they'll be numbered 1-10. If you immediately delete the 10 animals and then add 10 new animals the new ones will be numbered 11-20 and the experiment won't have any animals numbered 1-10 at all.

1.3 Treatment

Description	The name of the treatment given to the animal this test was performed on.
Independent variable	Yes
Dependent variable	No
Notes	None

1.4 Treatment code

Description	The code of the treatment given to the animal this test was performed on.
Independent variable	Yes
Dependent variable	No
Notes	None

1.5 Stage

Description	The name of the stage which this test was part of.
Independent variable	Yes
Dependent variable	No
Notes	All tests must be part of a stage - even if an experiment only contains a single default stage.

1.6 Trial number

Description	The trial number within the stage for the animal which this test was performed on.
Independent variable	Yes - see notes.
Dependent variable	No
Notes	Within a stage an animal can be tested more than once - i.e. have repeated trials. The first test in a stage is the animal's trial 1, the second test is the animal's trial 2, etc. Although the trial numbers will be repeated in different stages, ANY-maze still views them as different when using Trial number as an independent variable. Thus, for example, Trial 1 in an *Acquisition* stage would be seen to be different to trial 1 in a *Re-test* stage.

1.7 Apparatus

Description	The name of the apparatus that the test was performed on.
Independent variable	Yes
Dependent variable	No
Notes	None

1.8 The reason for test end

Description	The reason the test ended. This is either a description of a standard reason (see notes), the name of a procedure that ended the test, or a test end reason created for a procedure. *If your protocol is set up to use Events and Actions rather than procedures, then the test end reason can be the name of the event that triggered an action that ended the test (the name of the event is used because this reflects the reason why the test ended, for example, 'Island entry').*
Independent variable	Yes
Dependent variable	Yes. Nominal data. Can't be analysed across time.

Notes	The standard reasons for ANY-maze to end a test are:	
	User ended test	The user ended the test by clicking the *Stop test* button.
	Test duration	The test ended because the test duration was reached.
	End of video	This reason will be used if you're using a video file for the test (rather than tracking the animal 'live'), and the end of this video file is reached.
	Lost video signal	The video signal showing the apparatus was lost (for example, the camera was unplugged).
	Lost I/O device	An I/O device used in the experiment was lost (i.e. unplugged from the ANY-maze computer).
	Out of memory	While running a test, ANY-maze records the test results in the computer's memory - if this memory becomes full then the test will be ended for this reason. This is very unlikely to occur.
	Error saving results	For some reason, ANY-maze is unable to save the results to the experiment file. This is very unlikely to occur.

1.9 Test time

Description	The time when the test *started*.
Independent variable	No
Dependent variable	No
Notes	None

1.10 Test day of the week

Description	The day of the week (Monday-Sunday) when the test *started*.
Independent variable	Yes
Dependent variable	Yes. Nominal data. Can't be analysed across time.
Notes	None

1.11 Test time of day

Description	The time of day, am or pm, when the test *started*.
Independent variable	Yes
Dependent variable	Yes. Nominal data. Can't be analysed across time.
Notes	None

1.12 Test date

Description	The date when the test was *started*.
Independent variable	Yes
Dependent variable	No
Notes	None

1.13 User

Description	The name of the user who was logged on while the test was performed.
Independent variable	No
Dependent variable	No
Notes	None

1.14 Test notes

Description	Any notes recorded for the individual test - see notes.
Independent variable	No
Dependent variable	No
Notes	Only the first 80 characters of the notes are actually used for this measure's value. The notes themselves can be up to 32,000 characters in length.

1.15 Animal notes

Description	Any notes recorded for the individual animal this test was performed on - see notes.
Independent variable	No
Dependent variable	No
Notes	Only the first 80 characters of the notes are actually used for this measure's value. The notes themselves can be up to 32,000 characters in length.

1.16 Animal lighter/darker than apparatus

Description	Whether the animal is lighter or darker than the apparatus background, as specified in the protocol list under Animal colour.
Independent variable	Yes
Dependent variable	No

Notes	None

1.17 Segment of test

Description	A segment of the test, described as x-y seconds, for example, 30-60 seconds.
Independent variable	Yes.
Dependent variable	No
Notes	ANY-maze can break tests down into equal length segments and then perform analysis on them. The length of the segments that tests are broken into is specified in the protocol's Analysis across time element. ⚠ It's very important to understand that when you use the *segment of test* measure, you effectively tell ANY-maze to start analysing segments rather than tests. This means, for example, that the Data page spreadsheet will include one row per test segment rather than one row per test.

2 Apparatus measures

2.1 Test duration

Description	Reports the duration of a test.
Calculation method	The value of the test clock when the test ended.
Analysis across time	This measure can be analysed across time. The result for a period is the amount of the test duration which fell inside the period. This will be the full duration of the period for all periods except the last one in the test. This result is most useful in calculations.
Units	Seconds
Notes	None

2.2 Total distance travelled

Description	Reports the total distance that the animal travelled during the test.
Calculation method	Sum of the distance between each point in the track - see note below.
Analysis across time	This measure can be analysed across time. The result for a period is the distance that the animal travelled during the period.
Units	Metres
Notes	In some situations tracks can have small oscillations in them which tend to generate unrepresentatively large values for distance travelled. This occurs most often when an animal travels slowly while moving its body a lot - for example, while exploring an open field. To overcome this ANY-maze uses an adaptive smoothing algorithm to attenuate these oscillations when calculating distance travelled - see figure 1. Note: The definition of what's a *small* oscillation is based on the animal's size.

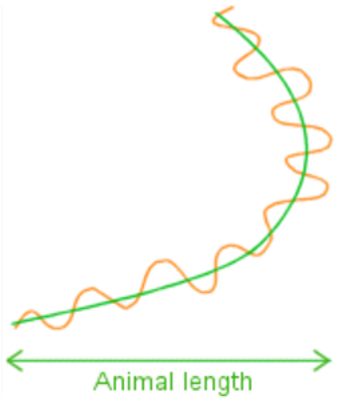

Figure 1. Measuring the length of the actual track (shown in orange) would yield an unrepresentatively large value for distance travelled. ANY-maze uses a 'smoothed' track (shown in green) to better estimate the true distance travelled. [Note: The oscillations in this track have been exaggerated to aid explanation.]

2.3 Overall average speed

Description	Reports the average speed of the animal during a test.
Calculation method	Calculated by dividing the Total distance travelled by the Test duration.
Analysis across time	This measure can be analysed across time. The result for a period is the Total distance travelled during the period divided by the Test duration for the period. Note: The 'Test duration' for a period is the amount of the test duration which fell in the period - this is the period's duration for all periods except the last one in the test.
Units	Metres per second
Notes	If you want to know average speed while mobile (i.e. ignoring periods when the animal was stationary) then use a calculation of *Total distance travelled / Total time mobile*.

2.4 First zone entered

Description	Reports the name of the first zone that the animal entered during the test.
Calculation method	Simply reflects the first zone entry. This is affected by the *Don't score any results in this zone until the first 'true' entry* option on the *Zone entry settings* page. See Choosing how ANY-maze should detect entries into a zone for more details.
Analysis across time	This measure cannot be analysed across time.
Units	None
Notes	When analysed this value will be treated as a nominal value - see statistical tests included in ANY-maze. In some circumstances it's possible that two or more zones could be the 'first zone entered'. For example, if you create a protocol in which a single area of the apparatus is included in two zones then, if the animal enters this area first, it will have entered both zones at the same time - meaning there are two 'first zones entered'. In this situation ANY-maze will report the 'first zone entered' as being the first one of the zones in the zone list shown in the protocol.

2.5 Total time mobile

Description	Reports the amount of time the animal was mobile during the test.

Calculation method	Calculated by subtracting the Total time immobile from the Test duration.
Analysis across time	This measure can be analysed across time. For any time period the result is the Test duration of the period minus Total time immobile during the period. Note: The 'Test duration' for a period is the amount of the test duration which fell in the period - this is the period's duration for all periods except the last one in the test.
Units	Seconds
Notes	None

2.6 Total time immobile

Description	Reports the amount of time the animal was immobile during the test.
Calculation method	Sums the duration of each immobile episode in the test. The definition of immobility depends on the current tracking options - see Detecting immobility.
Analysis across time	This measure can be analysed across time. For any time period the result is the sum of the duration of each immobile episode in the period. Episodes of immobility which fall partly in a period but which start or end outside it are calculated as if they started or ended at the start or end of the period, respectively. This means that it is possible to have a result for Total immobile episodes in the period which is zero and a result for *Total time immobile* in the period which is not zero. For example, if the animal is immobile at the start of a period and remains immobile throughout the period then the *Total time immobile* in the period will be the period's duration but the Total immobile episodes in the period will be zero because no transition from a mobile state to an immobile state occurred during the period.
Units	Seconds
Notes	None

2.7 Total mobile episodes

Description	Reports the number of times the animal was mobile during the test.
Calculation method	Counts the number of transitions from an immobile state to a mobile state during the test. For the purposes of this calculation the animal is assumed to be immobile at the start of the test. The definition of immobility depends on the current tracking options - see Detecting immobility.
Analysis across time	This measure can be analysed across time. For any time period the result is the count of the number of transitions from an immobile state to a mobile state during the period.
Units	Seconds
Notes	None

2.8 Total immobile episodes

Description	Reports the number of times the animal was immobile during the test.
Calculation method	Counts the number of transitions from a mobile state to an immobile state during the test. For the purposes of this calculation the animal is assumed to be mobile at the start of the test. The definition of immobility depends on the current tracking options - see Detecting immobility.
Analysis across time	This measure can be analysed across time. For any time period the result is the count of the number of transitions from a mobile state to an immobile state during the period.
Units	Seconds
Notes	None

2.9 Total time active

Description	Reports the amount of time the animal was active during the test.
Calculation method	Calculated by subtracting the Total time inactive from the Test duration.
Analysis across time	This measure can be analysed across time. For any time period the result is the Test duration of the period minus Total time inactive during the period. Note: The 'Test duration' for a period is the amount of the test duration which fell in the period - this is the period's duration for all periods except the last one in the test.
Units	Seconds
Notes	None

2.10 Total time inactive

Description	Reports the amount of time the animal was inactive during the test.
Calculation method	Sums the duration of each inactive episode in the test.
Analysis across time	This measure can be analysed across time. For any time period the result is sum of the duration of the inactive episodes in the period. Episodes of inactivity which fall partly in a period, but which start or end outside it are calculated as if they started or ended at the start or end of the period, respectively. This means that it is possible to have a result for Total inactive episodes in the period which is zero and a result for *Total time inactive* in the period which is not zero. For example, if the animal is inactive at the start of a period and remains inactive throughout the period then the *Total time inactive* in the period will be the period's duration but the Total inactive episodes in the period will be zero because no transition from an active state to an inactive state occurred during the period.
Units	Seconds

Notes	Inactivity is defined as NOT activity. An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.11 Total active episodes

Description	Reports the number of times the animal was active during the test.
Calculation method	Counts the number of transitions from an inactive to an active state. For the purposes of this calculation the animal is assumed to be inactive at the start of the test.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of transitions from an inactive to an active state that occurred during the period.
Units	None
Notes	An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.12 Total inactive episodes

Description	Reports the number of times the animal was inactive during the test.
Calculation method	Counts the number of transitions from an active to an inactive state. For the purposes of this calculation the animal is assumed to be active at the start of the test.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of transitions from an active to an inactive state that occurred during the period.
Units	None
Notes	Inactivity is defined as NOT activity. An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.13 Longest active episode

Description	Reports the duration of the longest continuous period of activity during the test.
Calculation method	The duration of each episode of activity is calculated when the episode ends. The

	longest one is found.
Analysis across time	This measure can be analysed across time. For any time period the result is the longest episode of activity that occurred during the period.
Units	Seconds
Notes	An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.14 Shortest active episode

Description	Reports the duration of the shortest continuous period of activity during the test.
Calculation method	The duration of each episode of activity is calculated when the episode ends. The shortest one is found.
Analysis across time	This measure can be analysed across time. For any time period the result is the shortest episode of activity that occurred during the period.
Units	Seconds
Notes	An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.15 Longest inactive episode

Description	Reports the duration of the longest continuous period of inactivity during the test.
Calculation method	The duration of each episode of inactivity is calculated when the episode ends. The longest one is found.
Analysis across time	This measure can be analysed across time. For any time period the result is the longest episode of inactivity that occurred during the period.
Units	Seconds
Notes	Inactivity is defined as NOT activity. An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.16 Shortest inactive episode

Description	Reports the duration of the shortest continuous period of inactivity during the test.

Calculation method	The duration of each episode of inactivity is calculated when the episode ends. The shortest one is found.
Analysis across time	This measure can be analysed across time. For any time period the result is the shortest episode of inactivity that occurred during the period.
Units	Seconds
Notes	Inactivity is defined as NOT activity. An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example, grooming. If the immobility detection element specifies that mobility should NOT be detected then activity analysis will be based purely on the performance of other behaviours.

2.17 Number of line crossings

Description	Reports the number of times the animal's centre point moved from one area of the apparatus map to another - i.e. crossed the lines which constitute the map.
Calculation method	The apparatus is divided into unique areas by the apparatus map. For each animal position recorded in the experiment the area which contains the animal's centre point is found. Each time this changes the measure's value if increased by 1.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	This measure DOES NOT count transitions between ZONES. It counts transitions between areas of the apparatus map, irrespective of whether the areas are part of a zone. This measure is primarily intended to provide an easy way to measure 'grid line crossings' in a similar way to that commonly used manually - viz: A regular grid is drawn on the apparatus and the experimenter counts the number of times the animal moves from one grid square to another. It's important to understand that ANY-maze uses the animal's centre point when calculating the measure and therefore it can be prone to 'spurious entries' if an animal straddles a line between two areas (i.e. by moving a very small amount the animal can apparently cross a line many times). This problem can be overcome by setting one zone for each area, using the percentage of the animal that's in the zone to score zone entries and then using a calculation to sum all the entries into these zones.

2.18 Absolute turn angle

Description	Reports the sum of the absolute angle between each movement vector of the animal.
Calculation method	A vector of movement from one position of the animal's centre point to the next is created. For each vector the angle between it and the previous vector is calculated with anti-clockwise movement being negative and clockwise movement being positive (i.e. the angle is from -180° to 180°). The absolute value of this angle is summed for all the positions of the animal throughout the test or time period.

Analysis across time	This measure can be analysed across time. The result is the based on just those positions within the specific time period.
Units	Degrees
Notes	From this measure it is easy to use calculations to derive measures such as *Meander* and *Angular velocity*. The former is the *Absolute turn angle* divided by the *Total distance travelled* and the latter is the *Absolute turn angle* divided by the *Test duration*.

2.19 Total distance travelled by the animal's head

Description	Reports the total distance that the animal's head travelled during the test.
Calculation method	Sum of the distance between each point in the head track.
Analysis across time	This measure can be analysed across time.
Units	Metres
Notes	As for the Total distance travelled ANY-maze will smooth the animal's head track to remove small oscillations which would otherwise distort the result of this measure.

2.20 Maximum speed

Description	Reports the maximum speed of the animal.
Calculation method	The speed of the animal between positions is calculated and the maximum speed is found.
Analysis across time	This measure can be analysed across time.
Units	Metres per seconds
Notes	The calculation of maximum speed does not use *successive* positions but instead requires that the animal move at least a minimum distance (which is based on the animal's size) and the speed to cover *this* distance is calculated. This method of calculation is used to avoid reporting the speed of movements that don't constitute locomotion of the animal. For example if an animal scratches, its centre point may oscillate rapidly but this will not be reported as the animal's maximum speed.

2.21 Rotations of the animal's body

Description	Reports the number of times the animal's body completed an entire rotation of 360°.
Calculation method	The animal's centre point is taken as a virtual origin; i.e. this origin is adjusted to be in the same place in each frame. A line is then taken from the animal's centre point to its head creating a vector. The angle between successive vectors is calculated and while the angle continues to have the same sign the angles are accumulated -

when the accumulated angle reaches 360° the animal has completed a rotation. In fact this is a simplification as the exact method used takes partial reversals of direction into account - see the figure below.

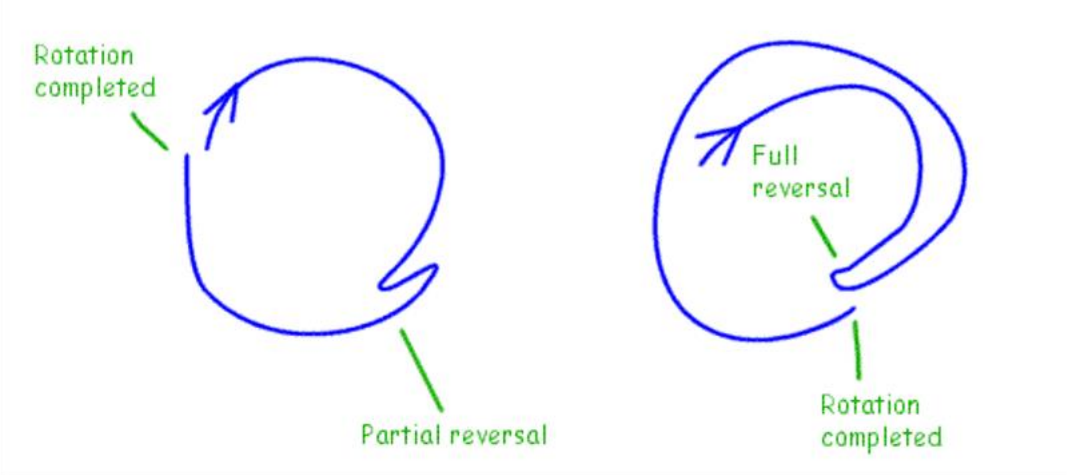

Figure 2. A partial reversal in direction doesn't alter the end of the rotation. A complete reversal however, means the animal has to rotate back to the reversal point to complete the rotation.

Analysis across time	This measure can be analysed across time. A rotation is deemed to occur at the time it is completed.
Units	None
Notes	None

2.22 Clockwise rotations of the animal's body

Description	Reports the number of times the animal's body completed an entire rotation of 360° in a clockwise direction.
Calculation method	This measure is calculated in the same way as rotations of the animal's body only it reports just the clockwise rotations.
Analysis across time	This measure can be analysed across time. A rotation is deemed to occur at the time it is completed.
Units	None
Notes	

2.23 Anti-clockwise rotations of the animal's body

Description	Reports the number of times the animal's body completed an entire rotation of 360° in an anti-clockwise direction.
Calculation method	This measure is calculated in the same way as rotations of the animal's body only it reports just the anti-clockwise rotations.
Analysis across time	This measure can be analysed across time. A rotation is deemed to occur at the time it is completed.
Units	None
Notes	

2.24 Path efficiency

Description	This measure represents an index of the efficiency of the path taken by the animal to get from the first position in the test to the last position. A value of 1 indicates perfect efficiency - the animal moved in a straight line - values less than 1 indicate decreasing efficiency.
Calculation method	The straight line distance between the first position in the test and the last position is divided by the total distance travelled by the animal during the test.
Analysis across time	This measure cannot be analysed across time.
Units	None
Notes	This measure is intended for use in water-maze experiments but is available in all tests.

