Uses of the Event Wizard

Event Designer

This tool allows the user to design up to 16 independently targetable threshold/voice modules, which supplement the 32 built-in threshold/voice modules in the BrainMaster 2.5 software. It is based on the real-time EEG processing provided by the BrainMaster 2.5SE software. Using the built-in processing modules and controls, the Event Wizard allows the user to tap into the data at any of a wide range of places, and to design control variables and feedback with a wide variety of options.

The conceptual plan of the internal signal processing in the BrainMaster 2.5SE software is as follows:



BrainMaster 2.5SE with Event Wizard

The BrainMaster 2.5SE software provides all of these processing modules at all times, as part of the built-in monitoring and control functions. These elements provide the equivalent of hundreds of individual signal processing objects, in a single, integrated system. With the Event Wizard, users are able to define complex protocols and sequences of operations, using an intuitive and extensible interface. All of the built-in functions (8 adjustable frequency bands per channel, autothresholding, real-time coherence and phase metrics, etc) are available under the Event Wizard, where they can

be used as training variables, thresholds, or in equations and expressions defining new quantities or functions.

Using the Event Designer, protocols can be created to respond to any of the following components. Note: All components will be available for Channel 1, Channel 2, Sum (Channel 1 + 2) (forthcoming), and Difference (Channels 1 - 2) (forthcoming). We may also include channel multiplication / division at the EEG signal level if desired

Components (8 adjustable bands): Delta, Theta, Alpha, Lobeta, Beta, Hibeta, Gamma, User

Values:

Amplitude (uV computed via quadrature filtering) Modal Frequency (Hz, computed via FFT) % Energy (%, computed via FFT) Threshold (from built-in threshold system) % Time over threshold (from built-in autothresholding system) Variability (forthcoming) Etc.

When 2 channels are used: For Channels 1, Channel 2, and for the Sum and difference "virtual" channels: Coherence Similarity Phase Comodulation (forthcoming) Etc.

The user interface provides the ability to apply scale factors, offset factors, and damping factors independently to the components, for use in tailoring training protocols.

Z scores are also available via. the NeuroGuide real-time interface (forthcoming)

Other criteria that can be used for events include:

Time elapsed in session Points earned in session

The Event Condition is defined using the control panel that provides selections of channel, component, value, and user-defined values to control the signal processing. The Condition consists generally of the comparison of two values. Either value may be any available component, with adjustable scale and offset factors, and each value has its own damping factor. The Condition is stated in terms of "IF (value1) (Rule) (value2) THEN". Where value1 and value2 may be defined as a wide range of values and computations, under user control.

Once the Condition is defined, the Event Wizard makes it possible to define "Result" events that follow when the Condition is met. The results include producing MIDI sounds with up to 128 voices and 88 notes, playing sound files, displaying messages (forthcoming), changing protocols (forthcoming), etc.

Event Text Panel

This panel displays the status of the built-in components (delta, theta, etc), as well as any events that have been enabled. It is useful as a real-time indicator of current levels, percent energy, and percent time that events meet their conditions, etc.

Event Trend Viewer

The Event Trend Viewer automatically displays the enabled events as an optional panel on the BrainMaster Training Screen. It can be viewed alongside any other panels as desired.

🔯 Training/Control Screen - BrainMaster 2.5SE	
<u>D</u> ata D <u>i</u> splay <u>F</u> req.Bands <u>C</u> olor <u>S</u> ound	
GO STOP Window Clock: 19	:08 Points: 000 Close
System is Idling	
reaning many man my providing the way the way to	may many for the proper of the second second
Component Ampl(u¥) %	Full Scale: 12.8 microvolts
Delta (0.5-4.0): 4.8 5 Theta (4.0-8.0): 6.2 11 Alpha (8.0-12.0): 5.9 12 Lobeta (12.0-16.0): 4.2 7 Beta (16.0-20.0): 6.7 11 Hibeta (20.0-24.0): 6.1 13 Gamma (28.0-32.0): 3.4 7 User (20.0-32.0): 12.0 32	10.0
EVENT CONDITIONS: VALUE % Time 1 if CH1:A:uV LT 5.0 do tone : 5.1 17 2 if CH1:A:uV GT 5.0 do tone : 5.1 82 3 if CH1:A:uV GT 5.5 do tone : 5.1 50 4 if CH1:A:uV GT 6.0 do tone : 5.1 28 5 if CH1:A:uV GT 6.5 do tone : 5.1 9 6 if CH1:A:uV GT 11.0 do tone : 5.1 0 7 if CH1:A:uV GT 11.2 do tone : 5.1 0 8 if CH1:A:uV GT 12.0 do tone : 5.1 0 9 if CH1:A:uV GT 12.0 do tone : 5.1 0	Events 1-9: CHAN 1 Alpha Amplitude

