Data Dictionary for BrainMaster 2.5SE and 3.0 with Event Wizard and Math Wizard Equation Processor		
1/28/2007		
Any of the following variables can be used at any time, in any BrainMaster session.		
	Any values computed using the equation processor can be used to display as trends, to produce sound feedback, to send control signals (inhibits, etc), or to be sent to the Macromedia Flash Player for BrainMaster	REMEMBER TO ALWAYS PRESS "Check Equation" after entering or changing any equation in the Event Wizard control panel. Otherwise, your changes will not be saved.
User-defined bands		
	Any component names may be used to access data, including user-defined variables.	band name: channel 1 amplitude (from digital filters) for 8 components e.g. "User1" or "EMG"
	Any component name followed directly by the letter "T" will automatically access the current threshold from the protocol processor for that band.	channel 1 thresholds (from digital filters) for 8 components, e.g. "User1T" or "EMGT"
	Note: User-defined bandnames will automatically override any built-in names. For example, if you define your own band called "D", then "D" will be used for your band, not the default D (Delta) band. This allows you to completely redesign the component band names and use all of your redefined band names in the Math Wizard.	
Standard 1-channel variables computed in real time using BrainMaster built-in filter and protocol processing system		
	D, T, A, L, B, H, G, U	channel 1 amplitude (from digital filters) for 8 components
	DELTA, THETA, ALPHA, LOBETA, BETA, HIBETA, GAMMA, USER	channel 1 amplitude (from digital filters) for 8 components
	DTHR, TTHR, ATHR, LTHR, BTHR, HTHR, GTHR, UTHR	channel 1 thresholds (from digital filters built-in autothresholder)
	D1, T1, A1, L1, B1, H1, G1, U1	channel 1 amplitude (from digital filters) for 8 components

	DELTA1, THETA1, ALPHA1, LOBETA1, BETA1, HIBETA1, GAMMA1, USER1	channel 1 amplitude (from digital filters) for 8 components
	C1DA, C1TA, C1AA, C1LA, C1BA, C1HA, C1GA, C1UA	channel 1 amplitude (from digital filters) for 8 components
	C1DF, C1TF, C1AF, C1LF, C1BF, C1HF, C1GF, C1UF	channel 1 modal frequency (from FFT) for 8 components
	C1DE, C1TE, C1AE, C1LE, C1BE, C1HE, C1GE, C1UE	channel 1 percent energy (from FFT) for 8 components
	C1DP, C1TP, C1AP, C1LP, C1BP, C1HP, C1GP, C1UP	channel 1 percent time over threshold (using digital filters)
	C1DT, C1TT, C1AT, C1LT, C1BT, C1HT, C1GT, C1UT	channel 1 thresholds (from digital filters built-in autothresholder)
	C1DV, C1TV, C1AV, C1LV, C1BV, C1HV, C1GV, C1UV	channel 1 variability (from digital filters)
Standard variables for channel 2		
	D2, T2,…DELTA2, THETA2,...C2DA, C2TA,…C2GV, C2UV	channel 2 repeats all channel 1 variables shown above that use a "1" e.g. D1, C1AF, etc., with the "1" replaced by "2"
Standard variables for sum channel (not yet implemented)		
	DS, TS,…DELTAS, THETAS,...CSDA, CSTA,…CSGV, CSUV	The sum of channels 1 and 2 is always computed and available. Sum Channel repeats all channel1 variables shown above, with "1" replaced by "S"
Standard variables for difference channel (not yet implemented)		
	DD, TD,…DELTAD, THETAD,...CDDA, CDTA,…CDGV, CDUV	The difference of channels 1 and 2 is always computed and available. Difference Channel repeats all channel1 variables shown above, with "1" replaced by "D"
Cross-channel calculations:		
	Note: use first channel to designate the pair, e.g. channels 1/2 calculations are identified with Channel 1	
	CT	Coherence Threshold currently in use in built-in coherence processor. This will automatically track any changes in the coherence threshold.
	C1DC, C1TC, C1AC, C1LC, C1BC, C1HC, C1GC, C1UC	Coherence (currently selected type) between channels 1 and 2
	DCOH, TCOH, ACOH, LCOH, BCOH, HCOH, GCOH, UCOH	Coherence (currently selected type) between channels 1 and 2