2.25 Latency to start of first mobile episode

Description	Reports the latency to the start of the first moment in the test when the animal is considered to be mobile. If the animal is mobile at the start of the test this measure's value will be zero.
Calculation method	The test time when the animal first becomes mobile.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

2.26 Latency to start of first immobility episode

Description	Reports the latency to the start of the first moment in the test when the animal is considered to be immobile. If the animal is immobile at the start of the test this measure's value will be zero.
Calculation method	The test time when the animal first becomes immobile.

Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

2.27 Total freezing episodes

Description	Reports the number of times the animal froze during the test.
Calculation method	Each time the animal begins to freeze a counter is incremented. The result is the counter's value at the end of the test.
Analysis across time	This measure can be analysed across time. The result for a time period is the number of freezing episodes that *started* during the period.
Units	None
Notes	None

2.28 Total time freezing

Description	Reports the total amount of time during the test that the animal was freezing.
Calculation method	The duration of each freezing episode is calculated and these values are summed.
Analysis across time	This measure can be analysed across time. The result for a time period is the amount of time the animal was freezing during the period. If the animal is freezing at the start of the period then the result includes the time until the animal stops freezing (or the period ends). This means that the total freezing episodes during a time period can be zero when the time freezing during the period is non-zero.
Units	Seconds
Notes	None

2.29 Latency to start of first freezing episode

Description	Reports the latency to the start of the first moment in the test when the animal freezes. If the animal is freezing at the start of the test this value will be zero.
Calculation method	The test time when the first freezing episode occurs.
Analysis across time	This measure can be analysed across time. The result for a time period is the time when the animal *first* froze during the time period. This means that if the animal is freezing at the start of the time period then the latency is not reported as zero.
Units	Seconds
Notes	None

2.30 Average freezing score

Description	Reports the average of the animal's freezing score.
Calculation method	The freezing scores are summed and divided by their count.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	This measure is most useful when applied to time segments as comparison of the score between segments gives an indication of the changes in the animal's activity across time.

2.31 Visited zone list

Description	Reports a comma-separated list of the names of the zones the animal visited, in the order in which they were visited.
Calculation method	Each time the animal enters a zone the zone's name is added to the list.
Analysis across time	This measure cannot be analysed across time.
Units	None
Notes	It is possible to define an area of the apparatus as being part of two (or more) zones. If the animal enters such an area then it is necessarily entering all the zones simultaneously and the list will therefore include them all. In this case the zones are added to the list in the order in which they appear in the protocol.

2.32 On/Off inputs positive reversal

Description	The number of times the sequence in which on/off inputs were being activated changed from a decreasing sequence to an increasing one.
Calculation method	This measure is only applied to on/off inputs which have index values defined. As an input is activated the system checks to see whether the index value of the newly activated input is greater or less than the index value of the previously active input. If the newly activated input has a lower index value then the inputs are being activated in a decreasing sequence, whereas if it is higher then they are being activated in an increasing sequence. Once the 'direction' of the sequence has been determined then any change in direction is deemed to be a *reversal*. This measure counts the number of times the sequence changes from decreasing to increasing.
Analysis across time	This measure can be analysed across time. The result for a time period is the number of positive reversals which occurred during the time period.
Units	None
Notes	This measure will only be available if the protocol includes two or more On/off inputs which have index values defined.

2.33 On/Off inputs negative reversal

Description	The number of times the sequence in which on/off inputs were being activated changed from an increasing sequence to a decreasing one.
Calculation method	This measure is only applied to on/off inputs which have index values defined. As an input is activated the system checks to see whether the index value of the newly activated input is greater or less than the index value of the previously active input. If the newly activated input has a lower index value then the inputs are being activated in a decreasing sequence, whereas if it is higher then they are being activated in an increasing sequence. Once the 'direction' of the sequence has been determined then any change in direction is deemed to be a *reversal*. This measure counts the number of times the sequence changes from increasing to decreasing.
Analysis across time	This measure can be analysed across time. The result for a time period is the number of negative reversals which occurred during the time period.
Units	None
Notes	This measure will only be available if the protocol includes two or more On/off inputs which have index values defined.

2.34 Number of rears

Description	Reports the number of times the animal reared.
Calculation method	Counts the number of times the animal started to rear.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

2.35 Total time rearing

Description	Reports the total amount of time for which the animal was rearing.
Calculation method	Sums the duration of each bout of rearing that occurred during the test. If the animal was rearing at the test end then the last bout of rearing ends with the test end.
Analysis across time	This measure can be analysed across time.
Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

2.36 Latency to first rear

Description	Reports the latency to the first time that the animal reared.
Calculation method	The time when the first bout of rearing started.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

2.37 Average duration of a rear

Description	Reports the average duration of the rearing bouts.
Calculation method	The result of Total time rearing divided by Number of rears.
Analysis across time	This measure can be analysed across time.
Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

2.38 Maximum duration of a rear

Description	Reports the duration of the longest bout of rearing.
Calculation method	The duration of each bout of rearing is calculated and the longest bout is found.
Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

2.39 Minimum duration of a rear

Description	Reports the duration of the shortest bout of rearing.
Calculation method	The duration of each bout of rearing is calculated and the shortest bout is found.
Units	Seconds

Notes This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

2.40 RAPC - Type 1 errors

Description Reports the total number of *Type 1 errors* in the RAPC apparatus. A *Type 1 error* occurs when the animal tries to open a door that is latched shut.

Calculation method The number of door 'openings' for all the doors in the RAPC apparatus is analysed (note that doors which are latched shut will still be registered as 'opening' when the animal pushes against the door because the door will move a few millimetres). The last door opened in each chamber is, necessarily, the non-latched door, therefore the other doors must be latched. The number of openings of the latched doors is summed and this is the total number of *Type 1 errors*.

Units None

Notes This measure is only available if the protocol includes 12 'switch inputs' with 'index' values of 1 - 12.

2.41 RAPC - Type 2 errors

Description Reports the total number of *Type 2 errors* in the RAPC apparatus. A *Type 2 error* occurs when the animal opens a non-latched door but does not go though it into the next chamber.

Calculation method The number of door 'openings' for all the doors in the RAPC apparatus is analysed (note that doors which are latched shut will still be registered as 'opening' when the animal pushes against the door because the door will move a few millimetres). The last door opened in each chamber is, necessarily, the non-latched door, therefore the other doors must be latched. The number of openings of the non-latched door for each chamber less 1 is the number of *Type 2 errors* for that chamber. The sum for all the chambers is the total number of *Type 2 errors*.

Units None

Notes This measure is only available if the protocol includes 12 'switch inputs' with 'index' values of 1 - 12.

2.42 RAPC - Door sequence

Description Reports the sequence of non-latched doors in the RAPC apparatus, where the doors in each chamber are number 1 through 3. Thus a value of 1321 would mean that door 1 between the first and second chamber was not latched, door 3 between the second and third chamber was not latched, and so on.

Calculation method	The number of door 'openings' for all the doors in the RAPC apparatus is analysed (note that doors which are latched shut will still be registered as 'opening' when the animal pushes against the door because the door will move a few millimetres). The last door opened in each chamber is, necessarily, the non-latched door.
Units	None
Notes	This measure is only available if the protocol includes 12 'switch inputs' with 'index' values of 1 - 12.

3 Zone measures

3.1 Number of entries to the zone

Description	Counts the number of times the animal entered the zone.
Calculation method	Depends on the method used to detect zone entries - see Choosing how ANY-maze should detect entries into a zone for more details.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	None

3.2 Was first zone entered

Description	Reports whether the zone was the first zone the animal entered in the test.
Calculation method	Calculated by detecting the first zone entry in the test. This is affected by the *Don't score any results in this zone until the first 'true' entry* option on the *Zone entry settings* page. See Choosing how ANY-maze should detect entries into a zone for more details.
Analysis across time	This measure cannot be analysed across time.
Units	None
Notes	The result of this measure is either YES or NO, therefore when analysed it will be treated as a 2 level nominal value - see Statistical tests included in ANY-maze.

3.3 Time in the zone

Description	Reports the total amount of time the animal spent in the zone.
Calculation method	Calculated by summing the duration of each visit to the zone where a visit starts at the time of a zone entry and ends at the time of a zone exit.
Analysis across time	This measure can be analysed across time. For any time period the result is the amount of the period that the animal spent in the zone. For example, if an animal entered a zone at time 45 seconds and exited it at time 80 seconds, then for the time period 30-60 seconds the result would be 15 seconds.
Units	Seconds
Notes	None

3.4 Distance travelled in the zone

Description	Reports the distance the animal travelled while in the zone

Calculation method Calculated by summing the distance travelled during each visit to the zone. A visit starts when an animal enters the zone and ends when it exits the zone.

Analysis across time This measure can be analysed across time. For any time period the result is the distance travelled within the zone during that time period.

Units Metres

Notes As the position of the animal prior to a zone entry must, by definition, be outside the zone and the position after it enters the zone must be inside, the distance between the two positions will be partly outside and partly inside the zone. ANY-maze adds all this distance to the distance travelled in the zone the animal's leaving. Although this can lead to inaccuracies they are generally very small because: a) ANY-maze detects many positions per second so the distance between any two positions is usually very small; b) Any small distance 'lost' when the animal enters a zone entry is usually counterbalanced by a small distance which is 'gained' when it leaves the zone - see figure 1.

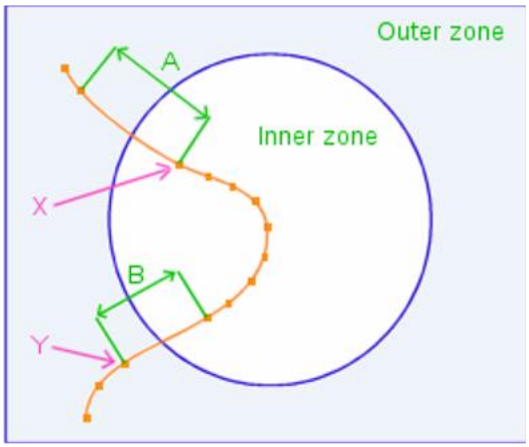

Figure 1. When the zone change at point 'X' is detected, ANY-maze adds all the distance 'A' to the distance travelled in the 'Outer zone'. When the second zone change, at point 'Y', is detected, ANY-maze adds all the distance 'B' to the distance travelled in the 'Inner zone'. [Note: Distances A and B have been exaggerated in this diagram to aid explanation.]

In some situations tracks can have small oscillations in them which tend to generate unrepresentatively large values for distance travelled. This occurs most often when an animal travels slowly while moving its body a lot - for example, while exploring an open field. To overcome this ANY-maze uses an adaptive smoothing algorithm to attenuate these oscillations when calculating distance travelled - see figure 2. Note: The definition of what's a small oscillation is based on the animal's size.

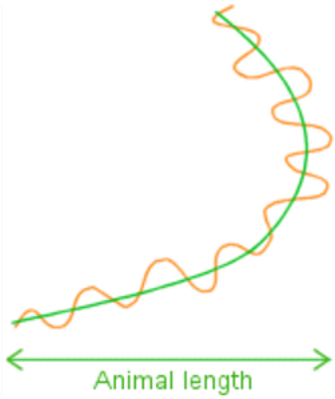

Figure 2. Measuring the length of the actual track (shown in orange) would yield an unrepresentatively large value for distance travelled. ANY-maze uses a 'smoothed' track (shown in green) to better estimate the true distance travelled. [Note: The oscillations in this track have been exaggerated to aid explanation.]

3.5 Latency to first entry to the zone

Description	Reports the length of time which elapsed before the animal entered the zone for the first time.
Calculation method	This value is the time at which the first zone entry occurred. If the animal doesn't enter the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is the time from the start of the period to the first entry. If the animal doesn't enter the zone during the time period then the result is undefined.
Units	Seconds
Notes	This measure is affected by the *Don't score any results in this zone until the first 'true' entry* option on the *Zone entry settings* page. See Choosing how ANY-maze should detect entries into a zone for more details. This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis options element.

3.6 Latency to first exit from the zone

Description	Reports the length of time which elapsed before the animal exited the zone for the first time.
Calculation method	This value is the time at which the first zone exit occurred. If the animal doesn't exit the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is the time from the start of the period to the first exit. If the animal doesn't exit the zone

during the time period then the result is undefined.

Units	Seconds
Notes	This measure is affected by the *Don't score any results in this zone until the first 'true' entry* option on the *Zone entry settings* page. See Choosing how ANY-maze should detect entries into a zone for more details. This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis options element.

3.7 Average speed in the zone

Description	Reports the average speed of the animal while it was in the zone.
Calculation method	Calculated by dividing the Distance travelled in the zone by the Time in the zone. If the animal was never in the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is the Distance travelled in the zone during the time period divided by the Time spent in the zone during the time period. If the animal was never in the zone during the time period then the result is undefined.
Units	Metres per second
Notes	If you want to know the average speed in the zone while mobile (i.e. ignoring periods when the animal was stationary) then use a calculation of *Distance travelled in the zone / Time mobile in the zone*. This measure is affected by the option to *Use zero as the result for undefined averages* in the Analysis options element.

3.8 Longest visit to the zone

Description	Reports the duration of the longest single visit to the zone.
Calculation method	Each zone visit is delimited by a zone entry and a zone exit - the time between the two is the duration of the visit. The duration of each visit is calculated and the largest value is found. If the animal was never in the zone during the test then the result is zero.
Analysis across time	This measure can be analysed across time. For any time period the result is the duration of the longest visit to the zone during the time period. If the animal spent the entire period in the zone then the result will be the duration of the time period itself.
Units	Seconds
Notes	None

3.9 Shortest visit to the zone

Description	Reports the duration of the shortest single visit to the zone.
Calculation method	Each zone visit is delimited by a zone entry and a zone exit - the time between the two is the duration of the visit. The duration of each visit is calculated and the smallest value is found. If the animal was never in the zone during the test then the result is zero.
Analysis across time	This measure can be analysed across time. For any time period the result is the duration of the shortest visit to the zone during the time period.
Units	Seconds
Notes	None

3.10 Average duration of visit to the zone

Description	Reports the average duration of visits to the zone.
Calculation method	Calculated by dividing the Time spent in the zone by the Number of entries to the zone. If the animal was never in the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is Time spent in the zone during the time period divided by the Number of entries to the zone in the time period. If the animal was never in the zone during the time period then the result is undefined.
Units	Seconds
Notes	This measure is affected by the option to *Use zero as the result for undefined averages* in the Analysis options element.

3.11 Time mobile in the zone

Description	Reports the total time that the animal was mobile in the zone.
Calculation method	Calculated by subtracting the Time immobile in the zone from the Time spent in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the Time spent in the zone during the period minus the Time immobile in the zone during the period.
Units	Seconds
Notes	None

3.12 Time immobile in the zone

Description	Reports the total time that the animal was immobile in the zone.

Calculation method	Sums the duration of each immobile episode in the zone - see notes for the definition of an immobile episode.
Analysis across time	This measure can be analysed across time. For any time period the result is the sum of the duration of each immobile episode in the zone during the period.
Units	Seconds
Notes	An immobile episode in the zone starts when the animal becomes immobile after being mobile or when the animal is already immobile and enters the zone. Generally it's unlikely that an immobile animal will enter a zone because to enter the zone it will probably have to be mobile. Nevertheless if the animal is immobile right on the border of a zone it could enter the zone by moving very slightly but not by enough to end the immobile episode. An immobile episode in the zone ends when the animal becomes mobile or when it leaves the zone. The definition of immobility depends on the protocol - see Immobility detection.

3.13 Immobile episodes in the zone

Description	Reports the number of times the animal became immobile while in the zone.
Calculation method	Counts the number of times the animal changed from being mobile to being immobile while in the zone. If an *immobile* animal enters a zone (see note below) then the entry will be considered to start a new immobile episode in the zone, i.e. the count of immobile episodes in the zone will be incremented. This means that the sum of the immobile episodes in all the zones may be greater than the number of immobile episodes in the apparatus as a whole.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of immobile episodes that started in the zone during the time period. If an animal is already immobile in the zone at the start of the time period then a new immobile episode is NOT counted for the period. This means that it's possible to have a period for which the result of this measure is zero but the result for the Time immobile in the zone is not zero.
Units	None
Notes	An immobile episode in the zone starts when the animal becomes immobile after being mobile or when the animal is already immobile and enters the zone. Generally it's unlikely that an immobile animal will enter a zone because to enter the zone it will probably have to be mobile. Nevertheless if the animal is immobile right on the border of a zone it could enter the zone by moving very slightly but not by enough to end the immobile episode. An immobile episode in the zone ends when the animal becomes mobile or when it leaves the zone. The definition of immobility depends on the protocol - see Immobility detection.

3.14 Time active in the zone

Description	Reports the total time that the animal was active in the zone.
Calculation method	Calculated by subtracting the Time inactive in the zone from the Time in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the Time spent in the zone during the period minus the Time inactive in the zone during the period.
Units	Seconds
Notes	As animal is active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - grooming for example.

3.15 Time inactive in the zone

Description	Reports the total time that the animal was inactive in the zone.
Calculation method	Sums the duration of each inactive episode in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the sum of the duration of each inactive episode in the zone during the period.
Units	Seconds
Notes	An inactive episode in the zone starts when the animal becomes inactive after being active or when the animal enters the zone and is already inactive. An inactive episode in the zone ends when an animal becomes active or when it leaves the zone. Inactivity is defined as NOT activity. An animal is defined to be active if it is either mobile OR it's performing some other behaviour which has been specified as an activity - for example grooming. If the protocol specifies that immobility should not be detected then activity analysis will be based purely on the performance of other behaviours.

3.16 Inactive episodes in the zone

Description	Reports the total number of times the animal became inactive while in the zone.
Calculation method	Counts the number of times the animal changed from being active to being inactive while in the zone. If an *inactive* animal enters a zone then the entry will be considered to start a new inactivity episode in the zone, i.e. the count of inactive episodes in the zone will be incremented. This means that the sum of the inactive episodes in all the zones may be greater than the number of inactive episodes in the apparatus as a whole.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of inactive episodes that started in the zone during the time period. If an animal is already inactive in the zone at the start of the time period then a new inactive episode is NOT counted for the period. This means that it's possible to have a period for which the result of this measure is zero but the result for the Time

inactive in the zone is not zero.

Units None

Notes An inactive episode in the zone starts when the animal becomes inactive after being active or when the animal enters the zone and is already inactive. An inactive episode in the zone ends when an animal becomes active or when it leaves the zone.

3.17 Average distance from the zone

Description Reports the average distance from the animal to the zone when the animal is *outside* the zone.

Calculation method ANY-maze calculates the distance from the animal to the zone for every position of the animal that is outside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest part of the zone.

Having determined the distance from the zone ANY-maze maintains a cumulative sum of each distance multiplied by the time the animal remained at that distance. The final result for the average distance from the zone is this cumulative sum divided by the total duration of the test or period.