Uses of the Event Wizard

Dynamic Thresholding:

The following screen uptrains alpha by using a damped version of the alpha amplitude as the threshold:

🔯 Training/Control Screen for B	rainMaster 2.5
<u>D</u> ata D <u>i</u> splay <u>F</u> req.Bands <u>C</u> olor <u>S</u> o	und
GO STOP Window	Clock: 19:01 Points: 000 Close
Custom in Idling	Chaoli Sizzal
System is luning	
Component Ampl(uV) Delta (0.5-4.0): 4.3 Theta (4.0-8.0): 7.9 Alpha (8.0-12.0): 4.9 Lobeta (12.0-16.0): 5.1 Beta (16.0-20.0): 18.4 Hibeta (20.0-24.0): 5.4 Gamma (28.0-32.0): 6.3 User (20.0-32.0): 24.7 EVENT CONDITIONS: 1 if CH2:A:uV GT 7.7 do tone	% Full Scale: 18.5 microvolts Energy 1 2 4 4 4 6 17 VALUE % 10.0 Time 10.0
	۲ Event: 1, C: CHAN 2 Alpha Amplitude

As shown in the Event Designer screen, the alpha is damped with a factor of 20, then added to an offset of 2.0 microvolts, to cause it to be more challenging. As a result, the % time over threshold is around 30%. A single continuous tone signals when the instantaneous value of the envelope exceeds the dynamic threshold.

Event Wizard for BrainMaster - Preliminary 11/17/05

Multiple Thresholding:

By defining events that respond to a given component, but use different thresholds, it is possible to put up to 16 independent thresholds (with MIDI voices, etc)., on one component. This facilitates sensitive level training, for any component such as amplitude, frequency, and so on.

🔯 Training/Control Screen for B	BrainMaster 2.5
<u>D</u> ata D <u>i</u> splay <u>F</u> req.Bands <u>C</u> olor <u>S</u> ou	ound
GO STOP Window	Clock: 19:09 Points: 000 Close
System is Idling	Check Signal
Component Ampl(uV)	Full Scale: 8.9 microvoltss Energy 1
Defta [0.5-4.0]: 5.3 Theta [4.0-8.0]: 6.9 Alpha [8.0-12.0]: 7.0 Lobeta [12.0-16.0]: 6.0 Beta [16.0-20.0]: 8.5 Hibeta [20.0-24.0]: 9.3 Gamma [28.0-32.0]: 7.5 User [20.0-32.0]: 19.1 EVENT CONDITIONS: 1 if CH2:A:uV GT 6.0 do tone : 2 if CH2:A:uV LT 6.0 do tone : 3 if CH2:A:uV LT 5.5 do tone : 4 if CH2:A:uV LT 5.0 do tone : 5 if CH2:A:uV LT 4.5 do tone : 6 if CH2:A:uV LT 4.0 do tone :	$ \begin{array}{c} 1 \\ 3 \\ 3 \\ 2 \\ 4 \\ 5 \\ 5 \\ 17 \\ \hline VALUE \% \\ Time 5.0 \\ \hline 4.9 27 \\ 4.9 66 \\ 4.9 51 \\ 4.9 18 \\ 4.9 5 \\ \hline 4.9 5 \\ \hline 4.0 $
	Events 1-6: CHAN 2 Alpha Amplitude

The trainee hears one of two things:

A soft organ tone when alpha is above 6.0, or Piano notes walking down the keyboard as the alpha amplitude decreases.

The first 6 events are defined to "look at" the same component, i.e. Channel 1 Alpha Amplitude. As a result, the Event Trend Display combines the events into one plot.