	DPCOH, TPCOH, APCOH, LPCOH, BPCOH, HPCOH, GPCOH, UPCOH	"Pure" coherence between channels 1 and 2
	DTCOH, TTCOH, ATCOH, LTCOH, BTCOH, HTCOH, GTCOH, UTCOH	Similarity ("Training Coherence") between channels 1 and 2
	DSIM, TSIM, ASIM, LSIM, BSIM, HSIM, GSIM, USIM	Similarity ("Training Coherence") between channels 1 and 2
	DCOR, TCOR, ACOR, LCOR, BCOR, HCOR, GCOR, UCOR	"Spectral Correlation Coefficient" (SCC) between channels 1 and 2
	DCOM, TCOM, ACOM, LCOM, BCOM, HCOM, GCOM,	Comodulation (Sterman/Kaiser "SKIL" type) between channels 1 and 2
	C1DH, C1TH, C1AH, C1LH, C1BH, C1HH, C1GH, C1UH	Phase between channels 1 and 2
	DPHASE, TPHASE, APHASE, LPHASE, BPHASE, HPHASE, GPHASE, UPHASE	Phase between channels 1 and 2
Values from other events:		
	Events can read real-time data from other events. The events are processed in numerical order, so that the events are evaluated and act in order, e.g. Event 1 before Event 2, etc. Note that all events are checked for to see if any inhibits are generated, before events take action. All data passed between events are treated as double precision, floating-point numbers.	
	E1A, E2A, E3A, E4A, E5A, E6A, E7A, E8A, E9A, E10A, E11A, E12A, E13A, E14A, E15A, E16A	values of "antecedent" variables in Events 1-16. These are the selected component values, or the values of the "x=" equation in the "IF" portion of the event design. Note: These are also the values of "In1", "In2", "In3", through "In16", in the Macromedia Flash Player for BrainMaster
	E1, E2, E3, E4, E5, E6, E7, E8, E9, E10, E11, E12, E13, E14, E15, E16	values of "antecedent" variables in Events 1-16. These are the selected component values, or the values of the "x=" equation in the "IF" portion of the event design. Note: These are also the values of "In1", "In2", "In3", through "In16", in the Macromedia Flash Player for BrainMaster

	E1B, E2B, E3B, E4B, E5B, E6B, E7B, E8B, E9B, E10B, E11B, E12B, E13B, E14B, E15B, E16B	values of "condition" variables in Events 1-16. These are the selected component values, or the values of the "x=" equation after the "RULE" portion of the event design. Note: These are also the values of "In16", "In17", "In18", through "In32", in the Macromedia Flash Player for BrainMaster
	E1F, E2F, E3F, E4F, E5F, E6F, E7F, E8F, E9F, E10F, E11F, E12F, E13F, E14F, E15F, E16F	values of flags for Events 1-16. These are 0 if the event's condition is not met, and 1.0 if the event's condition is met. These are also the values of "Flg1", "Flg2", through "Flg16" in the Macromedia Flash Player for BrainMaster
	E1P, E2P, E3P, E4P, E5P, E6P, E7P, E8P, E9P, E10P, E11P, E12P, E13P, E14P, E15P, E16P	percent time meeting the condition for Events 1-16. These allow any events to "see" how often other events are "true" and use these values in rules. Values are returned as percent, e.g. between 0 and 100
Built-in Training Control Variables:		
	INHF1, ENHF1, NUME1	channel 1 training flags: number of "stops" meeting criterion, number of "gos" meeting criterion, number of possible "go's"
	INHF2, ENHF2, NUME2	channel 2 training flags: number of "stops" meeting criterion, number of "gos" meeting criterion, number of possible "go's"
	ALLOK	indicates that all "gos" are met, and no "stops" exceed threshold. Use e.g. "x=ALLOK" for Event 5, to allow games like BrainMan and BrainCell to work automatically with any amplitude-based protocol that is set up using the standard "Training Protocol" setup.
Special Built-in Functions (note that "arg" can be any number or variable name, including other Event Values, flags, etc. etc.		
	Zor1(arg)	returns 0 if argument is <1, 1 otherwise. Note: when used with a fraction e.x. X/Y, returns 1.0 if X >= Y, 0.0 otherwise
	GT(arg)	returns 0 if argument is <1, 1 otherwise. Note: when used with a fraction e.x. X/Y, returns 1.0 if X >= Y, 0.0 otherwise
	Rng(arg1, arg2, arg3)	returns 0 if arg1 is within arg2 of arg3. E.g. Rng (C1AF, 0.5, 10) returns 1 if Channel 1 Alpha Frequency is within 0.5 Hz of 10 Hz. E.g. between 9.5 and 10.5 Hz, and returns 0 otherwise