The reason the system works this way is best explained using an example. Imagine the animal was 50cm from a zone and remained there for 55 seconds; it then moved to be 30cm from the zone and remained there for 5 second; the test then ended. Just taking the average of the two distances would imply that the average distance from the zone was 40cm but this is very misleading as the animal spent almost the entire test 50cm from the zone. Instead ANY-maze would calculate the average distance as [(50 x 55) + (30 x 5)] / 60 = 48.33cm Effectively, the system weights the distances depending on how long the animal remained there.

Analysis across time This measure can be analysed across time. The result is based on just those positions of the animal that fall within the time period.

Units Metres

Notes If the animal spends the entire duration of the test (or of a time period) inside the zone, then the result will be zero (i.e. the animal was no distance from the zone).

3.18 Maximum distance from the zone

Description	Reports the maximum distance from the animal to the zone when the animal is *outside* the zone.
Calculation method	ANY-maze calculates the distance from the animal to the zone for every position of the animal that is outside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest part of the zone. Having determined the distance from the animal to zone the system simply notes the maximum value during the test or time period.
Analysis across time	This measure can be analysed across time. The result is the maximum distance considering just those positions of the animal that fall within the time period.
Units	Metres
Notes	If the animal spends the entire duration of the test (or of a time period) inside the zone, then the result will be zero (i.e. the animal was no distance from the zone).

3.19 Minimum distance from the zone

Description	Reports the minimum distance from the animal to the zone when the animal is *outside* the zone.
Calculation method	ANY-maze calculates the distance from the animal to the zone for every position of the animal that is outside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest part of the zone. Having determined the distance from the animal to zone the system simply notes the minimum value during the test or time period.
Analysis across time	This measure can be analysed across time. The result is the minimum distance considering just those positions of the animal that fall within the time period.
Units	Metres
Notes	If the animal enters the zone then this value is automatically set to zero.

3.20 Average distance to the zone border

Description Reports the average distance from the animal to the border of the zone when the animal is *inside* the zone.

Calculation method ANY-maze calculates the distance from the animal to the zone border for every position of the animal that is inside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone border will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone border will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest border of the zone.

Having determined the distance to the zone border ANY-maze maintains a cumulative sum of each distance multiplied by the time the animal remained at that distance. The final result for the average distance to the zone border is this cumulative sum divided by the total duration of the test or period.

The reason the system works this way is best explained using an example. Imagine the animal was 20cm from a zone border and remained there for 55 seconds; it then moved to be 10cm from the zone border and remained there for 5 second; the test then ended. Just taking the average of the two distances would imply that the average distance from the zone border was 15cm but this is very misleading as the animal spent almost the entire test 20cm from the border. Instead ANY-maze would calculate the average distance as [(20 x 55) + (10 x 5)] / 60 = 19.16cm Effectively, the system weights the distances depending on how long the animal remained there.

Analysis across time This measure can be analysed across time. The result is based on just those positions of the animal that fall within the time period.

Units Metres

Notes If the animal never enters the zone then the result is either undefined or zero depending on the setting *Use zero as the result for undefined averages* in the Analysis options element.

3.21 Maximum distance to the zone border

Description Reports the maximum distance from the animal to the border of the zone when the animal is *inside* the zone.

Calculation method ANY-maze calculates the distance from the animal to the zone border for every position of the animal that is inside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the

	animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone border will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone border will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest border of the zone. Having determined the distance to the border the system simply notes the maximum value during the test or time period.
Analysis across time	This measure can be analysed across time. The result is the maximum distance considering just those positions of the animal that fall within the time period.
Units	Metres
Notes	If the animal never enters the zone then the result is undefined.

3.22 Minimum distance to the zone border

Description	Reports the minimum distance from the animal to the border of the zone when the animal is *inside* the zone.
Calculation method	ANY-maze calculates the distance from the animal to the zone border for every position of the animal that is inside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone border will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone border will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest border of the zone. Having determined the distance to the border the system simply notes the minimum value during the test or time period.
Analysis across time	This measure can be analysed across time. The result is the minimum distance considering just those positions of the animal that fall within the time period.
Units	Metres
Notes	If the animal never enters the zone then the result is undefined. If the animal exits the zone this value is automatically set to zero.

3.23 Time getting closer to the zone

Description	Reports the total amount of time that the animal was outside the zone and was getting closer to it.

Calculation method ANY-maze calculates the distance from the animal to the zone for every position of the animal that is outside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest part of the zone.

Having calculated the distance to the zone, ANY-maze compares it to previous distance to the zone, if it is less then the animal is getting closer to the zone and the time from the previous position to this one is added to the total time getting closer to the zone. Note that very small movements of the animal will be ignored by the system (the definition of very small being based on the animal's size).

Analysis across time This measure can be analysed across time. The result is based on just those positions of the animal that fall within the time period.

Units Seconds

Notes This measure seems very similar to the Time moving towards the zone but is calculated quite differently (see the definition of Time moving towards the zone for details on how it's calculated). The principal difference is that this measure relates to the animal's distance from the zone whereas the *Time moving towards the zone* measure relates to the animal's heading. A good example of this difference is when a zone is in the form of a ring. In this case if the animal is moving inside the ring it would always be 'moving towards' the zone as the zone surrounds it, but it could still either be getting closer or further from the zone. (In fact, it would always be moving both towards and away from the zone, so because of this ambiguity, ANY-maze simply wouldn't score either of these measures.)

3.24 Time getting further away from the zone

Description Reports the total amount of time that the animal was outside the zone and was getting further away from it.

Calculation method ANY-maze calculates the distance from the animal to the zone for every position of the animal that is outside the zone. Exactly how this is done depends on whether zone entries *(sic)* are set to use the entire area of the animal or the animal's centre point (see Choosing how ANY-maze should detect entries into a zone for details). If entries are based on the entire area of the animal then the calculation of the distance from the animal to the zone will also be based on the entire area of the animal - specifically the system will use the distance from the point on the animal's edge that is closest to the zone border; on the other hand if zone entries are based on the centre of the animal then the distance to the zone will also be based on the centre of the animal - i.e. the distance to the zone will simply be the distance from the centre to the nearest part of the zone.

	Having calculated the distance to the zone, ANY-maze compares it to previous distance to the zone, if it is greater, then the animal is getting further away from the zone and the time from the previous position to this one is added to the total time getting further away from the zone. Note that very small movements of the animal will be ignored by the system (the definition of very small being based on the animal's size).
Analysis across time	This measure can be analysed across time. The result is based on just those positions of the animal that fall within the time period.
Units	Seconds
Notes	This measure seems very similar to the Time moving away from the zone but is calculated quite differently (see the definition of Time moving away from the zone for details on how it's calculated). The principal difference is that this measure relates to the animal's distance from the zone whereas the *Time moving away from the zone* measure relates to the animal's heading. A good example of this difference is when a zone is in the form of a ring. In this case if the animal is moving inside the ring it would always be 'moving away from' the zone as the zone surrounds it, but it could still either be getting closer or further from the zone. (In fact, it would always be moving both towards and away from the zone, so because of this ambiguity, ANY-maze simply wouldn't score either of these measures.)

3.25 Absolute turn angle while in the zone

Description	Reports the sum of the absolute angle between each movement vector of the animal while it was inside the zone.
Calculation method	For each position of the animal that is inside the zone, a vector of movement from one position of the animal's centre point to the next is created. For each vector the angle between it and the previous vector is calculated with anti-clockwise movement being negative and clockwise movement being positive (i.e. the angle is from -180° to 180°). The absolute value of this angle is summed for all the positions of the animal within the zone throughout the test or time period.
Analysis across time	This measure can be analysed across time. The result is based on just those positions within the specific time period.
Units	Degrees
Notes	From this measure it is easy to use calculations to derive measures such as *Meander in the zone* and *Angular velocity in the zone*. The former is the *Absolute turn angle while in the zone* divided by the *Distance travelled in the zone* and the latter is the *Absolute turn angle while in the zone* divided by the *Time in the zone*.

3.26 Time the animal's head was in the zone

Description	Reports the total amount of time that the animal's head was in the zone.
Calculation method	Calculated by summing the duration of each visit of the animal's head to the zone

	where a visit starts at the time the animal's head entered the zone and ends at the time the animal's head exited the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the amount of the period that the animal's head spent in the zone. For example, if an animal's head entered a zone at time 45 seconds and exited it at time 80 seconds, then for the time period 30-60 seconds the result would be 15 seconds.
Units	Seconds
Notes	This measure is only available if Head tracking is turned on.

3.27 Number of entries of the animal's head into the zone

Description	Counts the number of times the animal's head entered the zone.
Calculation method	Counts the number of times the animal's head position changed from being outside the zone to being inside it.
Analysis across time	This measure can be analysed across time. The result is based on just those head positions within the time period.
Units	None
Notes	This measure is only available if Head tracking is turned on.

3.28 Distance travelled by the animal's head in the zone

Description	Reports the distance the animal's head travelled while the head was in the zone.
Calculation method	Calculated by summing the distance travelled by the animal's head during each visit to the zone. A visit starts when the animal's head enters the zone and ends when it exits the zone.
Analysis across time	This measure can be analysed across time.
Units	Metres
Notes	As the position of the animal's head prior to a zone entry must, by definition, be outside the zone and the position after it enters the zone must be inside, the distance between the two positions will be partly outside and partly inside the zone. ANY-maze adds all this distance to the distance travelled by the animal's head in the zone that the animal is *leaving*. Although this can lead to inaccuracies they are generally very small because: a) ANY-maze detects many positions per second so the distance between any two positions is usually very small; b) Any small distance 'lost' when the animal enters a zone entry is usually counterbalanced by a small distance which is 'gained' when it leaves the zone. This measure is only available if Head tracking is turned on.

3.29 Latency to the first entry of the animal's head into the zone

Description	Reports the length of time which elapsed before the animal's head entered the zone for the first time.
Calculation method	This value is the time at which the animal's head first entered the zone. If the animal's head doesn't enter the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is the time from the start of the period to the first entry of the animal's head into the zone. If the animal's head doesn't enter the zone during the time period then the result is undefined.
Units	Seconds
Notes	This measure is only available if Head tracking is turned on. This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis options element.

3.30 Latency to the first exit of the animal's head from the zone

Description	Reports the length of time which elapsed before the animal's head exited the zone for the first time.
Calculation method	This value is the time at which the animal's head first exited the zone. If the animal doesn't exit the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is the time from the start of the period to the first exit of the animal's head from the zone. If the animal's head doesn't exit the zone during the time period then the result is undefined.
Units	Seconds
Notes	This measure is only available if Head tracking is turned on. This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis options element.

3.31 Average distance of the animal's head from the zone

Description	Reports the average distance from the animal's head to the zone when the animal is *outside* the zone.
Calculation method	ANY-maze calculates the distance from the animal's head to the closest point on the zone border for every position of the animal's head that is outside the zone. The system maintains a cumulative sum of each distance multiplied by the time the animal remained at that distance. The final result for the average distance of the animal's head from the zone is this cumulative sum divided by the total duration of the test or period. The reason the system works this way is best explained using an example. Imagine

	the animal's head was 50cm from a zone and remained there for 55 seconds; it then moved to be 30cm from the zone and remained there for 5 second; the test then ended. Just taking the average of the two distances would imply that the average distance from the zone was 40cm but this is very misleading as the animal spent almost the entire test 50cm from the zone. Instead ANY-maze would calculate the average distance as [(50 x 55) + (30 x 5)] / 60 = 48.33cm Effectively, the system weights the distances depending on how long the animal remained there.
Analysis across time	This measure can be analysed across time. The result is based on just those positions of the animal's head that fall within the time period.
Units	Metres
Notes	This measure is only available if Head tracking is turned on.
	If the animal's head spends the entire duration of the test (or of a time period) inside the zone, then the result will be zero (i.e. the animal's head was no distance from the zone).

3.32 Maximum distance of the animal's head from the zone

Description	Reports the maximum distance from the animal's head to the zone when the animal is *outside* the zone.
Calculation method	For each position of the animal's head that is outside the zone, ANY-maze calculates the distance from the head to the closest point on the zone border. This maximum such distance is found.
Analysis across time	This measure can be analysed across time. The result is based on just those positions of the animal's head that fall within the time period.
Units	Metres
Notes	This measure is only available if Head tracking is turned on.
	If the animal's head spends the entire duration of the test (or of a time period) inside the zone, then the result will be zero (i.e. the animal's head was no distance from the zone).

3.33 Minimum distance of the animal's head from the zone

Description	Reports the minimum distance from the animal's head to the zone when the animal is *outside* the zone.
Calculation method	For each position of the animal's head that is outside the zone, ANY-maze calculates the distance from the head to the closest point on the zone border. This minimum such distance is found.
Analysis across time	This measure can be analysed across time. The result is based on just those positions of the animal's head that fall within the time period.
Units	Metres

Notes This measure is only available if Head tracking is turned on.

If the animal's head enters the zone then this value will be zero.

3.34 Average distance from the animal's head to the zone border

Description Reports the average distance from the animal's head to the border of the zone when the animal is *inside* the zone.

Calculation method ANY-maze calculates the distance from the animal's head to the closest point on the zone border for every position of the animal's head that is inside the zone. The system maintains a cumulative sum of each distance multiplied by the time the animal remained at that distance. The final result for the average distance to the zone border is this cumulative sum divided by the total duration of the test or period.

The reason the system works this way is best explained using an example. Imagine the animal's head was 20cm from a zone border and remained there for 55 seconds; it then moved to be 10cm from the zone border and remained there for 5 second; the test then ended. Just taking the average of the two distances would imply that the average distance from the animal's head to the zone border was 15cm but this is very misleading as the animal's head spent almost the entire test 20cm from the border. Instead ANY-maze would calculate the average distance as [(20 x 55) + (10 x 5)] / 60 = 19.16cm Effectively, the system weights the distances depending on how long the animal remained there.

Analysis across time This measure can be analysed across time. The result is based on just those positions of the animal's head that fall within the time period.

Units Metres

Notes If the animal's head never enters the zone then the result is either undefined or zero depending on the setting *Use zero as the result for undefined averages* in the Analysis options element.

This measure is only available if Head tracking is turned on.

3.35 Maximum distance from the animal's head to the zone border

Description Reports the maximum distance from the animal's head to the border of the zone when the animal is *inside* the zone.

Calculation method For each position of the animal's head that is inside the zone, ANY-maze calculates the distance from the head to the closest point on the zone border. This maximum such distance is found.

Analysis across time This measure can be analysed across time. The result is based on just those positions of the animal's head that fall within the time period.

Units Metres

Notes If the animal's head never enters the zone then the result is undefined.

This measure is only available if Head tracking is turned on.

3.36 Minimum distance from the animal's head to the zone border

Description	Reports the minimum distance from the animal's head to the border of the zone when the animal is *inside* the zone.
Calculation method	For each position of the animal's head that is inside the zone, ANY-maze calculates the distance from the head to the closest point on the zone border. This minimum such distance is found.
Analysis across time	This measure can be analysed across time. The result is based on just those positions of the animal's head that fall within the time period.
Units	Metres
Notes	If the animal's head never enters the zone then the result is undefined. This measure is only available if Head tracking is turned on.

3.37 Number of rears in the zone

Description	Reports the number of times the animal reared while in the zone.
Calculation method	Depends on the method used to detect zone entries (and thus by implication, zone exits too) - see Choosing how ANY-maze should detect entries into a zone for more details.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

3.38 Total time rearing in the zone

Description	Reports the total amount of time for which the animal was rearing while it was in the zone.
Calculation method	Sums the duration of each bout of rearing that occurred while the animal was in the zone. If the animal enters the zone when it is already rearing then the time will be counted from the time the animal entered the zone and not when the rearing bout started. If the animal exits the zone while rearing then the time will stop at the time the animal exits the zone and not at the end of the rearing bout. For these reasons it is possible for the result of this measure to be non-zero when the result for Number of rears in the zone is zero.
Analysis across time	This measure can be analysed across time.

Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

3.39 Latency to first rear in the zone

Description	Reports the latency to first time that the animal reared in the zone.
Calculation method	The time when the first bout of rearing started while the animal was in the zone
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus. This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis options element.

3.40 Average duration of a rear in the zone

Description	Reports the average duration of the rearing bouts in the zone.
Calculation method	The result of Total time rearing in the zone divided by Number of rears in the zone.
Analysis across time	This measure can be analysed across time.
Units	Seconds
Notes	This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus. This measure is affected by the option to *Use zero as the result for undefined averages* in the Analysis options element.

3.41 Maximum duration of a rear in the zone

Description	Reports the duration of the longest bout of rearing in the zone.
Calculation method	The duration of each bout of rearing in the zone is calculated and the longest bout is found. Note that a bout of rearing in the zone starts when the animal is in the zone and begins to rear OR when the animal enters the zone when it is already rearing. Similarly a bout ends when the animal is in the zone and stops rearing OR

the animal exits the zone while rearing.

Units Seconds

Notes This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

3.42 Minimum duration of a rear in the zone

Description Reports the duration of the shortest bout of rearing in the zone.

Calculation method The duration of each bout of rearing in the zone is calculated and the shortest bout is found. Note that a bout of rearing in the zone starts when the animal is in the zone and begins to rear OR when the animal enters the zone when it is already rearing. Similarly a bout ends when the animal is in the zone and stops rearing OR the animal exits the zone while rearing.

Units Seconds

Notes This measure is only available if the apparatus is being viewed from the side. ANY-maze actually detects rearing by analysing the shape of the animal and therefore this measure will only work reliably if there is good contrast between the animal and the background of the apparatus.

3.43 Initial heading error to the zone

Description Reports the angle between the animal's heading at the start of the test and a direct heading to the zone.

Calculation method Calculation of this measure depends on the settings in the Analysis options > Heading error sub-element of the protocol. Specifically the options control both how the animal's heading at the start of the test is determined and what part of the zone is used to calculate the heading error.

There are two options for how the animal's heading at the start of the test is determined one uses a specific time delay, the other a specific distance. In the first case the animal's heading is taken to be the vector from the its first position in the test to the first position detected after the specified time interval has elapsed. In the second case the heading is taken to be the vector from the animal's first position in the test to the first position that's more than the specified distance from it. In both cases positions that are detected while the animal is considered to be immobile (if immobility detection is switched on) are ignored - thus in the first case the animal must be *mobile* for the period that is specified.

Having determined the animal's initial heading, the system then calculates the heading from the first position in the test to the zone. To do this ANY-maze can use one of two methods (again these are specified using the Analysis options > Heading error sub-element in the protocol); it can either simply calculate the

heading to the centre of the zone or it can calculate the heading to any part of the zone.

In the first case (see figure 3) the *centre* of the zone is taken to be the zone's 'centre of mass' (i.e. the mean x, y coordinate of all the points in the zone) and the heading error is defined as the angle between this heading and the animal's initial heading.