The Trend Text display shows the percent time in criterion for each event. Note that this is the time that the component meets the rule ("less than", "greater than"), etc., not simply the time that the value is above threshold.

This type of training can be used with any available values including amplitude, frequency, relative energy (ratio training), and percent time over threshold. Regarding the use of percent time over threshold, it is possible to set fixed thresholds, and then us as the training signal the percentage of time the trainee exceeds that threshold. Thus, in certain types of training, it is possible to train up to a limit, at which, if the trainee is producing any particular component more or less than a given percentage of the time, a sound can be generated, etc.

💑 Event Designer for BrainMaster	
Event Number:	This Event Is: C 15 C 16
Event Condition: IF: Channel 1 Alpha Amplitude Damping Factor: Constant: 0 Scale Factor: 100 Offset: 0.0 Edit Equation Equation: RULE: IS LESS THAN Threshold: Delta Damping Factor: 0 Damping Factor: 0 Damping Factor: 0 Edit Equation Equation: Edit Equation Equation:	MIDI Sound Properties: Starting Note: 45 F (698.5) 1 to 88 Instrument: 0 Piano 1 128 choices Playing Style: Sustained Percus. or Sust. Modulation: Amplitude Ampl. or Pitch Starting Loudness: Levet 1 1 to 128 Loudness Change Rate: 410 10 to 10 Note Change Rate: 410 10 to 10 Musical Scale (Mode): Major (Ionian) 15 choices Musical Key: C C C to B Flat Play Note or Chord: 1 Note
Event Result: THEN: Play MIDI Sound	Enable All Events Disable All Events Clear All Events Show All Events Help Cancel

Training/Control Screen for BrainMaster 2.5 Data Display Freq.Bands Color Sound Points: GO STOP Window Clock: Close 000Artifact Seen! Please correct EEG signal! Full Scale: 26.6 microvolts Component Ampl(uV) % Energy Delta (0.5-4.0): 39.7 13 Theta (4.0-8.0): 10.9 15 20.0 Alpha (8.0-12.0): 11.0 18 Lobeta (12.0-16.0): 2.8 8 (16.0-20.0): Beta 5.6 1 Hibeta (20.0-24.0): 0 2.7 10.0 Gamma (28.0-32.0): 1.8 0 User (20.0-32.0): 2.1 0 EVENT CONDITIONS: VALUE % Events 1-9: CHAN 2 Alpha Ampli Time 1 if CH2:A:uV GT 12.0 do tone : 7.6 12 2 if CH2:A:uV LT 11.0 do tone : 7.6 81 3 if CH2:A:uV LT 10.0 do tone : 7.6 61 20.0 20.0 4 if CH2:A:uV LT 9.0 do tone : 7.6 37 5 if CH2:A:uV LT 8.0 do tone : 7.6 26 6 if CH2:A:uV LT 7.0 do tone : 7.6 9 10.07 if CH2:A:uV GT 15.0 do tone : 6 7.6 8 if CH2:A:uV GT 20.0 do tone : 7.6 0 9 if CH2:A:uV GT 18.0 do tone : 7.6 1 16 if CH2:D:uV GT 20.0 do art. : 36.0 23 Event 16: CHAN 2 Delta Amplitude

Further example of multiple thresholding:

This example plays descending notes if the trainee's alpha is falling below a set threshold level, and plays different notes when the alpha is above. When above threshold, the trainee hears first an organ tone, then a higher pipe organ tone, and finally a tubular bell, as the top threshold is reached. As the trainee attempts to achieve more bells during the session, the top bar provides an effective indicator of precise progress. Delta is used as an artifact detector, and shows in its own graph.