	Bnd(channel, low, high) or Band(channel, low, high)	returns total FFT energy in a band for a channel. E.g. Bnd(2, 4, 6) returns the energy in channel 2 between 4 Hz and 6 Hz
	Modf(channel, low, high)	returns modal frequency ("first moment") from FFT in a band for a channel. E.g. Modf(2, 4, 6) returns the modal frequency in channel 2 in band from 4 Hz to 6 Hz
	Peakf(channel, low, high)	returns peak frequency (highest amplitude) from FFT in a band for a channel. E.g. Modf(2, 4, 6) returns the peak frequency in channel 2 in band from 4 Hz to 6 Hz
Special Built-in Constants:		
	Schumann, SCH	Schumann Frequency = 7.81
	PHI, GOLDEN, GM	Golden Mean = 1.618
	PI	PI = 3.14159
Standard Operators: Note: all arguments and parameters are treated as double precision floating point values		
	+ - * /	add, subtract, multiply, divide
	%	modulus returns the remainder after an integer division
	^	power: y = x ^ 2
	()	parenthetical gropuing, unlimited, e.g. (2 + BETA) / THETA
	;	semicolon, needed at end of each equation in formula
	//	comment, single line
	/*…*/	comment, multiple lines
Priority of Operators:		
	()	highest
	^	next
	-x (unary minus)	next (e.g. y=-x^2, the ^ occurs before -)
	*/^	next
	+-	lowest
Standard Built-in Functions:		
	abs(x)	return absolute value
	acos(x)	calculate arccosine

	asin(x)	calculate arcsine
	atan(x)	calculate arctangent
	atan2(x,y)	calculate arctangent with two parameters to preserve quadrant angle
	bessj(n,v)	Bessel function of the first kind. n is order and v is input value
	bessy(n,v)	Bessell function of the second kind. n is order and v is input value.
	Ceil(x)	Find integer ceiling
	Cos(x)	Calculate cosine
	Cosh(x)	Calculate hyperbolic cosine
	exp(x)	calculate exponential function "e to the x"
	floor(x)	Find integer floor
	hypot(a,b)	calculate hypotenuse of right triangle
	log(x)	calculate natural logarithm
	log10(x)	calculate base-10 logarithm
	max(x,y)	return larger of two values
	min(x,y)	return smaller of two values
	rand(x)	get pseudorandom number between 0 and 1
	sin(x)	calculate sine
	sinh(x)	calculate hyperbolic sine
	sqrt(x)	find square root
	srand(x)	initialize pseudorandom series
	tan(x)	calculate tangent
	tanh(x)	calculate hyperbolic tangent
Scripting:		
	x=HIBETA;	equations must include an expression assigning value of "x" and must have a final semicolon (;)
	ratio=T/B; x=10*ratio;	expressions can include more than one equation, separated by semicolons. you may define your own variables. the expression assigning x must be the last one in the definition
	ratio1=A/H; ratio2=A2/H2; x=log(ratio1/ratio2);	many equations may be put together separated by semicolons
	x = Zor1(THETA/TTHR);	built-in functions may be used at any time
	x = ((1-Zor1(THETA/TTHR)) + Zor1(LOBETA/LTHR)) / 2;	complex expressions may be used to construct training values
	x = (D + T + A + L) / (B + H + G);	it is easy to combine components and values in equations