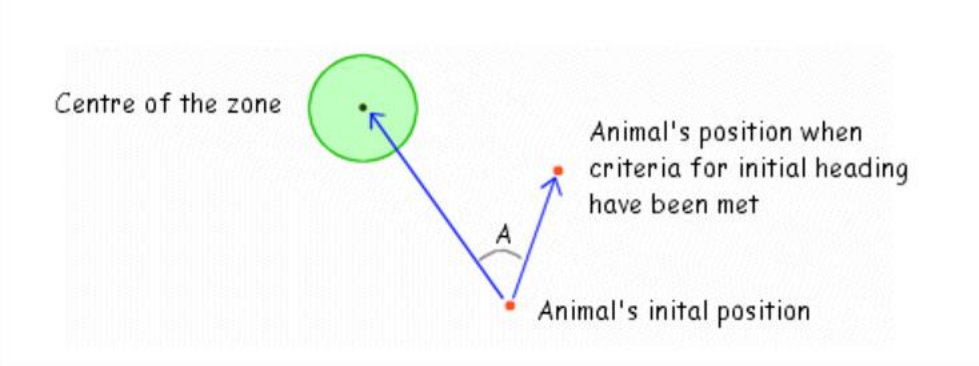

Figure 3. Calculation of the initial heading error using the centre of the zone: The animal's initial heading error is the angle 'A' between its initial heading and the direct heading to the centre of the zone.

It's important to understand that a zone's centre of mass may actually be outside the zone. For example, consider a ring shaped zone, the centre of mass will be in the centre of the ring but this point will not be within the zone.

The second method of calculating the heading to the zone is to consider the heading to every position on the zone's perimeter - in this case the heading error is the smallest angle between the animal's heading and the heading to any perimeter point - see figure 4.

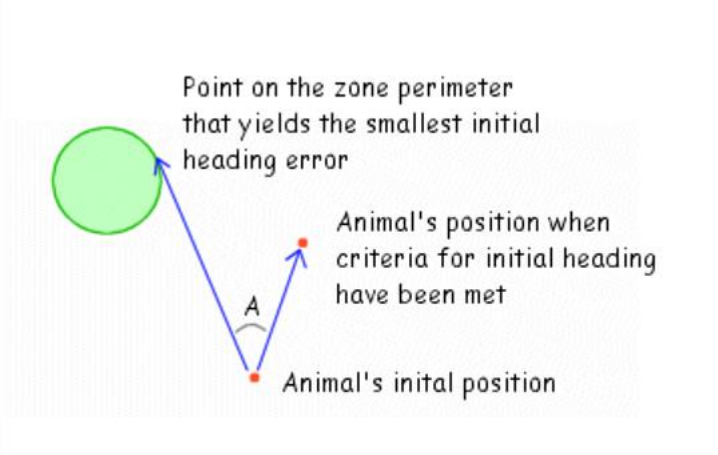

Figure 4. Calculation of the initial heading error using the entire area of the zone: The animal's initial heading error is the smallest angle, 'A', between its initial heading and any point on the zone perimeter.

In the case of small zones the difference between the two calculation techniques is usually minimal, but for a large zone it can make a substantial difference to the result.

Analysis across time This measure cannot be analysed across time.

Units Degrees

Notes None

3.44 Average absolute heading error to the zone

Description Reports the average absolute angle between the animal's heading and a direct heading to the zone.

Calculation method The method used to calculate this measure depends on the option specified in the Analysis options > Heading error sub-element in the protocol. Specifically there are two ways to determine the heading to the zone, using the centre of the zone or using the entire zone area.

In the first case the heading to the zone is taken to be the heading to the *centre* of the zone, where the centre is defined as the zone's 'centre of mass' (i.e. the mean x, y coordinate of all the points in the zone). It's important to understand that the centre of mass may actually be outside the zone. For example, consider a ring shaped zone, the centre of mass will be in the centre of the ring but this point will not be within the zone. With this definition of the heading to the zone, the heading error for a position is calculated as follows: The animal's heading is defined as the vector that joins the position with the next position in time. The heading to the zone is defined as the vector that joins the position to the centre of the zone and the heading error is defined as the angle between the two vectors - see figure 5.

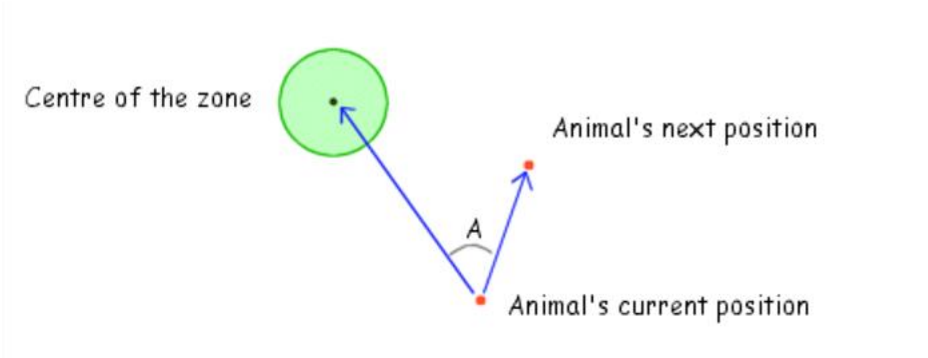

Figure 5. Calculation of the average heading error using the centre of the zone:

The animal's heading error is the angle 'A' between its heading and the direct heading to the centre of the zone.

In the case where the heading to the zone is defined using the entire zone area the calculation of the heading error is performed as follows: The animal's heading is defined as the vector that joins the position with the next position in time. The heading to the zone is then calculated for every point on the zone's perimeter and the angle between this heading and the animal's heading is calculated. The smallest angle is the heading error - see figure 6.

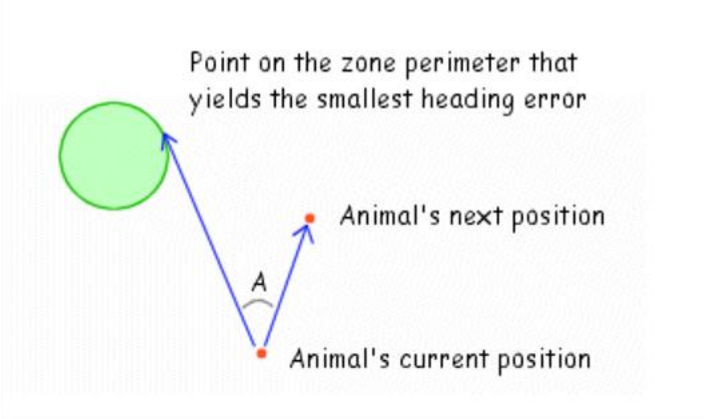

Figure 6. Calculation of the average heading error using the entire area of the zone: The animal's heading error is the smallest angle, 'A', between its heading and the direct heading to any point on the zone perimeter.

Irrespective of which method is used to calculate the individual heading errors, the *average* absolute heading error is calculated in the same way: Each absolute heading error angle is multiplied by the time for which it persisted (i.e. the time from one position of the animal to the next). This product is then summed for the entire test (or time period). The final sum is then divided by the test duration (or the duration of the time period). This seemingly strange method of calculating the average is required because positions in ANY-maze are not necessarily recorded at a fixed frequency.

If immobility is being detected in a test then all positions when the animal is deemed to be immobile are ignored in the calculation of the average heading error. If immobility is not being detected then all positions are used with the caveat that a position must be at least a minimum distance from the previous position for it to be considered. The minimum used is based on the size of the animal.

Analysis across time	This measure can be analysed across time. The result is based on just those positions that fall within the time period.
Units	Degrees.
Notes	None

3.45 Time moving towards the zone

Description Reports the total amount of time for which the animal was moving towards the zone.

Calculation method The method used to calculate this measure depends on the option specified in the Analysis options > Movement towards and away from zones and points sub-element in the protocol. Specifically the measure can either be based on the centre of the zone or on the zone's entire area.

In the first case the measure is calculated as follows: For each position of the animal, a vector is created between the current position and the next position. A second vector is then created between the current position and the centre of the zone. The angle between these two vectors is calculated - see figure 7.

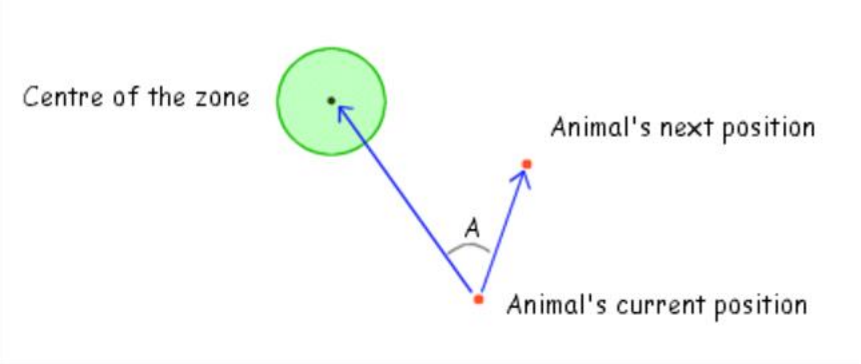

Figure 7. ANY-maze calculates the angle 'A' between the animal's heading and a direct heading to the zone; if this is less than a critical angle the animal is deemed to be moving towards the zone.

Here the *centre* of the zone is defined as the zone's 'centre of mass' (i.e. the mean x, y coordinate of all the points in the zone). It's important to understand that the centre of mass may actually be outside the zone. For example, consider a ring shaped zone, the centre of mass will be in the centre of the ring but this point will not be within the zone.

Having calculated the angle between the two vectors ('A') it is compared to the critical angle for movement towards a zone (see notes). If the angle is less than this critical angle then the animal is deemed to be moving towards the zone (unless it is *also* moving away from it - see notes) and the time it took to move from the current position to the next position is added to the total time moving towards the zone.

The second method used to calculate this measure uses the entire area of the zone. In this case, for each position of the animal, a vector is created between the current position and the next position. All possible vectors from the current position to the

points on the zone's perimeter are then calculated and the angle between each one and the animal's heading vector is calculated. The smallest of these angles is found. This angle is then compared to the critical angle for movement towards a zone in the same way as for the first calculation method (see above).

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal is moving towards the zone is also specified in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as described here as this is more intuitive. The default critical angle is 90° (i.e. by default the angle 'A' will be compared to 45°).

When calculating whether the animal is moving towards a zone the system takes into consideration whether the animal is *also* moving away from the zone (see Time moving away from the zone), if it is then the position is deemed to be ambiguous and the time from the position to the next position is NOT added to the overall result. A simple example of when this situation would arise is a ring shaped zone. If the animal is inside the ring then no matter what direction it moves in it we be moving both towards the zone and away from it (as the zone surrounds the animal). The measures Time getting closer to the zone and Time getting further away from the zone offer alternatives that avoid this problem.

3.46 Time moving away from the zone

Description Reports the total amount of time for which the animal was moving away from the zone.

Calculation method The method used to calculate this measure depends on the option specified in the Analysis options > Movement towards and away from zones and points sub-element in the protocol. Specifically the measure can either be based on the centre of the zone or on the zone's entire area.

In the first case the measure is calculated as follows: For each position of the animal, a vector is created between the current position and the next position. A second vector is then created between the current position and the centre of the zone. The angle between these two vectors ('B') is calculated and deducted from 180° yielding angle 'A' - see figure 8.

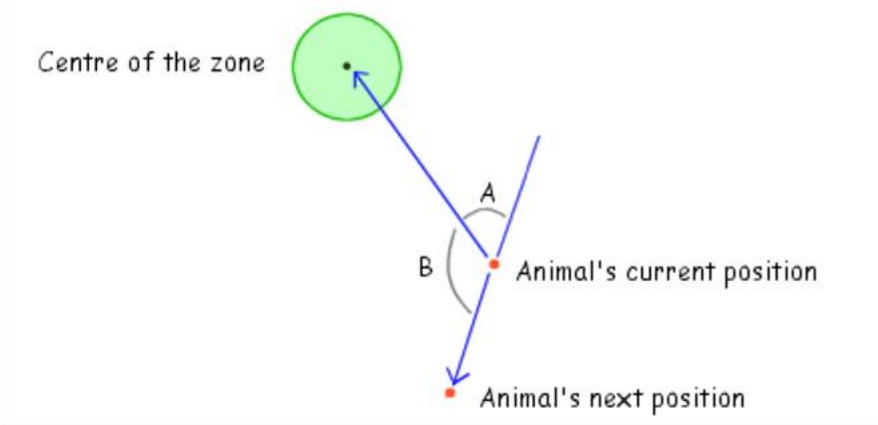

Figure 8. ANY-maze calculates the angle 'B' between the animal's heading and a direct heading to the zone, this is deducted from 180° yielding angle 'A', if this angle is less than a critical angle the animal is deemed to be moving away from the zone.

Here the *centre* of the zone is defined as the zone's 'centre of mass' (i.e. the mean x, y coordinate of all the points in the zone). It's important to understand that the centre of mass may actually be outside the zone. For example, consider a ring shaped zone, the centre of mass will be in the centre of the ring but this point will not be within the zone.

Having calculated the angle 'A' it is compared to the critical angle for movement away from a zone (see notes). If the angle is less than this critical angle then the animal is deemed to be moving away from the zone (unless it is *also* moving towards it - see notes) and the time it took to move from the current position to the next position is added to the total time moving away from the zone.

The second method used to calculate this measure uses the entire area of the zone. In this case, for each position of the animal, a vector is created between the current position and the next position. All possible vectors from the current position to the points on the zone's perimeter are then calculated and the angle between each one and the animal's heading vector is calculated. The largest of these angles is found. This angle is deducted from 180° and the result is compared to the critical angle for movement away from a zone in the same way as for the first calculation method (see above).

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal is moving away from the zone is also specified in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as described here as this is more intuitive. The default critical angle is 90° (i.e. by default the angle 'A' will be compared to 45°).

When calculating whether the animal is moving away from a zone the system takes into consideration whether the animal is *also* moving towards the zone (see Time moving towards the zone), if it is then the position is deemed to be ambiguous and the time from the position to the next position is NOT added to the overall result. A simple example of when this situation would arise is a ring shaped zone. If the animal is inside the ring then no matter what direction it moves in it we be moving both towards the zone and away from it (as the zone surrounds the animal). The measures Time getting closer to the zone and Time getting further away from the zone offer alternatives that avoid this problem.

3.47 Distance travelled until first entry to the zone

Description	Reports the distance travelled by the animal up to its first entry into the specified zone.
Calculation method	The distance the animal travels is summed until it enters the zone. If the animal doesn't enter the zone during the test then the result is undefined.
Analysis across time	This measure cannot be analysed across time.
Units	Metres
Notes	This measure is affected by the *Don't score any results in this zone until the first 'true' entry* option on the *Zone entry settings* page. See Choosing how ANY-maze should detect entries into a zone for more details.

3.48 Latency to last entry to the zone

Description	Reports the length of time that elapsed up to the moment when the animal made its last entry into the zone during the test.
Calculation method	This value is updated at the moment of each entry into the zone. The value at the end of the test is, necessarily, the latency to the last zone entry. If the animal doesn't enter the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. For any time period the result is the time from the start of the period to the last entry during that period. If the animal doesn't enter the zone during the time period then the result is undefined.
Units	Seconds This measure is particularly useful in water-maze tests to report the time taken by the animal to find a platform zone. In such tests it's common to only consider the animal as finding the platform if it remains on it for a certain period, for example 5 seconds. In this case it's possible that the animal will enter the platform zone a number of times and therefore the time to 'find' the platform will be the latency to the last entry to the zone. This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis element.

3.49 Maximum speed in the zone

Description	Reports the maximum speed of the animal while in the zone.
Calculation method	The speed of the animal between positions within the zone is calculated and the maximum speed is found. If the animal doesn't enter the zone during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. If the animal doesn't enter the zone during the time period then the result is undefined.
Units	Metres per seconds
Notes	The calculation of maximum speed does not use *successive* positions but instead requires that the animal move at least a minimum distance (which is based on the animal's size) and the speed to cover *this* distance is calculated. This method of calculation is used to avoid reporting the speed of movements that don't constitute locomotion of the animal. For example if an animal scratches, its centre point may oscillate rapidly but this will not be reported as the animal's maximum speed.

3.50 Number of exits from the zone

Description	Reports the number of times the animal exited from a zone.
Calculation method	Depends on the method used to detect zone entries - see Choosing how ANY-maze should detect entries into a zone for more details.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	None

Corrected integrated path length

Description	Reflects how efficiently the animal moved from the start position to the zone. A score of 0 implies perfect (straight line) efficiency.
Reference	**Barnes CA, et al.** (1997) Multistability of cognitive maps in the hippocampus of old rats *Nature* **388**: 272-5
Calculation method	The difference between the sum of the sampled distances from the target zone and the shortest possible sum if the rat had swum directly to the platform at its mean speed.
Analysis across time	This measure can be analysed across time.
Units	m·s
Notes	None

3.51 Initial distance from the zone

Description	Reports the distance from the animal's first position in the test to the zone
Calculation method	The straight line distance from the first position of the animal (see notes) to the nearest point of the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Metres
Notes	The position of the animal is either the animal's centre or the point of the animal that is closest to the zone. Which is used depends on whether or not the zone entry settings use the animal area to determine zone entries; when they do then the distance from the animal to the zone is based on the distance from the point of the animal that is closest to the zone, otherwise the distance is based on the centre of the animal.

3.52 Cumulative distance from the zone

Description	Reports the sum of the product of the distance from the zone and the time at that distance.
Calculation method	For every position of the animal calculates the distance from the zone multiplied by the time the animal stayed at that position. The final result is the sums all these values.
Analysis across time	This measure can be analysed across time.
Units	m·s
Notes	This value represents the area under the curve of a graph of distance from zone vs. time.

3.53 Time oriented towards the centre of the zone when inside zone

Description	Reports the amount of time the animal was oriented towards the centre of the zone while it was inside the zone
Calculation method	The animal's orientation is a vector connecting its centre position to its head position. A second vector from the animal's head position to the centre of the zone is determined and if the angle between the vectors is less than or equal to a *critical angle* (see notes) then the animal is deemed to be oriented towards the zone. The amount of time for which this is the case while the animal is inside the zone (as determined by the zone entry criteria) is summed.
Analysis across time	This measure can be analysed across time.
Units	Seconds
Notes	The *critical angle* used to define whether the animal is moving towards the zone is also specified in the protocol's Analysis options > Movement towards and away

from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as described here as this is more intuitive. The default critical angle is 90° (i.e. by default the angle between the vectors will be compared to 45°).

3.54 Time the animal's head was in the zone when its centre was outside the zone

Description	Reports the amount of time for which the animal's head position was in the zone while its centre position was outside the zone
Calculation method	For every position of the animal's head a check is made whether the head position is in the zone and the centre position is outside the zone (note that this determination does not use the zone entry criteria). The duration of each occurrence is calculated and the total duration of all occurrences is summed.
Analysis across time	This measure can be analysed across time
Units	Seconds
Notes	None

3.55 Path efficiency to first entry to the zone

Description	This measure represents an index of the efficiency of the path taken by the animal to get from the first position in the test to the first position within the zone. A value of 1 indicates perfect efficiency - the animal moved in a straight line - values less than 1 indicate decreasing efficiency.
Calculation method	The straight line distance between the first position in the test and the first position in the zone is divided by the total distance travelled by the animal until it first entered the zone
Analysis across time	This measure cannot be analysed across time.
Units	None
Notes	This measure is intended for use in water-maze experiments but is available in all tests.