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1	Summary for Event 1: IF: Channel 2 Alpha Amplitude IS GREATER THAN Value: 120 THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 1 IS CURRENTLY: ENABLED
	Summary for Event 2: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 110 THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 2 IS CURRENTLY: ENABLED
	Summary for Event 3: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 100 THEN: Play MIDI Sound MODE: 2 NOTE: 44 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 3 IS CURRENTLY: ENABLED
	Summary for Event 4: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 90 THEN: Play MIDI Sound MODE: 2 NOTE: 43 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 4 IS CURRENTLY: ENABLED
	Summary for Event 5: IF: Channel 2 Alpha Amplitude IS LESS THAN Value; 80 THEN: Play MIDI Sound MODE: 2 NOTE: 42 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 5 IS CURRENTLY: ENABLED
	Summary for Event 6: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 70 THEN: Play MIDI Sound MODE: 2 NOTE: 41 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 6 IS CURRENTLY: ENABLED
	Summary for Event 7: IF: Channel 2 Alpha Amplitude IS GREATER THAN Value: 150 THEN: Play MIDI Sound MODE: 2 NOTE: 57 INSTR: 19 Church org. 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 7 IS CURRENTLY: ENABLED
	Summary for Event 8: IF: Channel 2 Alpha Amplitude IS GREATER THAN Value: 200 THEN: Play MIDI Sound MODE: 2 NOTE: 52 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 8 IS CURRENTLY: ENABLED
	OK J	

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⚠	Summary for Event 9: IF: Channel 2 Alpha Amplitude IS GREATER THAN Value: 180 THEN: Play MIDI Sound MODE: 2 NOTE: 64 INSTR: 14 Tubular bell STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 9 IS CURRENTLY: ENABLED
	Summary for Event 10: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 10 IS CURRENTLY: DISABLED
	Summary for Event 11: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 11 IS CURRENTLY: DISABLED
	Summary for Event 12: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 12 IS CURRENTLY: DISABLED
	Summary for Event 13: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 13 IS CURRENTLY: DISABLED
	Summary for Event 14: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 14 IS CURRENTLY: DISABLED
	Summary for Event 15: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 15 IS CURRENTLY: DISABLED
	Summary for Event 16: IF: Channel 2 Delta Amplitude IS GREATER THAN Value: 200 THEN: Signal Artifact	EVENT 16 IS CURRENTLY: ENABLED
	(OK	

Training two components against each other:

The following example trains alpha vs. theta, in a relaxation protocol.

🕱 Training/Control Screen for BrainMaster	2.5
<u>D</u> ata D <u>i</u> splay <u>F</u> req.Bands <u>C</u> olor <u>S</u> ound	
GO STOP Window Clock:	19:18 Points: 000 Close
System is Idling Component Ampl(uV) % Energy	Check Signal Full Scale: 10.7 microvolts
Delta (0.5-4.0): 6.4 2 Theta (4.0-8.0): 7.4 4 Alpha (8.0-12.0): 6.5 3 Lobeta (12.0-16.0): 10.9 2 Beta (16.0-20.0): 10.4 4 Hibeta (20.0-24.0): 7.4 5 Gamma (28.0-32.0): 13.1 7 User (20.0-32.0): 16.2 19	10.0 -
EVENT CONDITIONS: VALUE 9 Ti 1 if CH2:A:uV LT 5.6 do tone : 4.4 2 if CH2:A:uV GT 5.6 do tone : 4.4	6 me 72 26 () () () () () () () () () () () () ()
	Events 1-2: CHAN 2 Alpha Ampli

Asymmetry training:

This is achieved using a single event to control the reward feedback tone.