Freezing bouts in the zone

Description	Reports the number of times the animal *froze* while in the zone
Calculation method	Each time the animal starts to freeze a check is made whether it is in the zone, if it is the count is incremented by one.
Analysis across time	This measure can be analysed across time.
Units	None
Notes	None

3.56 Time freezing in the zone

Description	Reports the number of times the animal *froze* while in the zone
Calculation method	The duration of each bout of freezing is calculated. If the animal was in the zone while frozen then the duration is added to the result for the zone.
Analysis across time	This measure can be analysed across time.
Units	Seconds
Notes	None

3.57 Signed initial heading error to the zone

Description	Reports the angle between the animal's heading at the start of the test and a direct heading to the zone. A positive initial heading error means the zone is to the animal's right and a negative initial heading error signifies the zone is to the animal's left.
Calculation method	Calculation of this measure depends on the settings in the Analysis options > Heading error sub-element of the protocol. Specifically the options control both how the animal's heading at the start of the test is determined and what part of the zone is used to calculate the heading error. There are two options for how the animal's heading at the start of the test is determined one uses a specific time delay, the other a specific distance. In the first case the animal's heading is taken to be the vector from the its first position in the test to the first position detected after the specified time interval has elapsed. In the second case the heading is taken to be the vector from the animal's first position in the test to the first position that's more than the specified distance from it. In both cases positions that are detected while the animal is considered to be immobile (if immobility detection is switched on) are ignored - thus in the first case the animal must be *mobile* for the period that is specified. Having determined the animal's signed initial heading, the system then calculates the heading from the first position in the test to the zone. To do this ANY-maze can use one of two methods (again these are specified using the Analysis options > Heading error sub-element in the protocol); it can either simply calculate the heading to the centre of the zone or it can calculate the heading to any part of the zone. In the first case (see figure 9) the *centre* of the zone is taken to be the zone's 'centre of mass' (i.e. the mean x, y coordinate of all the points in the zone) and the heading error is defined as the angle between this heading and the animal's initial heading.

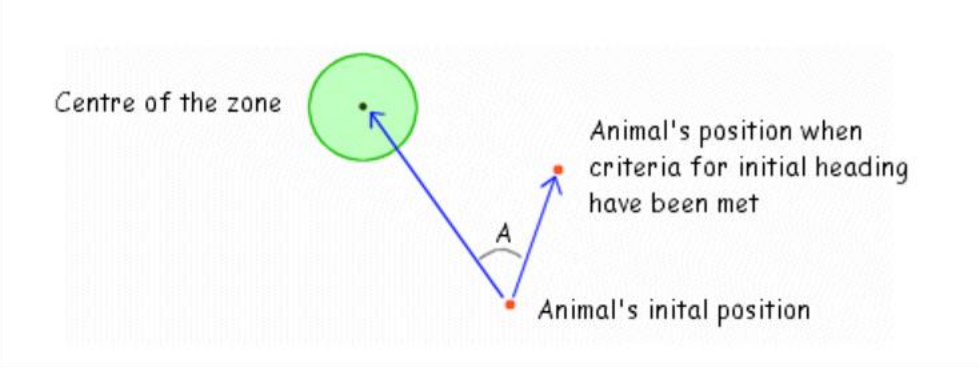

Figure 9. Calculation of the signed initial heading error using the centre of the zone: The animal's signed initial heading error is the angle 'A' between its initial heading and the direct heading to the centre of the zone. In this figure, the signed initial heading error will be a negative value as the zone is to the animal's left.

It's important to understand that a zone's centre of mass may actually be outside the zone. For example, consider a ring shaped zone, the centre of mass will be in the centre of the ring but this point will not be within the zone.

The second method of calculating the heading to the zone is to consider the heading to every position on the zone's perimeter - in this case the heading error is the smallest angle between the animal's heading and the heading to any perimeter point - see figure 10.

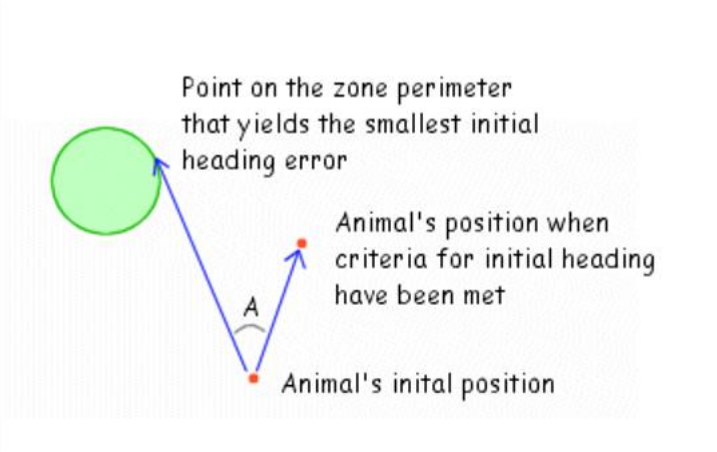

Figure 10. Calculation of the signed initial heading error using the entire area of the zone: The animal's initial heading error is the smallest angle, 'A', between its initial heading and any point on the zone perimeter.

In the case of small zones the difference between the two calculation techniques is usually minimal, but for a large zone it can make a substantial difference to the

result.

Analysis across time This measure cannot be analysed across time.

Units Degrees

Notes None

3.58 Time spent in Whishaw's corridor

Description Reports the amount of time the animal spent in the Whishaw corridor for the zone.

Calculation method The Whishaw's corridor for the zone is determined based on the start position of the animal in the test, the centre point of the zone and the width of the corridor specified in the protocol - see figure 11.

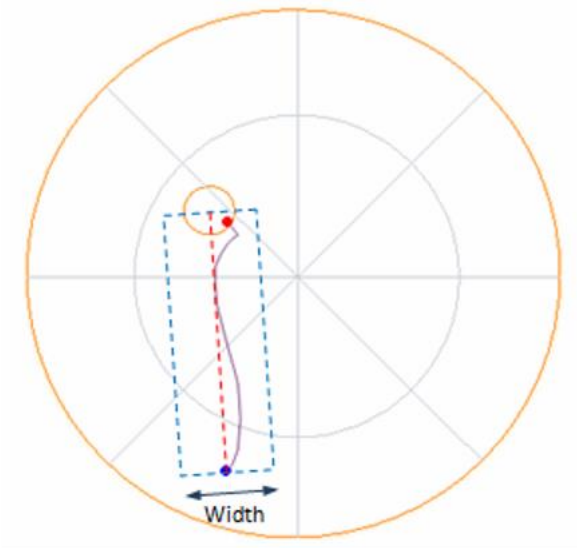

Figure 11. Example of Whishaw's Corridor in a water-maze. The corridor is centred on a line (shown in red) running from the animal's start position to the centre of the platform zone. The corridor itself (shown in blue) has a width specified in the protocol.

The time spent in the corridor is then calculated by summing the duration of each visit to the corridor where a visit starts at the time of an entry and ends at the time of an exit.

Analysis across time This measure can be analysed across time. For any time period the result is the total amount of time the animal spent within the corridor during that time period.

Units Seconds

Notes This measure is only available if the Whishaw Corridor width has been specified for the zone - see setting up a zone.

3.59 Distance travelled in Whishaw's corridor

Description Reports the distance travelled by the animal in the Whishaw corridor for the zone.

Calculation method The Whishaw's corridor for the zone is determined based on the start position of the animal in the test, the centre point of the zone and the width of the corridor specified in the protocol - see figure 12.

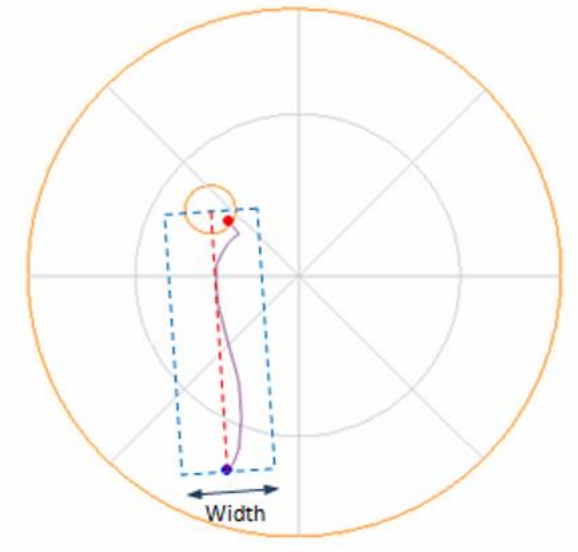

Figure 12. Example of Whishaw's Corridor in a water-maze. The corridor is centred on a line (shown in red) running from the animal's start position to the centre of the platform zone. The corridor itself (shown in blue) has a width specified in the protocol.

The distance travelled in the corridor is then calculated by summing the distance travelled during each visit to the corridor, where a visit starts when an animal enters the zone and ends when it exits the zone.

Analysis across time This measure can be analysed across time. For any time period the result is the distance travelled within the corridor during that time period.

Units Metres

Notes This measure is only available if the Whishaw Corridor width has been specified for the zone - see Setting up a zone.

In common with the way in which distance travelled in a zone is calculated, the distance travelled by the animal between a point outside the corridor and a point inside the corridor (i.e. when entering the corridor) is NOT included in the distance travelled in the corridor, whereas the distance travelled by the animal between a point inside the corridor and a point outside the corridor (i.e. when exiting the

corridor) IS included in the distance travelled in the corridor.

3.60 List of the duration of each visit to the zone

Description	Reports a comma-separated list of the duration of each visit to the zone. For example, if the animal visited the zone three times during the test, for 1 second on the first occasion and for 20 seconds on the second and third occasions then the list would be '1.0, 20.0, 20.0'.
Calculation method	The time of the animal's entry to the zone is noted then, when the animal exits the zone the duration of the visit is calculated and added to the list. If the animal is in the zone at the end of the test then the time from the entry to the end of the test is used as the duration of the last visit.
Analysis across time	This measure cannot be analysed across time.
Units	The duration of all visits is reported in seconds
Notes	When included on the Data page this measure will show all the visits to the zone in a single cell. If the spreadsheet is saved in CSV format and then opened in, for example Microsoft Excel, then the visits will be listed in individual cells. The length of the list is limited to 8192 characters, but usually at least 1,000 visits will be listed before the limit is reached.

4 Point measures

4.1 Average distance from the point

Description	Reports the average distance from the animal to the point.
Calculation method	For each position of the animal calculates the distance from the point to the animal and averages this distance throughout the entire test or time period. The method actually used to calculate this distance depends on the setting made when setting up the point. Specifically, the distance can either be calculated based on the part of the animal which is closest to the point (excluding its tail) or based on the position of the centre of the animal.
Analysis across time	This measure can be analysed across time. The result is the average distance from the point to the animal during the time period.
Units	Metres
Notes	None

4.2 Maximum distance from the point

Description	Reports the maximum distance from the animal to the point.
Calculation method	For each position of the animal calculates the distance from the point to the part of the animal that's closest to the point (the animal's tail is excluded). The maximum distance during the entire test or time period is the result. The method actually used to calculate this distance depends on the setting made when setting up the point. Specifically, the distance can either be calculated based on the part of the animal which is closest to the point (excluding its tail) or based on the position of the centre of the animal.
Analysis across time	This measure can be analysed across time. The result is the maximum distance from the animal to the point during the time period.
Units	Metres
Notes	None

4.3 Minimum distance from the point

Description	Reports the minimum distance from the animal to the point.
Calculation method	For each position of the animal calculates the distance from the point to the part of the animal that's closest to the point (the animal's tail is excluded). The minimum distance during the entire test or time period is the result. The method actually used to calculate this distance depends on the setting made when setting up the point. Specifically, the distance can either be calculated based on the part of the

	animal which is closest to the point (excluding its tail) or based on the position of the centre of the animal.
Analysis across time	This measure can be analysed across time. The result is the minimum distance from the animal to the point during the time period.
Units	Metres
Notes	None

4.4 Time moving towards the point

Description	Reports the total amount of time for which the animal was moving towards the point.
Calculation method	For each position of the animal, a vector is created between the current position and the next position. A second vector is then created between the current position and the point. The angle between these two vectors is calculated - see figure 1.

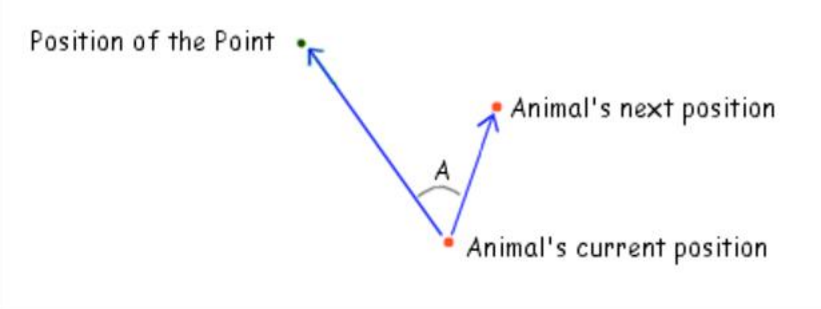

Figure 1. ANY-maze calculates the angle 'A' between the animal's heading and a direct heading to the point.

	The absolute angle between the two vectors, 'A', is compared to the critical angle for movement towards a point (see notes). If the angle is less than this critical angle then the animal is deemed to be moving towards the point. If the animal is moving towards the point then the time it took to move from the previous position to the current position is added to the total time moving towards the point.
Analysis across time	This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.
Units	Seconds
Notes	The *critical angle* used to define whether the animal is moving towards the point is specified in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as this is more intuitive. The default critical angle is 90° (i.e. by default the angle 'A' will be compared to 45°).

4.5 Time moving away from the point

Description Reports the total amount of time for which the animal was moving away from the point.

Calculation method For each position of the animal, a vector is created between the current position and the next position. A second vector is then created between the current position and the point. The angle between these two vectors is calculated and subtracted from 180° - see figure 2.

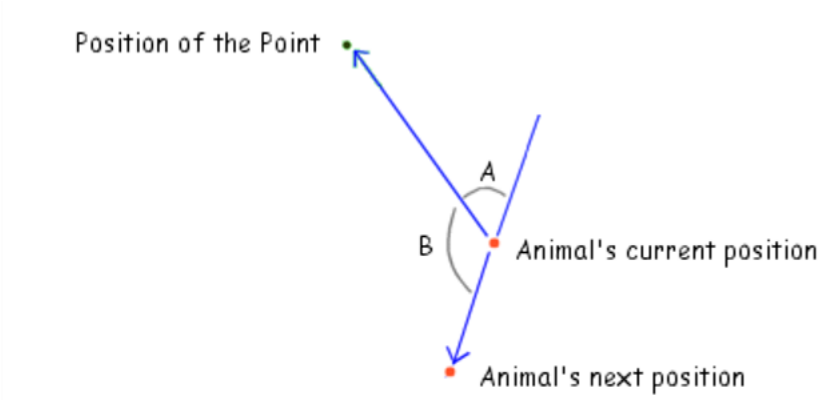

Figure 2. ANY-maze calculates the angle 'B' between the animal's heading and a direct heading to the point. This is then subtracted from 180° yielding angle 'A'.

The angle 'A' is compared to the critical angle for movement away from a point (see notes). If the value is less than this critical angle then the animal is deemed to be moving away from the point. If the animal is moving away from the point then the time it took to move from the previous position to the current position is added to the total time moving away from the point.

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal is moving away from the point is specified in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as this is more intuitive. The default critical angle is 90° (i.e. by default the angle 'A' will be compared to 45°).

4.6 Initial heading error to the zone

Description Reports the angle between the animal's heading at the start of the test and a direct heading to the point.

Calculation method	Calculation of this measure depends on the settings in the Analysis options > Heading error sub-element of the protocol. Specifically there are two options for how the animal's heading at the start of the test is determined one uses a specific time delay, the other a specific distance. In the first case the animal's heading is taken to be the vector from the its first position in the test to the first position detected after the specified time interval has elapsed. In the second case the heading is taken to be the vector from the animal's first position in the test to the first position that's more than the specified distance from it. In both cases positions that are detected while the animal is considered to be immobile (if immobility detection is switched on) are ignored - thus in the first case the animal must be *mobile* for the period that is specified. Having determined the animal's initial heading, the system then calculates the vector from the first position in the test to the point. The angle between this vector and the animal's heading vector is the initial heading error.
Analysis across time	This measure cannot be analysed across time.
Units	Degrees
Notes	

4.7 Average absolute heading error to the point

Description	Reports the average absolute angle between the animal's heading and a direct heading to the point.
Calculation method	The animal's heading is defined as the vector that joins the position with the next position in time. The heading to the point is defined as the vector that joins the animal's position to the point and the heading error is defined as the angle between the two vectors. This angle is calculated for every position of the animal and the angle's absolute value is summed and then divided by the number of positions. If immobility is being detected in a test then all positions when the animal is deemed to be immobile are ignored in the calculation of the average heading error. If immobility is not being detected then all positions are used with the caveat that a position must be at least a minimum distance from the previous position for it to be considered. The minimum used is based on the size of the animal.
Analysis across time	This measure can be analysed across time. The result is based on just those positions that fall within the time period.
Units	Degrees
Notes	None

4.8 Average distance of the animal's head from the point

Description	Reports the average distance from the animal's head to the point.

Calculation method	Calculates the distance from the point to the position of the animal's head. Averages this distance through the entire test or time period.
Analysis across time	This measure can be analysed across time. The result is the average distance from the point to the animal's head during the time period.
Units	Metres
Notes	This measure is only available if Head tracking is turned on.

4.9 Maximum distance of the animal's head from the point

Description	Reports the maximum distance from the animal's head to the point.
Calculation method	Calculates the distance from the point to the position of the animal's head. The maximum distance during the entire test or time period is the result.
Analysis across time	This measure can be analysed across time. The result is the maximum distance from the animal's head to the point during the time period.
Units	Metres
Notes	This measure is only available if Head tracking is turned on.

4.10 Minimum distance of the animal's head from the point

Description	Reports the minimum distance from the animal's head to the point.
Calculation method	Calculates the distance from the point to the position of the animal's head. The minimum distance during the entire test or time period is the result.
Analysis across time	This measure can be analysed across time. The result is the minimum distance from the animal's head to the point during the time period.
Units	Metres
Notes	This measure is only available if Head tracking is turned on.

4.11 Time the animal's head was moving towards the point

Description	Reports the total amount of time for which the animal's head was moving towards the point.
Calculation method	For each position of the animal's head, a vector is created between the current position and the next position. A second vector is then created between the current position and the point. The angle between these two vectors is calculated - see figure 3.

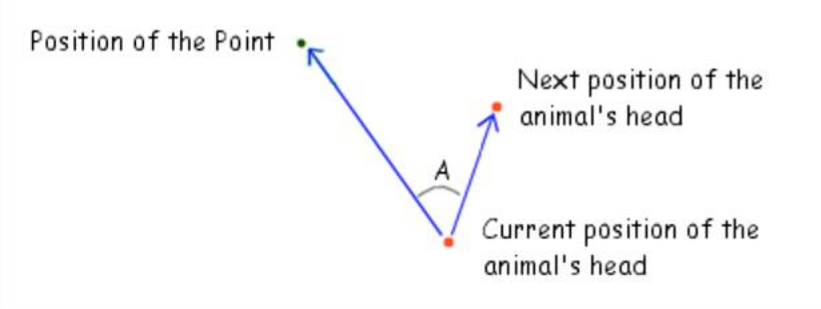

Figure 3. ANY-maze calculates the angle 'A' between the heading of the animal's head and the direct heading to the point.

The angle 'A', is compared to the critical angle for movement towards a point (see notes). If the angle is less than this critical angle then the animal's head is deemed to be moving towards the point. If the animal's head is moving towards the point then the time it took to move from the previous position to the current position is added to the total time moving towards the point.

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal is moving towards the point is specified in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as this is more intuitive. The default critical angle is 90° (i.e. by default the angle *beta* is compared to 45°).

This measure is only available if Head tracking is turned on.

4.12 Time the animal's head was moving away from the point

Description Reports the total amount of time for which the animal's head was moving away from the point.

Calculation method For each position of the animal's head, a vector is created between the current position and the next position. A second vector is then created between the current position and the point. The angle between these two vectors is calculated and the result is subtracted from 180° - see figure 4.

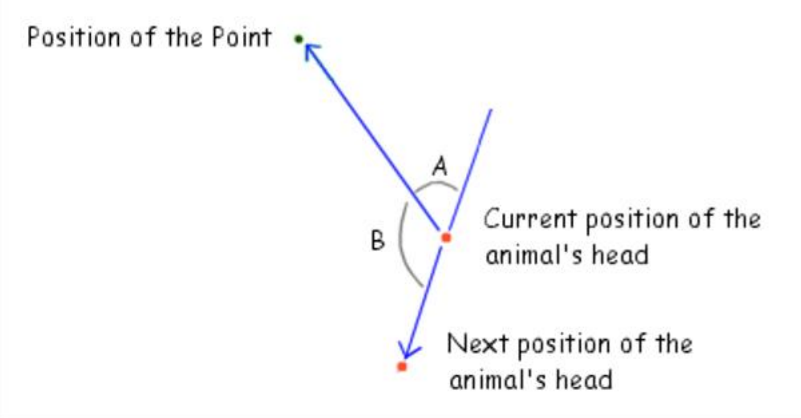

Figure 4. ANY-maze calculates the angle 'B' between the heading of the animal's head and the direct heading to the point, this is then subtracted from 180° yielding angle 'A'.

The angle 'A' is compared to the critical angle for movement away from a point (see notes). If the angle is less than this critical angle then the animal's head is deemed to be moving away from the point. If the animal's head is moving away from the point then the time it took to move from the previous position to the current position is added to the total time moving away from the point.

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal's head is moving away from the point is specified in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as this is more intuitive. The default critical angle is 90° (i.e. by default the angle 'A' will be compared to 45°).

This measure is only available if Head tracking is turned on.

4.13 Time the animal's head was oriented towards the point

Description Reports the total amount of time for which the animal's head was oriented towards the point.

Calculation method A vector is created between the centre point of the animal and the animal's head - this vector defines the direction in which the animal is oriented. A second vector is created between the position of the animal's head and the position of the point. The angle between these two vectors is calculated - see figure 5.

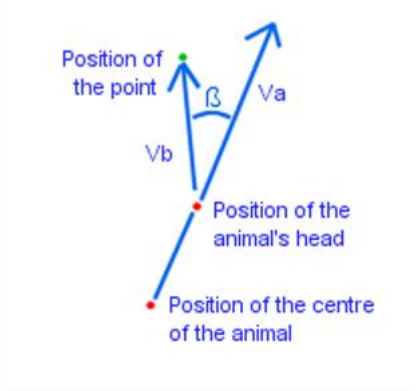

Figure 1. ANY-maze calculates the angle beta between the two vectors Va (the vector which defines the animal's orientation) and Vb (the vector from the animal to the point).

The absolute angle between the two vectors (*beta*) is compared to the critical angle for movement away from/towards a point (see notes). If the angle is less than this critical angle then the animal is deemed to be oriented towards the point. If the animal is oriented towards the point then the time between the previous position of the animal and its current position is added to the total time oriented towards the point (irrespective of whether it was oriented towards the point at the previous position).

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal is oriented towards the point is the same angle as is used to determine whether the animal is moving towards or away from a point and is defined in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as this is more intuitive. The default critical angle is 90° (i.e. by default the angle *beta* will be compared to 45°).

This measure is only available if Head tracking is turned on.

4.14 Time the animal's head was oriented away from the point

Description Reports the total amount of time for which the animal's head was oriented away from the point.

Calculation method A vector is created between the centre point of the animal and the animal's head - this vector defines the direction in which the animal is oriented. A second vector is created between the position of the animal's head and the position of the point. The angle between these two vectors is calculated - see figure 6.

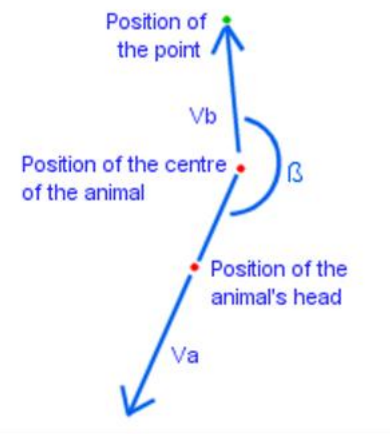

Figure 1. ANY-maze calculates the angle beta between the two vectors Va (the vector which defines the animal's orientation) and Vb (the vector from the animal to the point).

The angle between the two vectors (*beta*) is subtracted from 180° and the absolute value of the result is calculated; this is compared to the critical angle for movement towards/away from a point (see notes). If the angle is less than this critical angle then the animal is deemed to be oriented away from the point. If the animal is oriented away from the point then the time between the previous position of the animal and its current position is added to the total time oriented away from the point (irrespective of whether it was orientated away from the point at the previous position).

Analysis across time This measure can be analysed across time. The result is calculated using just those positions which fall within the time period.

Units Seconds

Notes The *critical angle* used to define whether the animal's head is oriented away from the point is the same angle as is used to determine whether the animal is moving towards or away from a point and is defined in the protocol's Analysis options > Movement towards and away from zones and points sub-element. In fact the value entered in the analysis options is twice the critical angle as this is more intuitive. The default critical angle is 90° (i.e. by default the angle *abs(180-beta)* will be compared to 45°).

This measure is only available if Head tracking is turned on.

5 Sequence measures

5.1 Latency to start of first sequence

Description	Reports the length of time which elapsed before the first sequence in the test started.
Calculation method	Time at which first sequence starts.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis element.

5.2 Latency to completion of first sequence

Description	Reports the length of time which elapsed before the first sequence in the test ended.
Calculation method	Time at which first ended.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	This measure is affected by the option to *Use the test duration as the latency for events which don't occur* in the Analysis element.

5.3 Number of sequences

Description	Reports the number of times the sequence was performed.
Calculation method	Each time a sequence ends the number of sequences is incremented by one.
Analysis across time	This measure can be analysed across time. A sequence is considered to occur in the time period in which it **ends**. For example if a sequence starts at time 15 seconds and continues to time 45 seconds, then (for 30 second time periods) it would be counted in the time period 30-60 seconds because this is the period in which it ended.
Units	None
Notes	None

5.4 Total time performing sequences

Description	Reports the total amount of time that the animal was performing sequences during the test.

Calculation method	Sums the time taken to complete each sequence.
Analysis across time	This measure can be analysed across time. A sequence is considered to occur in the time period in which it **ends**, therefore the time performing the sequence is ALL attributed to the time period in which it ends. In an extreme case this can yield a result in which the time performing a sequence in a time period is *longer* than the period itself. For example, if a sequence started at time 5 seconds and ended at time 55 seconds then (for 30 second time periods) its duration, 50 seconds, would be counted in the time period 30-60 seconds because this is the period in which it ended, but the duration would actually be longer than the time period. This apparent strange way of calculating results for periods is done to ensure that the result for Average time to complete the sequence is correct.
Units	Seconds
Notes	None

5.5 Average time to complete the sequence

Description	Reports the average amount of time taken to complete the sequences.
Calculation method	Calculated by dividing the Total time performing sequences by the Number of sequences. If there are no sequences in the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result is Total time performing sequences in the period divided by the Number of sequences in the period. If no sequences were performed during a period then the result is undefined.
Units	Seconds
Notes	This measure is affected by the option to *Use zero as the result for undefined averages* in the Analysis options element.

5.6 Maximum duration of a sequence

Description	Reports the maximum amount of time taken to complete a single sequence.
Calculation method	The duration of each sequence is calculated when the sequence ends and the longest one is found. If no sequences were performed during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a time period is the duration of the longest sequence which **ended** during the time period. If no sequence ended during the time period then the result is undefined.
Units	Seconds
Notes	None

5.7 Minimum duration of a sequence

Description	Reports the minimum amount of time taken to complete a single sequence.
Calculation method	The duration of each sequence is calculated when the sequence ends and the shortest one is found. If no sequences were performed during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a time period is the duration of the shortest sequence which **ended** during the time period. If no sequence ended during the time period then the result is undefined.
Units	Seconds
Notes	None

5.8 Total distance travelled during sequences

Description	Reports the total distance travelled by the animal while performing sequences in the test.
Calculation method	Sums the distance travelled during each sequence in the test.
Analysis across time	This measure can be analysed across time. The result for a time period is the sum of the distance travelled for all the sequences that **ended** during the time period.
Units	Metres
Notes	None

5.9 Average distance travelled per sequence

Description	Reports the average distance travelled by the animal while performing each of the sequences in the test.
Calculation method	Calculated by dividing the Total distance travelled during sequences by the Number of sequences. If there were no sequences performed in the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a time period is the Total distance travelled during sequences which **ended** during the time period divided by the Number of sequences which **ended** during the time period. If there were no sequences which ended during the time period then the result is undefined.
Units	Metres
Notes	This measure is affected by the option to *Use zero as the result for undefined averages* in the Analysis options element.

5.10 Maximum distance travelled during a sequence

Description	Reports the maximum distance travelled by the animal while performing a single sequence.
Calculation method	The distance travelled while performing each sequence is calculated and the greatest distance is found. If no sequences were performed in the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a time period is the greatest distance travelled during any sequence which **ended** during the time period. If no sequence ended during the time period then the result is undefined.
Units	Metres
Notes	None

5.11 Minimum distance travelled during a sequence

Description	Reports the minimum distance travelled by the animal while performing a single sequence.
Calculation method	The distance travelled while performing each sequence is calculated and the smallest distance is found. If no sequences were performed in the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a time period is the smallest distance travelled during any sequence which **ended** during the time period. If no sequence ended during the time period then the result is undefined.
Units	Metres
Notes	None

5.12 Average speed during the sequence

Description	Reports the average speed of the animal while performing the sequences in the test.
Calculation method	Calculated by dividing Total distance travelled during sequences by the Total time performing sequences. If no sequences were performed in the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a time period is the Total distance travelled during sequences which **ended** during the period divided by the Total time performing sequences which **ended** during the period. If no sequence ended during the time period then the result is undefined.
Units	Metres per second
Notes	This measure is affected by the option to *Use zero as the result for undefined averages* in the Analysis options element.

5.13 Number of broken sequences

Description	Reports the number of times the animal started a sequence and then performed some movement that 'broke' the sequence.
Calculation method	When the animal starts a sequence by performing the first, or possibly any one of, the sequence steps a note is made that it is 'in a sequence'. If it then performs a movement that breaks the sequence steps the number of broken sequences in incremented.
Analysis across time	This measure can be analysed across time. The result is the count of sequences that were broken during the period.
Units	None
Notes	None

6 Key measures

Each key measure is available for the apparatus as whole (i.e. irrespective of where the behaviour occurred) and also for each defined zone. For example, if a protocol includes two zones called 'Left' and 'Right' and two keys have been defined, one for 'Grooming' and one for 'Rearing' then the following sets of measures will be available:

- All the measures listed above for grooming anywhere in the apparatus
- All the measures listed above for rearing anywhere in the apparatus
- All the measures listed above for grooming in the left zone
- All the measures listed above for rearing in the left zone
- All the measures listed above for grooming in the right zone
- All the measures listed above for rearing in the right zone

6.1 Number of presses

Description	Reports the number of times the key was pressed down, i.e. the number of times the animal started to exhibit the key's behaviour.
Calculation method	Counts the number of key presses.
Analysis in zones	Counts the number of times the key was pressed when the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of times the key was pressed down during the time period.
Units	None
Notes	None

6.2 Time pressed

Description	Reports the total amount of time the key was pressed down, i.e. the total amount of time that the animal was exhibiting the key's behaviour.
Calculation method	Sums the amount of time for which the key was pressed.
Analysis in zones	Sums the amount of time for which the key was pressed in the zone. For a particular zone it's possible for the *Time pressed* to be non-zero while the Number of presses is zero. This can occur if the animal enters the zone when the key is pressed. In this case the time the key is pressed will be registered but the key press itself won't be.
Analysis across time	This measure can be analysed across time. For any time period the result is the amount of time that the key was pressed during the period.

	For a particular time period it's possible for the *Time pressed* during the period to be non-zero while the Number of presses for the period is zero. This can occur if the key is already pressed at the start of the period. In this case the time the key is pressed will be registered but the key press itself won't be.
Units	Seconds
Notes	None

6.3 Latency to first press

Description	Reports the amount of time that elapsed in the test before the key was pressed for the first time. i.e. The amount of time that elapsed before the key's behaviour started for the first time.
Calculation method	The value of the test clock at the first key press.
Analysis in zones	The value of the test clock at the first key press that occurred within the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

6.4 Latency to first release

Description	Reports the amount of time that elapsed in the test before the key was released for the first time. i.e. The amount of time that elapsed before the key's behaviour ended for the first time.
Calculation method	The value of the test clock at the first key release.
Analysis in zones	The value of the test clock at the first key release that occurred within the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

6.5 Longest press

Description	Reports the duration of the longest period for which the key was continuously pressed down, i.e. the longest period for which the animal continuously exhibited the key's behaviour.
Calculation method	The duration of each key press is calculated and the largest value is found.
Analysis in zones	The longest period for which the key was continuously pressed in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the longest period for which the key was continuously pressed during the period.

Units	Seconds
Notes	None

6.6 Shortest press

Description	Reports the duration of the shortest period for which the key was continuously pressed down, i.e. the shortest period for which the animal continuously exhibited the key's behaviour.
Calculation method	The duration of each key press is calculated and the smallest value is found.
Analysis in zones	The shortest period for which the key was continuously pressed in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the shortest period for which the key was continuously pressed during the period.
Units	Seconds
Notes	None

6.7 Average press duration

Description	Reports the average duration for which the key was held down, i.e. the average duration of the episodes of the key's behaviour.
Calculation method	Calculated by dividing the Time pressed by the Number of presses.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

6.8 Press frequency

Description	Reports the frequency with which the key was pressed, i.e. the frequency with which the animal exhibited the key's behaviour.
Calculation method	Calculated by dividing the Number of presses by the *Test duration*.
Analysis in zones	Calculated by dividing the Number of presses in the zone by the *Total time in the zone*.
Analysis across time	This measure can be analysed across time. For any time period the result is the Number of presses which occurred during the period divided by the period's duration.
Units	Hertz
Notes	None

6.9 Distance travelled before 1st press

Description	Reports the distance the animal had travelled in the apparatus up to the moment the key was first pressed.
Calculation method	The accumulated total distance travelled is noted at the time of the first key press.
Analysis in zones	The measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Metres
Notes	None

6.10 List of activation durations

Description	Reports a comma-separated list of the duration of each activation of the key. For example, if key was activated three times, for 10s on the first occasion and for 20s on the second and third, then the list would show '10.0, 20.0, 20.0'.
Calculation method	The duration of each activation is calculated and added to the list. If the key is active at the end of the test then the last duration in the list will be from the time the key was activated to the time of the test end.
Analysis in zones	The measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	All the durations in the list are reported in seconds.
Notes	When included on the Data page this measure will show all the activation durations in a single cell. If the spreadsheet is saved in CSV format and then opened in, for example Excel, then the durations will be listed in individual cells. The length of the list is limited to 8192 characters, but usually at last 1,000 activations will be listed before the limit is reached.

7 On/Off Input measures

Each On/Off input measure is available for the apparatus as whole (i.e. irrespective of where the animal was when the input activation occurred) and also for each defined zone.

7.1 Number of activations

Description	Reports the number of times the input was activated.
Calculation method	Counts the number of activations.
Analysis in zones	Counts the number of activations when the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of activations during the time period.
Units	None
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.2 Time active

Description	Reports the total amount of time that the input was active.
Calculation method	Sums the amount of time for which the input was active.
Analysis in zones	Sums the amount of time for which the input was active while the animal was in the zone. For a particular zone it's possible for the *Time active* to be non-zero while the Number of activations is zero. This can occur if the animal enters the zone when the input is active. In this case the time the input is active will be registered but the activation itself won't be.
Analysis across time	This measure can be analysed across time. For any time period the result is the amount of time that the input was active during the period. For a particular time period it's possible for the *Time active* during the period to be non-zero while the Number of activations for the period is zero. This can occur if the input is already active at the start of the period. In this case the time the input is active will be registered but the input activation itself won't be.
Units	Seconds
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.3 Latency to first activation

Description	Reports the amount of time that elapsed in the test before the input was activated for the first time.

Calculation method	The value of the test clock at the first activation of the input.
Analysis in zones	The value of the test clock at the first activation of the input that occurred while the animal was within the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.4 Latency to first deactivation

Description	Reports the amount of time that elapsed in the test before the input was deactivated for the first time.
Calculation method	The value of the test clock at the first input deactivation.
Analysis in zones	The value of the test clock at the first input deactivation that occurred while the animal was within the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.5 Longest activation

Description	Reports the duration of the longest period for which the input was continuously active.
Calculation method	The duration of each input activation is calculated and the largest value is found.
Analysis in zones	The longest period for which the input was continuously active while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the longest period for which the input was continuously active during the period.
Units	Seconds
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.6 Shortest activation

Description	Reports the duration of the shortest period for which the input was continuously active.
Calculation method	The duration of each input activation is calculated and the smallest value is found.
Analysis in zones	The shortest period for which the input was continuously active while the animal was in the zone.

Analysis across time	This measure can be analysed across time. For any time period the result is the shortest period for which the input was continuously active during the period.
Units	Seconds
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.7 Average activation duration

Description	Reports the average duration for which the input was active.
Calculation method	Calculated by dividing the Time active by the Number of activations.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

7.8 Frequency of activations

Description	Reports the frequency with which the input was activated.
Calculation method	Calculated by dividing the Number of activations by the *Test duration*.
Analysis in zones	Calculated by dividing the Number of activations in the zone by the *Total time in the zone*.
Analysis across time	This measure can be analysed across time. For any time period the result is the Number of activations which occurred during the period divided by the period's duration.
Units	Hertz
Notes	*Activation* is defined when you create the input, see Setting up an On/Off Input.