Data Display Freq.Bands Color System is Idling Clock: 19:22 Points: 000 Close System is Idling Check Signal Check Signal Full Scale: 15.4 microvolts Full Scale: 15.4 microvolts Component Ampl[uV] % Energy Full Scale: 15.4 microvolts Delta (0.5-4.0): 5.2 1 Full Scale: 15.4 microvolts Lobeta (12.0-16.0): 5.2 2 Energy Beta (16.0-20.0): 11.5 4 Hibeta (20.0-24.0): 4.1 4 Gamma (28.0-32.0): 10.8 18 EVENT CONDITIONS: VALUE % Time 1 if CH2:A:uV LT 6.0 do tone : 5.8 58 Lift CH2:A:uV LT 6.0 do tone : 5.8 58	Data Display Freq.Bands Color Sound
GO STOP Window Clock: 19:22 Points: 0.00 Close System is Idling Check Signal Component Ampl[uV] % Full Scale: 15.4 microvolts Delta (0.5-4.0]: 5.2 1 Theta (4.0-8.0): 13.8 4 Alpha (8.0-12.0): 3.6 3 Lobeta (12.0-16.0): 5.2 2 Beta (16.0-20.0): 11.5 4 Hibeta (20.0-24.0): 4.1 4 Gamma (28.0-32.0): 10.8 18 EVENT CONDITIONS: VALUE % Time 1 if CH2:A:uV LT 6.0 do tone : 5.8 58 Event: 1, C: CHAN 2 Alpha Ampli	
Check Signal Component Ampl(uV) % Energy Full Scale: 15.4 microvolts Delta (0.5-4.0): 5.2 1 Theta [4.0-8.0]: 13.8 4 Alpha (80-12.0): 3.6 3 Lobeta [12.0-16.0]: 5.2 2 Beta [16.0-20.0]: 11.5 4 Hibeta [20.0-24.0]: 4.1 4 Gamma [28.0-32.0]: 8.1 6 User [20.0-32.0]: 10.8 18 EVENT CONDITIONS: VALUE % Time 1 if CH2:A:uV LT 6.0 do tone : 5.8 58 Event: 1, C: CHAN 2 Alpha Ampli	GO STOP Window Clock: 19:22 Points: 000 Close
Delta (0.5-4.0): 5.2 1 Theta (4.0-8.0): 13.8 4 Alpha (8.0-12.0): 3.6 3 Lobeta (12.0-16.0): 5.2 2 Beta (16.0-20.0): 11.5 4 Hibeta (20.0-24.0): 4.1 4 Gamma (28.0-32.0): 8.1 6 User (20.0-32.0): 10.8 18 EVENT CONDITIONS: VALUE % Time 1 if CH2:A:uV LT 6.0 do tone : 5.8 58 10.0 - Model of the second sec	System is Idling Check Signal Component Ampl(uV) % Full Scale: 15.4 microvolts
	Energy Delta (0.5-4.0): 5.2 1 Theta (4.0-8.0): 13.8 4 Alpha (8.0-12.0): 3.6 3 Lobeta (12.0-16.0): 5.2 2 Beta (16.0-20.0): 11.5 4 Hibeta (20.0-24.0): 4.1 4 Gamma (28.0-32.0): 8.1 6 User (20.0-32.0): 10.8 18 EVENT CONDITIONS: VALUE % Time 1 if CH2:A:uV LT 6.0 do tone : 5.8 58 10.0 - - 0 - - 0 - - 1 if CH2:A:uV LT 6.0 do tone : 5.8 58 10.0 - - Event: 1, C: CHAN 2 Alpha Ampli -

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1	Summary for Event 1: IF: Channel 2 Alpha Amplitude IS LESS THAN Channel 1 Theta Amplitude THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 1 IS CURRENTLY: ENABLED
	Summary for Event 2: IF: Channel 2 Alpha Amplitude IS GREATER THAN Channel 1 Theta Amplitude THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 102 Echo Drops STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 2 IS CURRENTLY: ENABLED
	Summary for Event 3: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 55 THEN: Play MIDI Sound MODE: 2 NOTE: 44 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 3 IS CURRENTLY: DISABLED
	Summary for Event 4: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 50 THEN: Play MIDI Sound MODE: 2 NOTE: 43 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 4 IS CURRENTLY: DISABLED
	Summary for Event 5: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 45 THEN: Play MIDI Sound MODE: 2 NOTE: 42 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 5 IS CURRENTLY: DISABLED
	Summary for Event 6: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 40 THEN: Play MIDI Sound MODE: 2 NOTE: 41 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 6 IS CURRENTLY: DISABLED
	Summary for Event 7: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 7 IS CURRENTLY: DISABLED
	Summary for Event 8: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 8 IS CURRENTLY: DISABLED
	OK	

Event Designer for Brainmaster	
Event Number: • 1	This Event Is: • 14 C 15 C 16 • Enabled C Disabled
Event Condition:	MIDI Sound Properties:
IF: Channel 1 Alpha Amplitude Damping Factor: Constant: 0 Scale Factor: 100 Offset: 0.0 Edit Equation: RULE: IS LESS THAN	Starting Note: 45 F (698.5) 1 to 88 Instrument: 16 Organ 1 128 choice Playing Style: Sustained Percus. or 9 Modulation: Amplitude Ampl. or Pite Starting Loudness: Level: 1 1 to 128 Loudness Chance Rate: +10 10 to +10
Channel 2 Alpha Amplitude Damping Factor: Dam	Note Change Rate: +10 -10 to +10
Threshold: 0 Scale Factor: 100 Offset: 0.0	Musical Scale (Mode): Major (Ionian) 🔄 15 choices
Edit Equation:	Musical Key: C _ C to B Flat Play Note or Chord: Note _ 1 to 8 Note
Event Result: THEN: Play MIDI Sound	Enable All Events Disable All Events
Event Summary:	Clear All Events Show All Events Print All Events
Summary for Event 1: EVENT 1 IS CURRENTLY: ENABLED IF: Channel 2 Alpha Amplitude IS LESS THAN Channel 2 Alpha Amplitude THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	Help Cancel Cancel

Event Wizard for BrainMaster - Preliminary 11/17/05

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⚠	Summary for Event 1: IF: Channel 2 Alpha Amplitude IS GREATER THAN Value: 60 THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 16 Organ 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 1 IS CURRENTLY: ENABLED
	Summary for Event 2: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 60 THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 2 IS CURRENTLY: ENABLED
	Summary for Event 3: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 55 THEN: Play MIDI Sound MODE: 2 NOTE: 44 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 3 IS CURRENTLY: ENABLED
	Summary for Event 4: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 50 THEN: Play MIDI Sound MODE: 2 NOTE: 43 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 4 IS CURRENTLY: ENABLED
	Summary for Event 5: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 45 THEN: Play MIDI Sound MODE: 2 NOTE: 42 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 5 IS CURRENTLY: ENABLED
	Summary for Event 6: IF: Channel 2 Alpha Amplitude IS LESS THAN Value: 40 THEN: Play MIDI Sound MODE: 2 NOTE: 41 INSTR: 0 Piano 1 STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	EVENT 6 IS CURRENTLY: ENABLED
	Summary for Event 7: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 7 IS CURRENTLY: DISABLED
	Summary for Event 8: IF: Channel 1 Delta Amplitude IS GREATER THAN Value: 0 THEN: Do Nothing	EVENT 8 IS CURRENTLY: DISABLED
	(OK	

Coherence Range Training:

🕅 Training/Control Scree	n for BrainMaster 2	.5									
Data Display Ereq.Bands Color Sound											
GO STOP Windo	w Clock: 1	9:23 Points:	000	Close							
System is Idling		Check Signal	Check Signal								
Component Amp Delta (0.5-4.0): Theta (4.0-8.0): 1	I(uV) % Energy 5.2 1 3.8 4	Full Scale: 15.4	l microvolts								
Apria (0.0-12.0). Lobeta (12.0-16.0): Beta (16.0-20.0): 1 Hibeta (20.0-24.0): Gamma (28.0-32.0): User (20.0-32.0): 1	5.0 5 5.2 2 1.5 4 4.1 4 8.1 6 0.8 18										
EVENT CONDITIONS: 1 if CH2:A:coh GT 2.0 d 2 if CH2:A:coh LT 4.0 d	VALUE % Time o tone : 2.1 92 o tone : 0.0 10	10.0 - ; 0									
		~	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	m.	4.0						
		Event	s 1-2: CHAN 2	Alpha Cohe	rence						
COHERENCE:		30	I	PHASE	:						
u: 42 a: 17				u: 50							
y. 17 b: 20				g: 54 b: 49							
b: 27		+		h: 43							
l: 12				1: 47							
a: 21				a: 47							
t: 23				t: 47							
d: 13				d: 47							

Note: coherence is currently being shown with a scale factor of 1/10, so 100% looks like a value of 10. This will be amended in a further revision.