8 Signal measures

8.1 Average

Description	The mean of the signal's value over the duration of the test.
Calculation method	All the signal's samples are summed across the duration of the test and the sum is divided by the count of samples.
Analysis in zones	This measure can be analysed in zones. It reports the mean of the signal's value while the animal was in the zone.
Analysis across time	This measure can be analysed across time. It reports the mean of the signal's value during the time period.
Units	Same as the signal's units
Notes	None

8.2 Maximum

Description	The signal's maximum value over the duration of the test.
Calculation method	All the signal's samples are scanned and the largest value is found.
Analysis in zones	This measure can be analysed in zones. It reports the signal's maximum value reports while the animal was in the zone.
Analysis across time	This measure can be analysed across time. It reports the signal's maximum value during the time period.
Units	Same as the signal's units
Notes	None

8.3 Minimum

Description	The signal's minimum value over the duration of the test.
Calculation method	All the signal's samples are scanned and the smallest value is found.
Analysis in zones	This measure can be analysed in zones. It reports the signal's minimum value reports while the animal was in the zone.
Analysis across time	This measure can be analysed across time. It reports the signal's minimum value during the time period.
Units	Same as the signal's units
Notes	None

8.4 Time of maximum

Description	The time at which the signal's maximum value occurred
Calculation method	The test clock at the time the maximum value occurred
Analysis in zones	This measure can be analysed in zones. It reports the time at which the signal's maximum value, while the animal was in the zone, occurred.
Analysis across time	This measure can be analysed across time. It reports the time *in the time period* at which the signal's maximum value during the time period occurred.
Units	Seconds
Notes	None

8.5 Time of minimum

Description	The time at which the signal's minimum value occurred
Calculation method	The test clock at the time the minimum value occurred
Analysis in zones	This measure can be analysed in zones. It reports the time at which the signal's minimum value, while the animal was in the zone, occurred.
Analysis across time	This measure can be analysed across time. It reports the time *in the time period* at which the signal's minimum value during the time period occurred.
Units	Seconds
Notes	None

8.6 Baseline

Description	The signal's baseline value
Calculation method	The average of the signal's values during the baseline period. All the signal's samples are summed across the baseline period and the sum is divided by the count of samples.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Same as the signal's units
Notes	None

8.7 Baseline deviation

Description	The signal's baseline deviation value as defined in the protocol. This is the amount the signal must deviate from the baseline value for it to count as a *deviation.* For example, if the protocol specifies that the signal's baseline deviation is 10% and the baseline value is 20 then the baseline deviation will be 2.

Calculation method	Depends on how the deviation is defined in the protocol.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Same as the signal's units
Notes	None

8.8 Baseline standard deviation

Description	The standard deviation of the signal's value during the baseline period.
Calculation method	The standard deviation of all of the signal's samples during the baseline period.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Same as the signal's units
Notes	None

8.9 Time of the end of the baseline period

Description	The time at which the baseline period ended
Calculation method	The test clock at the time the baseline period ended
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	If the baseline period is defined in the protocol as a set period, then this will be that period, but if the baseline period ends at some time marker (which could be different in different tests) then this will be the time of the time marker.

8.10 Time of first positive deviation from baseline

Description	The time at which the signal's value first deviated above the Baseline value by more than the Baseline deviation.
Calculation method	The test clock at the time at which the deviation occurred.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure can be analysed across time. It is the time *within the period* at which the signal's value first (within the period) deviated above the Baseline value by more than the Baseline deviation.
Units	Seconds
Notes	None

8.11 Time of first return to baseline from positive deviation

Description	The time at which the signal's value first returned from being above the Baseline value to be within the Baseline deviation of it.
Calculation method	The test clock at the time at which the return to the baseline occurred. It is implicit that a positive deviation from the baseline must already have occurred.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure can be analysed across time. It is the time *within the period* at which the signal's value first (within the period) returned from being above the Baseline value to be within the Baseline deviation of it.
Units	Seconds
Notes	None

8.12 Time of first negative deviation from baseline

Description	The time at which the signal's value first deviated below the Baseline value by more than the Baseline deviation.
Calculation method	The test clock at the time at which the deviation occurred.
Analysis in zones	This value measure be analysed in zones.
Analysis across time	This measure can be analysed across time. It is the time *within the period* at which the signal's value first (within the period) deviated below the Baseline value by more than the Baseline deviation.
Units	Seconds
Notes	None

8.13 Time of first return to baseline from negative deviation

Description	The time at which the signal's value first returned from being below the Baseline value to be within the Baseline deviation of it.
Calculation method	The test clock at the time at which the return to the baseline occurred. It is implicit that a negative deviation from the baseline must already have occurred.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure can be analysed across time. It is the time *within the period* at which the signal's value first (within the period) returned from being below the Baseline value to be within the Baseline deviation of it.
Units	Seconds
Notes	None

8.14 Integral above baseline

Description	The sum of the area under the signal's line and above the baseline
Calculation method	Every sample after the baseline period is compared to the baseline, if it is above it then the difference between the signal value and the baseline (divided by the sampling rate) is added to the integral.
Analysis in zones	This measure can be analysed in zones. It is the sum of the area under the signal's line and above the baseline for all the samples captured while the animal was in the zone.
Analysis across time	This measure can be analysed across time. It is the sum of the area under the signal's line and above the baseline for all the samples captured during the time period.
Units	Same as the signal's units · s
Notes	None

8.15 Integral below baseline

Description	The sum of the area above the signal's line and below the baseline
Calculation method	Every sample after the baseline period is compared to the baseline, if it is below it then the difference between the baseline and the signal value (divided by the sampling rate) is added to the integral.
Analysis in zones	This measure can be analysed in zones. It is the sum of the area above the signal's line and below the baseline for all the samples captured while the animal was in the zone.
Analysis across time	This measure can be analysed across time. It is the sum of the area above the signal's line and below the baseline for all the samples captured during the time period.
Units	Same as the signal's units · s
Notes	None

8.16 Average maximum for each visit to zone

Description	The average of the signal's maximum value on each of the animal's visits to the zone. This measure can **only** be reported for zones - it cannot be reported for the apparatus as a whole.
Calculation method	The maximum signal value on each of the animal's visits to the zone is found. These are summed and divided by the number of zone visits.
Analysis in zones	This measure can **only** be reported in zones.

Analysis across time	This measure can be analysed across time. For each time period it is the average of the signal's maximum value on each of the animal's visits to the zone during the period.
Units	Same as the signal's units
Notes	None

8.17 Average time to maximum for each visit to zone

Description	The average time after entering a zone at which the signal reaches the maximum value during the visit to the zone. This measure can **only** be reported for zones - it cannot be reported for the apparatus as a whole.
Calculation method	For each visit to the zone the maximum signal value is found. The value of the test clock when the animal entered the zone is subtracted from the value of the test clock at the time of this maximum and the resulting time is added to a sum of times. This sum is then divided by the total number of zone visits.
Analysis in zones	This measure can **only** be reported in zones.
Analysis across time	This measure can be analysed across time. For each visit to the zone during the time period the maximum signal value is found. The value of the test clock when the animal entered the zone (or when the time period started, whichever is later) is subtracted from the value of the test clock at the time of this maximum and the resulting time is added to a sum of times. This sum is then divided by the total number of zone visits during the time period.
Units	Seconds
Notes	None

8.18 Average minimum for each visit to zone

Description	The average of the signal's minimum value on each of the animal's visits to the zone. This measure can **only** be reported for zones - it cannot be reported for the apparatus as a whole.
Calculation method	The minimum signal value on each of the animal's visits to the zone is found. These are summed and divided by the number of zone visits.
Analysis in zones	This measure can **only** be reported in zones.
Analysis across time	This measure can be analysed across time. For each time period it is the average of the signal's minimum value on each of the animal's visits to the zone during the period.
Units	Same as the signal's units
Notes	None

8.19 Average time to minimum for each visit to zone

Description	The average time after entering a zone at which the signal reaches the minimum value during the visit to the zone. This measure can **only** be reported for zones - it cannot be reported for the apparatus as a whole.
Calculation method	For each visit to the zone the minimum signal value is found. The value of the test clock when the animal entered the zone is subtracted from the value of the test clock at the time of this minimum and the resulting time is added to a sum of times. This sum is then divided by the total number of zone visits.
Analysis in zones	This measure can **only** be reported in zones.
Analysis across time	This measure can be analysed across time. For each visit to the zone during a time period the minimum signal value is found. The value of the test clock when the animal entered the zone (or when the time period started, whichever is later) is subtracted from the value of the test clock at the time of this minimum and the resulting time is added to a sum of times. This sum is then divided by the total number of zone visits during the time period.
Units	Seconds
Notes	None

8.20 Average at zone entry

Description	The average of the signal's values at the moment the animal entered the zone. This measure can **only** be reported for zones - it cannot be reported for the apparatus as a whole.
Calculation method	Each time the animal enters the zone the signal's value is added to a sum. This sum is then divided by the number of zone entries.
Analysis in zones	This measure can **only** be reported in zones.
Analysis across time	This measure can analysed across time. For each zone entry during a time period, the signal's value at the moment the animal entered is added to a sum. This sum is then divided by the number of zone entries during the period.
Units	Same as the signal's units
Notes	None

8.21 Average at zone exit

Description	The average of the signal's values at the moment the animal exited the zone. This measure can **only** be reported for zones - it cannot be reported for the apparatus as a whole.
Calculation method	Each time the animal leaves the zone the signal's value is added to a sum. This sum is then divided by the number of zone exists.
Analysis in zones	This measure can **only** be reported in zones.

Analysis across time	This measure can analysed across time. For each zone exit during a time period, the signal's value at the moment the animal exited is added to a sum. This sum is then divided by the number of zone exists during the period.
Units	Same as the signal's units
Notes	None

9 Sensor measures

9.1 Initial value

Description	The sensor's value at the start of the test.
Calculation method	Depends on how the sensor is configured, either the last value reported by the sensor prior to the start of the test (this will typically be read less than 1 second before the start of the test), or the value read from the sensor when the sensor's key was pressed before the test started.
Analysis in zones	This value is not available within zones.
Analysis across time	This measure cannot be analysed across time.
Units	Depends on the sensor (lux, degrees, grams or %)
Notes	This is the only measure that is reported when a sensor is set to be read at the test start. When a sensor is set to report the change in its value during a test, this measure is NOT reported (as it would always be 0).

9.2 Average value

Description	Reports the average value reported by the sensor.
Calculation method	Simple average of the values reported by the sensor during the test.
Analysis in zones	Average of the values reported while the animal was in the zone.
Analysis across time	This measure can be analysed across time. The result is the average of the values reported during the time period.
Units	Depends on the sensor (lux, degrees, grams or %)
Notes	This measure is only reported when a sensor is set to be read continuously throughout a test.

9.3 Maximum value

Description	Reports the maximum value reported by the sensor.
Calculation method	The largest value reported by the sensor during the test.
Analysis in zones	The largest value reported while the animal was in the zone.
Analysis across time	This measure can be analysed across time. The result is the largest of the values reported during the time period.
Units	Depends on the sensor (lux, degrees, grams or %)
Notes	This measure is only reported when a sensor is set to be read continuously throughout a test.

9.4 Minimum value

Description	Reports the minimum value reported by the sensor.
Calculation method	The smallest value reported by the sensor during the test.
Analysis in zones	The smallest value reported while the animal was in the zone.
Analysis across time	This measure can be analysed across time. The result is the smallest of the values reported during the time period.
Units	Depends on the sensor (lux, degrees, grams or %)
Notes	This measure is only reported when a sensor is set to be read continuously throughout a test.

9.5 Change

Description	Reports the change in the sensor's value relative to the value at the start of the test.
Calculation method	The first value recorded in the test is subtracted from the last value recorded in the test.
Analysis in zones	This value is not available within zones.
Analysis across time	This measure can be analysed across time (see notes). The result is the value at the start of the time period subtracted from the last value recorded in the time period.
Units	Depends on the sensor (lux, degrees, grams or %)
Notes	This measure is only reported when a sensor is set to be read continuously throughout a test or is set to be read after the test when the sensor's key is pressed. If the sensor is not set to be read continuously then analysis across time is not possible.

10 Rotary encoder measures

10.1 Number of rotations

Description	Reports the number of complete rotations of the encoder.
Calculation method	Counts a rotation when an unbroken sequence of 'number of pulses per rotation' same direction pulses is received.
Analysis in zones	Counts a rotation when an unbroken sequence of 'number of pulses per rotation' same direction pulses is received and the animal is in the zone for the entire sequence.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of rotations that ENDED during the time period.
Units	None
Notes	None

10.2 Number of clockwise rotations

Description	Reports the number of complete clockwise rotations of the encoder.
Calculation method	Counts a rotation when an unbroken sequence of 'number of pulses per rotation' clockwise pulses is received.
Analysis in zones	Counts a rotation when an unbroken sequence of 'number of pulses per rotation' clockwise pulses is received and the animal is in the zone for the entire sequence.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of clockwise rotations that ENDED during the time period.
Units	None
Notes	None

10.3 Number of anti-clockwise rotations

Description	Reports the number of complete anti-clockwise rotations of the encoder.
Calculation method	Counts a rotation when an unbroken sequence of 'number of pulses per rotation' anti-clockwise pulses is received.
Analysis in zones	Counts a rotation when an unbroken sequence of 'number of pulses per rotation' anti-clockwise pulses is received and the animal is in the zone for the entire sequence.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of anti-clockwise rotations that ENDED during the time period.
Units	None

Notes	None

10.4 Number of reversals

Description	Reports the number of times the direction of the encoder changed.
Calculation method	Counts the number of times a clockwise pulse was followed by an anti-clockwise pulse and vice versa.
Analysis in zones	Counts the number of times a clockwise pulse was followed by an anti-clockwise pulse and vice versa when the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of reversals that occurred during the time period.
Units	None
Notes	None

10.5 Number of half rotations

Description	Reports the number of half rotations of the encoder.
Calculation method	Counts a half rotation when an unbroken sequence of 'number of pulses per rotation' divided by two, same direction pulses is received.
Analysis in zones	Counts a half rotation when an unbroken sequence of 'number of pulses per rotation' divided by two, same direction pulses is received and the animal is in the zone for the entire sequence.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of half rotations that ENDED during the time period.
Units	None
Notes	If the number of pulses per rotation is not exactly divisible by 2 then the result is rounded down. This can yield some inaccuracy. Consider when the number of pulses per rotation is 5, then the number of pulses per half rotation will be considered to be 5/2 = 2.5, which rounded down = 2. So after 2 same direction pulses a half rotation will be counted, thus after 2 complete rotations 5 half rotations will be counted, when the correct value is 4. For this reason it is not recommended to use encoders with a number of pulses per rotation (PPR) that is not divisible by 2. Fortunately many encoders use binary powers for their PPR, for example 16, 32, 64, etc.

10.6 Number of quarter rotations

Description	Reports the number of quarter rotations of the encoder.
Calculation method	Counts a quarter rotation when an unbroken sequence of 'number of pulses per rotation' divided by four, same direction pulses is received.

Analysis in zones	Counts a quarter rotation when an unbroken sequence of 'number of pulses per rotation' divided by four, same direction pulses is received and the animal is in the zone for the entire sequence.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of quarter rotations that ENDED during the time period.
Units	None
Notes	If the number of pulses per rotation is not exactly divisible by 4 then the result is rounded down. This can yield some inaccuracy. Consider when the number of pulses per rotation is 5, then the number of pulses per quarter rotation will be considered to be 5/4 = 1.25, which rounded down = 1. So after 1 pulses a quarter rotation will be counted, thus after 4 complete rotations 20 quarter rotations will be counted, when the correct value is 4. For this reason it is not recommended to use encoders with a number of pulses per rotation that is not divisible by 4. Fortunately many encoders use binary powers for their Pulses Per Rotation, for example 16, 32, 64, etc.

10.7 Maximum RPM

Description	Reports the maximum rotational velocity of the encoder in units of revolutions per minute.
Calculation method	Starts with a single pulse of a certain direction. Then counts the number of consecutive same direction pulses until at least 200 milliseconds has elapsed. Uses the elapsed time and the number of pulses detected during it to calculate the rotational velocity. This value is averaged (using a moving average) over three values and this is the instantaneous rotational velocity. The highest instantaneous rotational velocity is the maximum RPM.
Analysis in zones	The highest instantaneous rotational velocity while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the maximum value determined during the time period.
Units	Revolutions per minute
Notes	A rotary encoder has an inherent maximum rotational velocity above which the encoder will not be read accurately. This value is reported on the I/O page when an encoder is selected. In fact, strictly speaking, this is a limitation of the interface that reads the encoder and not of the encoder itself. For example, when reading a 32 PPR encoder with the ANY-maze interface, the maximum RPM is 416, which is approximately 7 revolutions per second (enough for most likely situations in behavioural research). Note that using an encoder with half as many pulses per rotation will double this value.

10.8 Minimum RPM

Description	Reports the minimum rotational velocity of the encoder in units of revolutions per minute.
Calculation method	Starts with a single pulse of a certain direction. Then counts the number of consecutive same direction pulses until at least 200 milliseconds has elapsed. Uses the elapsed time and the number of pulses detected during it to calculate the rotational velocity. This value is averaged (using a moving average) over three values and this is the instantaneous rotational velocity. The lowest instantaneous rotational velocity is the minimum RPM.
Analysis in zones	The lowest instantaneous rotational velocity while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the minimum value determined during the time period.
Units	Revolutions per minute
Notes	If the encoder stops turning the this value will be zero.

10.9 Average RPM

Description	Reports the average rotational velocity of the encoder in units of revolutions per minute.
Calculation method	Starts with a single pulse of a certain direction. Then counts the number of consecutive same direction pulses until at least 200 milliseconds has elapsed. Uses the elapsed time and the number of pulses detected during it to calculate the rotational velocity. This value is averaged (using a moving average) over three values and this is the instantaneous rotational velocity. The instantaneous rotational velocity is averaged throughout the test to yield this measure (see notes).
Analysis in zones	The average of the instantaneous rotational velocity values reported while the animal was in the zone (see notes).
Analysis across time	This measure can be analysed across time. For any time period the result is the average of the instantaneous rotational velocity values reported during the time period (see notes).
Units	Revolutions per minute
Notes	The averaging of the instantaneous rotational velocity (IRV) values uses a time based averaging technique, such that the average is the sum of each IRV values multiplied by the time between two consecutive values divided by the sum of the time between all values. This is required because the IRV values are not reported at a fixed frequency.

10.10 Degrees of clockwise rotation

Description	Reports the number of degrees of clockwise rotation of the encoder.

Calculation method	For each clockwise pulse of the encoder adds '360 / Number Pulses Per Rotation' to the result.
Analysis in zones	The number of degrees of clockwise rotation of the encoder while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is updated for each clockwise pulse that occurred during the time period.
Units	Degrees
Notes	This result is useful because it provides fine resolution (compared to number of rotations) while being normalised for all encoders (unlike number of pulses).

10.11 Degrees of anti-clockwise rotation

Description	Reports the number of degrees of anti-clockwise rotation of the encoder.
Calculation method	For each anti-clockwise pulse of the encoder adds '360 / Number Pulses Per Rotation' to the result.
Analysis in zones	The number of degrees of anti-clockwise rotation of the encoder while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is updated for each anti-clockwise pulse that occurred during the time period.
Units	Degrees
Notes	This result is useful because it provides fine resolution (compared to number of rotations) while being normalised for all encoders (unlike number of pulses).

10.12 Distance (only applies to running wheels)

Description	Reports the distance the animal 'travelled'.
Calculation method	The number of rotations multiplied by the circumference of the wheel.
Analysis in zones	The distance the animal 'travelled' in the wheel while it was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of rotations that occurred during the time period multiplied by the circumference of the wheel.
Units	Metres
Notes	This result is only available if the device which includes the rotary encoder reports a circumference - this feature is only supported by some running wheels.

11 Movement detector measures

11.1 Count

Description	Reports the number of times beams in the movement detectors photobeam array were broken
Calculation method	Counts breaks reported by the photobeam array. Note that ANY-maze does NOT count repeated breaks of the same beam - this is to avoid counting small oscillatory movements of the animal's body as *movement* (i.e. as in changes of location). For example, consider an animal that moves across the area covered by a photobeam array: we would see beam 1 broken, then beam 2, then beam 3, etc. Now consider an animal that is sitting in one place and grooming, it's leg might keep breaking the same beam again and again, this would not be counted as movement.
Analysis in zones	Not available
Analysis across time	This measure can be analysed across time. For any time period the result is the number of counts that occurred during the time period.
Units	None
Notes	None

11.2 Time moving

Description	Reports the amount of time that the animal was moving
Calculation method	Sums the durations of all the individual bouts of movement.
Analysis in zones	Not available
Analysis across time	This measure can be analysed across time. For any time period the result is the duration of the movement within the time period.
Units	Seconds
Notes	Movements are detected by a beam being broken. This is necessarily an instantaneous event, but it is deemed to mean that the animal is moving and will continue to do so for a certain period (the movement detector's time-out). If another beam is broken within this period then the animal is deemed to still be moving and so the movement bout extends to include this break. This continues until no break occurs within the timeout period, when the bout is then deemed to end. This mechanism is described in detail in this topic.

11.3 Latency to first beam break

Description	Reports the latency to the first beam being broken in the test - i.e. the first bout of movement.

Calculation method	The time up to the first beam break *during* the test is measured.
Analysis in zones	Not available
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	Beams that are already broken at the test start have no effect on this measure.

12 Output switch measures

Each Output switch measure is available for the apparatus as whole (i.e. irrespective of where the animal was when the output switch activation occurred) and also for each defined zone.

12.1 Number of activations

Description	Reports the number of times the switch was activated.
Calculation method	Counts the number of activations.
Analysis in zones	Counts the number of activations when the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of activations during the time period.
Units	None
Notes	None

12.2 Time active

Description	Reports the total amount of time that the switch was active.
Calculation method	Sums the amount of time for which the switch was active.
Analysis in zones	Sums the amount of time for which the switch was active while the animal was in the zone. For a particular zone it's possible for the *Time active* to be non-zero while the Number of activations is zero. This can occur if the animal enters the zone when the switch is active. In this case the time the switch is active will be registered but the activation itself won't be.
Analysis across time	This measure can be analysed across time. For any time period the result is the amount of time that the switch was active during the period. For a particular time period it's possible for the *Time active* during the period to be non-zero while the Number of activations for the period is zero. This can occur if the switch is already active at the start of the period. In this case the time the switch is active will be registered but the activation itself won't be.
Units	Seconds
Notes	None

12.3 Latency to first activation

Description	Reports the amount of time that elapsed in the test before the switch was activated for the first time.

Calculation method	The value of the test clock at the first activation of the switch.
Analysis in zones	The value of the test clock at the first activation of the switch that occurred while the animal was within the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

12.4 Latency to first deactivation

Description	Reports the amount of time that elapsed in the test before the switch was deactivated for the first time.
Calculation method	The value of the test clock at the first switch deactivation.
Analysis in zones	The value of the test clock at the first switch deactivation that occurred while the animal was within the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

12.5 Longest activation

Description	Reports the duration of the longest period for which the switch was continuously active.
Calculation method	The duration of each switch activation is calculated and the largest value is found.
Analysis in zones	The longest period for which the switch was continuously active while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the longest period for which the switch was continuously active during the period.
Units	Seconds
Notes	None

12.6 Shortest activation

Description	Reports the duration of the shortest period for which the switch was continuously active.
Calculation method	The duration of each switch activation is calculated and the smallest value is found.
Analysis in zones	The shortest period for which the switch was continuously active while the animal was in the zone.

Analysis across time	This measure can be analysed across time. For any time period the result is the shortest period for which the switch was continuously active during the period.
Units	Seconds
Notes	None

12.7 Average activation duration

Description	Reports the average duration for which the switch was active.
Calculation method	Calculated by dividing the Time active by the Number of activations.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

12.8 Frequency of activations

Description	Reports the frequency with which the switch was activated.
Calculation method	Calculated by dividing the Number of activations by the *Test duration*.
Analysis in zones	Calculated by dividing the Number of activations in the zone by the *Total time in the zone*.
Analysis across time	This measure can be analysed across time. For any time period the result is the Number of activations which occurred during the period divided by the period's duration.
Units	Hertz
Notes	None

13 Syringe pump measures

13.1 Volume infused

Description	The total volume infused by the syringe pump.
Calculation method	The sum of the amounts infused each time the pump was run in the infuse direction during the test. The amount infused is calculated by multiplying the infusion rate by the amount of time the pump was running.
Analysis in zones	The volume infused while the animal was in the zone.
Analysis across time	This measure can be analysed across time. The result for a time period is the total volume infused during the time period.
Units	Microlitres
Notes	None.

13.2 Volume withdrawn

Description	The total volume withdrawn by the syringe pump.
Calculation method	The sum of the amounts withdrawn each time the pump was run in the withdraw direction during the test. The amount withdrawn is calculated by multiplying the withdrawl rate by the amount of time the pump was running.
Analysis in zones	The volume withdrawn while the animal was in the zone.
Analysis across time	This measure can be analysed across time. The result for a time period is the total volume withdrawn during the time period.
Units	Microlitres
Notes	Not all syringe pumps can be run in the withdraw direction. For those that can't, the result of this measure will always be zero.

14 OPAD measures

OPAD measures are only available when ANY-maze is operating OPAD mode.

14.1 Temperature when contact broken

Description	The average temperature at which the animal broke contact with the thermal elements
Calculation method	Each time the animal breaks contact the temperature of the thermal elements is noted. The result is the average of all the noted values
Analysis across time	This measure can be analysed across time. The result for a time period is the average temperature at which the animal broke contact for all the breaks which occurred during the time period.
Units	Seconds
Notes	If OPAD is being used with independent control of the left and right thermal elements, then this measure will be reported independently for the left and right sides.

14.2 Temperature of interest: time in contact

Description	Reports the amount of time the animal was in contact with the thermal elements when the elements' temperature was within the bounds of the specific temperature of interest.
Calculation method	Each time the animal makes contact and the thermal elements are within the bounds of the temperature of interest (or when the animal is already in contact and the temperature changes to be within the bounds of the temperature of interest) a timer is started. Whenever the animal breaks contact (or the animal is in contact and the temperature changes to be outside the bounds of the temperature of interest) then the timer is stopped. The duration of each timed bout is summed to give the total time in contact.
Analysis across time	This measure can be analysed across time
Units	Seconds
Notes	If OPAD is being used with independent control of the left and right thermal elements, then this measure will be reported independently for the left and right sides.

14.3 Temperature of interest: number of times contact broken

Description	Reports the number of times that the animal broke contact with the thermal elements when the elements' temperature was within the bounds of the specific temperature of interest.
Calculation method	Each time the animal breaks contact with the thermal elements and the elements are within the bounds of the temperature of interest a counter is increased.
Analysis across time	This measure can be analysed across time
Units	None
Notes	If OPAD is being used with independent control of the left and right thermal elements, then this measure will be reported independently for the left and right sides.

14.4 Temperature of interest: number of times contact made

Description	Reports the number of times that the animal made contact with the thermal elements when the elements' temperature was within the bounds of the specific temperature of interest.
Calculation method	Each time the animal makes contact with the thermal elements and the elements are within the bounds of the temperature of interest a counter is increased.
Analysis across time	This measure can be analysed across time
Units	None
Notes	If OPAD is being used with independent control of the left and right thermal elements, then this measure will be reported independently for the left and right sides.

14.5 Temperature of interest: number of licks

Description	Reports the number of licks that occurred while the thermal elements' temperature was within the bounds of the specific temperature of interest.
Calculation method	Each time the animal licks and the thermal elements are within the bounds of the temperature of interest a counter is increased.
Analysis across time	This measure can be analysed across time
Units	None
Notes	If OPAD is being used with independent control of the left and right thermal elements, then this measure will be reported independently for the left and right sides.

14.6 Number of non-lick contacts

Description	Reports the number of licks that occurred when the animal was not making contact with the thermal elements.
Calculation method	Each time the animal licks, if it is not in contact with the thermal elements, a counter is increased.
Analysis across time	This measure can be analysed across time
Units	None
Notes	None

15 Procedure measures

Unlike almost all other measures in ANY-maze, procedure measures do not update to reflect post-test changes in the procedure definition. Therefore procedure measures are always based on the procedure that was in force when the test was performed.

Procedures don't have any measures defined themselves, but you can create your own measures by using *result variables*. These are essentially numeric values that your procedure can set as it runs, and these values can then be included in ANY-maze result analysis.

Once a procedure has been set up to use a result variable, a number of measures will be available for analysis:

If the result variable is set up to be noted 'only once, at the end of the test', then the following measure will be available for it:

- Value

If the result variable is set up to be noted 'every time it is changed by the procedure' or 'only when explicitly set', then the following measures will be available for it:

- Average value
- Maximum value
- Minimum value
- Sum of values
- Count of values

15.1 Value

Description	Reports the value of the result variable at the end of the test.
Calculation method	The value of the result variable at the end of the test. If the value is never noted, the value will be reported as 0 (since result variables are initialised to 0 at the start of a test).
Analysis in zones	The value of this result variable, if the animal is in the zone at the end of the test. If the animal is not in the zone at the end of the test, the value will be undefined.
Analysis across time	This measure cannot be analysed across time.
Units	No units defined; this is dependent on how the procedure calculates the value of this result variable.
Notes	This measure is only available if the result variable is set up to be noted 'only once, at the end of the test'.

15.2 Average value

Description	Reports the average value of the result variable.
Calculation method	Simple average of the values noted by the procedure during the test.

	If the value is never noted, the average will be undefined.
Analysis in zones	Average of the values reported while the animal is in the zone. If the value is never noted while the animal is in the zone, the average will be undefined.
Analysis across time	This measure can be analysed across time. The result is the average of the values reported during the time period. If the value is never noted during the time period, the average will be undefined.
Units	No units defined; this is dependent on how the procedure calculates the value of this result variable.
Notes	This measure is only available if the result variable is set up to be noted 'every time it is changed by the procedure' or 'only when explicitly set'.

15.3 Maximum value

Description	Reports the maximum value of the result variable noted by the procedure during the test.
Calculation method	The largest value of the result variable noted by the procedure during the test. If the value is never noted, the maximum value will be 0 (since result variables are initialised to 0 at the start of a test).
Analysis in zones	The largest value reported while the animal is in the zone. If the value is never noted while the animal is in the zone, the maximum value will be undefined.
Analysis across time	This measure can be analysed across time. The result is the largest of the values reported during the time period. If the value is never noted during the time period, the maximum value will be undefined.
Units	No units defined; this is dependent on how the procedure calculates the value of this result variable.
Notes	This measure is only available if the result variable is set up to be noted 'every time it is changed by the procedure' or 'only when explicitly set'.

15.4 Minimum value

Description	Reports the minimum value of the result variable noted by the procedure during the test.
Calculation method	The smallest value of the result variable noted by the procedure during the test. If the value is never noted, the minimum value will be 0 (since result variables are initialised to 0 at the start of a test).
Analysis in zones	The smallest value reported while the animal is in the zone.

	If the value is never noted while the animal is in the zone, the minimum value will be undefined.
Analysis across time	This measure can be analysed across time. The result is the smallest of the values reported during the time period. If the value is never noted during the time period, the minimum value will be undefined.
Units	No units defined; this is dependent on how the procedure calculates the value of this result variable.
Notes	This measure is only available if the result variable is set up to be noted 'every time it is changed by the procedure' or 'only when explicitly set'.

15.5 Sum of values

Description	Reports the total sum of the result variable's values during the test.
Calculation method	Every time the result variable is noted, the value is added to the ongoing sum. If the value is never noted, the sum of values will be 0 (since result variables are initialised to 0 at the start of a test).
Analysis in zones	The sum of the values reported while the animal is in the zone. If the value is never noted while the animal is in the zone, the sum will be 0.
Analysis across time	This measure can be analysed across time. The result for a time period is the total sum of all values of the result variable that are noted during the time period. If the value is never noted during the time period, the sum of values will be 0 (since a user-defined variable is always initialised to 0).
Units	No units defined; this is dependent on how the procedure calculates the value of this result variable.
Notes	This measure is only available if the result variable is set up to be noted 'every time it is changed by the procedure' or 'only when explicitly set'.

15.6 Count of values

Description	Reports the total number of times during the test that the result variable was noted.
Calculation method	Each time the result variable is noted, a counter is incremented. If the value is never noted, the count of values will be 0.
Analysis in zones	Counts the number of times the result variable is noted while the animal is in the zone. If the value is never noted while the animal is in the zone, the count will be 0.
Analysis across time	This measure can be analysed across time. The result for a period is the number of times the result variable is noted during the period.

	If the value is never noted during this time period, the count of values will be 0.
Units	None; this is simply a count of the number of times that a result variable was set by a procedure.
Notes	This measure is only available if the result variable is set up to be noted 'every time it is changed by the procedure' or 'only when explicitly set'.

16 Event measures

Events and actions have been replaced by Procedures, *but they are documented here as they can still be used in legacy experiments.*

Unlike almost all other measures in ANY-maze, event measures do not update to reflect post-test changes in the event definition. Therefore event measures are always based on the event definition that was in force when the test was performed.

16.1 Number of events

Description	Reports the number of times an event occurred.
Calculation method	Each time the event occurs, a counter is incremented.
Analysis across time	This measure can be analysed across time. The result for a period is the number of times the event occurred during the period.
Units	None
Notes	Event measures only report events which were detected while a test was being performed. Unlike almost all other measures, an event measure will not update to reflect post-test changes in the event definition.

16.2 Latency to first event

Description	Reports the latency to the first occurrence of an event.
Calculation method	When the event occurs the test time is noted as the latency. If the event doesn't occur during the test then the result is undefined.
Analysis across time	This measure can be analysed across time. The result for a period is the time within the period that the event first occurred. If the event doesn't occur during the time period then the result is undefined.
Units	Seconds
Notes	Event measures only report events which were detected while a test was being performed. Unlike almost all other measures, an event measure will not update to reflect post-test changes in the event definition.

17 Virtual switch measures

Most virtual switch measures are available for the apparatus as whole (i.e. irrespective of where the behaviour occurred) and also for each defined zone*. For example, if a protocol includes two zones called 'Left' and 'Right' and a virtual switch has been defined for 'Moving fast', then the following sets of measures will be available:

- The measures listed above for moving fast anywhere in the apparatus.
- The measures listed above* for moving fast in the left zone.
- The measures listed above* for moving fast in the right zone.

**Except for Average activation duration and Distance travelled before 1st activation, which are only available for the apparatus as a whole.*

17.1 Number of activations

Description	Reports the number of times the virtual switch was activated (turned on).
Calculation method	Counts the number of activations.
Analysis in zones	Counts the number of times the virtual switch was activated while the animal was in the zone. Note, that if the virtual switch is active when the animal enters the zone, an activation will not be counted.
Analysis across time	This measure can be analysed across time. For any time period the result is the number of activations during the time period.
Units	None
Notes	None

17.2 Time active

Description	Reports the total amount of time the virtual switch was active.
Calculation method	Sums the duration of each activation of the virtual switch.
Analysis in zones	Sums the amount of time for which the virtual switch was active when the animal was in the zone. For a particular zone it's possible for the *Time active* to be non-zero while the Number of activations is zero. This can occur if the animal enters the zone when the virtual switch is active. In this case the time the virtual switch is active in the zone will be registered, but the activation itself won't be (as it didn't occur in the zone).
Analysis across time	This measure can be analysed across time. For any time period the result is the amount of time that the virtual switch was active during the period. For a particular time period it's possible for the *Time active* during the period to be non-zero while the Number of activations for the period is zero. This can occur if

	the virtual switch is already active at the start of the period. In this case the time the virtual switch is active will be registered, but the activation itself won't be.
Units	Seconds
Notes	None

17.3 Latency to first activation

Description	Reports the amount of time that elapsed in the test before the virtual switch was activated for the first time.
Calculation method	The value of the test clock at the first activation.
Analysis in zones	The value of the test clock at the first activation that occurred when the animal was in the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

17.4 Latency to first deactivation

Description	Reports the amount of time that elapsed in the test before the virtual switch was deactivated for the first time.
Calculation method	The value of the test clock at the first deactivation.
Analysis in zones	The value of the test clock at the first deactivation that occurred when the animal was in the zone.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

17.5 Longest activation

Description	Reports the duration of the longest period for which the virtual switch was continuously active.
Calculation method	The duration of each activation is calculated and the largest value is found.
Analysis in zones	The longest period for which the virtual switch was continuously active while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the longest period for which the virtual switch was continuously active during the period.
Units	Seconds

Notes	None

17.6 Shortest activation

Description	Reports the duration of the shortest period for which the virtual switch was continuously active.
Calculation method	The duration of each activation is calculated and the smallest value is found.
Analysis in zones	The shortest period for which the virtual switch was continuously active while the animal was in the zone.
Analysis across time	This measure can be analysed across time. For any time period the result is the shortest period for which the virtual switch was continuously active during the period.
Units	Seconds
Notes	None

17.7 Average activation duration

Description	Reports the average duration for which the virtual switch was held active.
Calculation method	Calculated by dividing the Time active by the Number of activations.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Seconds
Notes	None

17.8 Frequency of activations

Description	Reports the frequency with which the virtual switch was activated.
Calculation method	Calculated by dividing the Number of activations by the *Test duration*.
Analysis in zones	Calculated by dividing the Number of activations in the zone by the *Total time in the zone*.
Analysis across time	This measure can be analysed across time. For any time period the result is the Number of activations which occurred during the period divided by the period's duration.
Units	Hertz
Notes	None

17.9 Distance travelled before 1st activation

Description	Reports the distance the animal had travelled in the apparatus up to the moment the virtual switch was first activated.
Calculation method	The accumulated total distance travelled is noted at the time of the first activation.
Analysis in zones	This measure cannot be analysed in zones.
Analysis across time	This measure cannot be analysed across time.
Units	Metres
Notes	None

17.10 Distance travelled while active

Description	Reports the distance the animal travelled in the apparatus while the virtual switch was active.
Calculation method	While virtual switch is active, the distance travelled is accumulated.
Analysis in zones	Calculated by summing the distance the animal travelled while in the zone when the virtual switch was active.
Analysis across time	This measure can be analysed across time. For any time period the result is the distance the animal travelled during the time period while the virtual switch was active.
Units	Metres
Notes	None