Use of equation processor:

It is possible to define up to two expressions per event, and to use them in place of simple variables such as amplitude, phase, etc. An expression consists of one or more equations, that define a value "x" that is used as the training variable. The component values that are available in the Event Wizard selectors are also available for use in equations. In addition, many additional values are available in equations, as defined in the Data Dictionary. Each expression must define the value of "x" in some way, as in the following examples:

x = ALPHA; // x is the current value of alpha

x = 100 * ALPHA1 / ALPHA2; // ratio of alpha, made into a percent ratio = THETA/BETA; x = 10 * ratio; // t/b ratio scaled for training total = d + t + a + l + b + h + u; x = total / 5.0; // average amplitude

The appendix shows the possible use of parameters in equations.

In this example, we are computing the average of 4 bands, as shown:

Kernet Designer for BrainMaster	
Event Number: C 1 C 2 C 3 C 4 C 5 C 6 C 7 C 8 C 9 C 10 € 11 C 12 C 13 C	14 C 15 C 16 C Enabled C Disabled
Event Condition: IF: Use Equation: Delta Amplitude Damping Factor: 30 Constant: 0.0 Scale Factor: 100 Offset: 0.0	MIDI Sound Properties: Starting Note: 46 F# (740.0) 1 to 88 Instrument: 14 Tubular bell 128 choices Playing Style: Sustained Percus. or Sust.
Check Equation X = (A + B + T + D) 7 4.0; RULE: IS GREATER THAN Entered Value: Delta Constant: Delta Constant: 10.0 Scale Factor: 100 Offset: 0.0	Modulation: Amplitude Ampl. or Pitch Starting Loudness: Level: 1 1 to 128 Loudness Change Rate: +10 -10 to +10 Note Change Rate: +10 -10 to +10 Musical Scale (Mode): Major (Ionian) 15 choices Musical Key: C -10 to 8 Flat
Event Result: THEN: Play MIDI Sound	Play Note or Chord: If Note Enable All Events Disable All Events Clear All Events Show All Events
Event summary for Event 11: IF: Channel 2 Delta Amplitude IS GREATER THAN Value: 100 THEN: Play MIDI Sound MODE: 2 NOTE: 45 INSTR: 14 Tubular bell STYLE: Sustained MODULATION: Amplitude LOUDNESS: Level: 1 LOUDNESS CHANGE RATE: +10 PITCH CHANGE RATE: +10	Help Cancel OK

This example shows the initial set of events providing multiple-threshold training, the remaining events used to process derived values.

Event Wizard for BrainMaster - Preliminary 11/17/05

🖄 Trainir	ng/Control S	Screen for Bi	rainMaste	er 2.5				
<u>D</u> ata D <u>i</u> spla	ay <u>F</u> req.Ban	ds <u>C</u> olor <u>S</u> ou	ind					
GO S	STOP V	Vindow	Clock:	19:0	7 Points:	000	Close	
System	is Idling			c	Check Signa	1		
Compon	ient	Ampl(uV)	% Energy	Fu	II Scale: 26	i.6 microvolts		1
Delta Theta Alpha	(0.5-4.0): (4.0-8.0): (8.0-12.0)	5.3 6.9	1 3		20.0 -			
Lobeta Beta	(12.0-16.0)	D): 6.0 D): 8.5	2 4		10.0 -		~~~~ <u>`</u>	12.0
Hibeta Gamma User	(20.0-24.0 (28.0-32.0 (20.0-32.0	D): 9.3 D): 7.5 D): 19.1	5 5 17		Eve	nts 1-9: CHAN	l 1 Alpha Ampl	itude
EVENT	CONDITION	45:	VALUE	% Fime	20.0-	<u>.</u>		
1 if CH1 2 if CH1 3 if CH1 4 if CH1 5 if CH1	I:A:uV LT 9 I:A:uV GT 9 I:A:uV GT 9 I:A:uV GT 1 I:A:uV GT 1	.0 do tone : 1.0 do tone : 1.5 do tone : 0.0 do tone : 0.5 do tone	4.5 4.5 4.5 : 4.5 : 4.5	100 0 0 0 0	Eve 20.0 -	nt 10: x = 1.5	* ALPHA ;	.0 0.0
7 if CH1 8 if CH1 9 if CH1 10 if EQ 11 if EQ	1:A:uV GT 1 1:A:uV GT 1 1:A:uV GT 1 1:A:uV GT 1 N: GT 0.0 (N: GT 10.0	1.5 do tone 1.5 do tone 2.0 do tone 2.0 do nothi do nothing : do tone :	4.5 4.5 4.5 ing :4.5 7.7 5.1	0 0 0 100 0	10.0 - Eve		+ B + T + D) / 4	10.0 1.0 ;

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Use of Variables in the BrainMaster Event Wizard Expression Evaluator:

The Expression Evaluator allows you to use a wide range of mathematical expressions to create training variables. All common mathematical operations are used including trigonometric and scientific functions, plus parenthesis, and multiple equations separated by semicolons Comments can be included using "//" or by delineating with "/*" and "*/" symbols. A simple expression might be:

x = 1.5 * ALPHA; // define x as 150% of channel 1 alpha

Which provides a training variable that is equal to 1.5 times the current value of alpha.

Expressions can include more than one statement, separated by semicolons. Even complex sequences of operations such as:

Ratio1 = DELTA / ALPHA; Ratio2 = C1DE / C1AE; x = 10 * Ratio1 / Ratio2;

can be used . As long as the sequence finishes by defining the value of "x", the expression should work in the Event Wizard.

Filter amplitudes can be accessed with simple keywords. Other variables can be accessed by constructing keywords as described below.

Names of components provide their current amplitudes: DELTA, THETA, ALPHA, LOBETA, BETA, HIBETA, GAMMA, USER

Initials of components also provide current amplitude values: D, T, A, L, B, H, G, U

Channel 2 values are similarly easily accessed with names such as DELTA2, THETA2, ALPHA2 or D2, T2, A2, and so on.

For completeness, we go ahead and also allow, e.g. DELTA1, ALPHA1, T1, L1, etc. for channel 1 amplitudes, so that equations that use both channels 1 and 2 can be more readable. For example, "x = (T1 + A1 + T2 + A2) / (L1 + B1 + L2 + B2);" defines the ratio of the sum of teh values of theta and alpha on both channels, to the sum of the values of lobeta and beta also on both channels.

More complex expressions are also possible:

Variables beginning with a C denote channel data. The following channel designators are possible as the first 2 letters:

C1 : channel 1 C2 : channel 2 CS : sum of channels (1 + 2) CD : difference of channels (1 - 2)

The third letter denotes the component, as follows:

D : delta

- T : theta
- A : alpha
- L : lobeta
- B : beta
- H : hibeta
- G : gamma
- U : user

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Total
Aux channel 1
Aux channel 2
HEG
Impedance (Act) (future)
Impedance (Ref) (future)
DC potential (future)
SCP Slow Cortical Potential (future)
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The fourth letter denotes the value to be accessed, as follows:

A : amplitude

- F : frequency
- E : percent energy
- T : percent time over threshold
- V : variability
- C : coherence
- S : similarity
- P : phase
- M : comodulation
 - : current threshold (from built-in amplitude-based procotol processor)

Note: when a measure involving two channels is used, use the first channel to designate it, e.g. C1DC is the coherence in delta, for channel 1 measured in comparison with channel 2.

In addition Z scores will be available when used with the NeuroGuide run-time processor:

ZAP Absolute Power 2 channels / 8 bands ZRP Relative Power 2 channels / 8 bands ZPR Power Ratios 2 channels /10 ratios ZAA Amplitude Asymmetry 8 bands ZCO Coherence 8 bands ZPH Phase Difference 8 bands

NG bands are: D: Delta (1-4), T: Theta (4-8), A: Alpha (8-12.5), B: Beta (12.5-25.5) G: Gamma (25.5-30.5), 1: Beta 1 (12 – 15.5), 2: Beta 2 (15-18), 3: Beta 3 (18 – 25.5)

Examples of usable variables are as follows:

C1DA = channel 1 delta amplitude C2AF = channel 2 alpha frequency CSAT = sum-channels alpha percent time over threshold C2DZAP = channel 2 delta z-scored absolute power C1AZCO = channel 1 alpha z-scored coherence (measured between channels 1 and 2) C13ZRP = channel 1 Beta 3 z-scored relative power Etc.

Z scores take values of + or - the number of standard deviations, e.g. -1.5, +3.1, etc.