Z-Scores (using optional NeuroGuide Real-Time Extensions for BrainMaster)		
	With this option, the equation processor can access real-time z-score computations based upon the NeuroGuide normative database. (www.appliedneuroscience.com)	**Note: With 2 channels, N Z scores = 26 * 2 + 24 = 76 targets (24 are connectivity-related). With 4 channels, N Z scores = 26 * 4 + 6 * 24 = 248 targets (144 are connectivity-related).**
Available output values: (76 total targets)		
	ZAP1D, ZAP1T, ZAP1A, ZAP1B, ZAP11, ZAP12, ZAP13, ZAP1G, ZAP2D, ZAP2T, ZAP2A, ZAP2B, ZAP21, ZAP22, ZAP23, ZAP2G	delta, theta, alpha, beta, beta1, beta2, beta3, gamma Absolute Power 2 channels / 8 bands
	ZRP1D, ZRP1T, ZRP1A, ZRP1B, ZRP11, ZRP12, ZRP13, ZRP1G, ZRP2D, ZRP2T, ZRP2A, ZRP2B, ZRP21, ZRP22, ZRP23, ZRP2G	delta, theta, alpha, beta, beta1, beta2, beta3, gamma Relative Power 2 channels / 8 bands
	ZPR1DT, ZPR1DA, ZPR1DB, ZPR1DG, ZPR1TA, ZPR1TB, ZPR1AB, ZPR1AG, ZPR1BG, ZPR2DT, ZPR2DA,…	d/t, d/a, d/b, d/g, t/a, t/b, t/g, a/b, a/g, b/g Power Ratios 2 channels / 10 ratios
	ZAAD, ZAAT, ZAAA, ZAAB, ZAA1, ZAA2, ZAA3, ZAAG	delta, theta, alpha, beta, beta1, beta2, beta3, gamma Amplitude Asymmetry 8 bands
	ZCOD, ZCOT, ZCOA, ZCOB, ZCO1, ZCO2, ZCO3, ZCOG	delta, theta, alpha, beta, beta1, beta2, beta3, gamma Coherence 8 bands
	ZPHD, ZPHT, ZPHA, ZPHB, ZPH1, ZPH2, ZPH3, ZPHG	delta, theta, alpha, beta, beta1, beta2, beta3, gamma Phase Difference 8 bands
Additional Z Scores for 4-channel systems: (248 total targets)		
	ZAP3D, ZAP3T,… ZAP4D, ZAP4T,…	delta, etc. absolute power, channels 3 and 4
	ZRP3D, ZRP3T,… ZRP4D, ZRP4T,…	delta, etc. relative power, channels 3 and 4
	ZPR3DT, ZPR3DA,… ZPR4DT, ZPR4DA,…	d/t, d/a, etc. power ratios, channels 3 and 4
	ZAA12D, ZAA12T, …	asymmetry between chans 1 and 2 (same as ZAAD, ZAAT, etc)
	ZAA13D, ZAA13T, …	asymmetry between chans 1 and 3
	ZAA14D, ZAA14T, …	asymmetry between chans 1 and 4
	ZAA23D, ZAA23T, …	asymmetry between chans 2 and 3
	ZAA24D, ZAA24T, …	asymmetry between chans 2 and 4
	ZAA34D, ZAA34T, …	asymmetry between chans 3 and 4

	ZCO12D, ZCO12T, …	coherence between chans 1 and 2 (same as ZCOD, ZCOT, etc)
	ZCO13D, ZCO13T, …	coherence between chans 1 and 3
	ZCO14D, ZCO14T, …	coherence between chans 1 and 4
	ZCO23D, ZCO23T, …	coherence between chans 2 and 3
	ZCO24D, ZCO24T, …	coherence between chans 2 and 4
	ZCO34D, ZCO34T, …	coherence between chans 3 and 4
	ZPH12D, ZPH12T, …	phase between chans 1 and 2 (same as ZPHD, ZPHT, etc)
	ZPH13D, ZPH13T, …	phase between chans 1 and 3
	ZPH14D, ZPH14T, …	phase between chans 1 and 4
	ZPH23D, ZPH23T, …	phase between chans 2 and 3
	ZPH24D, ZPH24T, …	phase between chans 2 and 4
	ZPH34D, ZPH34T, …	phase between chans 3 and 4
	PercentZOK(range)	Percent of Z scores that are within "range" of normal. Returns value between 0 and 100
	NeuroGuide 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 Z Score Training:		
	x=ZAP1A;	get the alpha amplitude z score
	x=ZPHT;	get the phase difference z score for theta
	x=ZCO1;	get the coherence z score for beta1
	x=ZPR1BG	get power ratio z score number 10 (beta/gamma) for Channel 1
	x=ZAAA;	get the alpha amplitude asymmetry
	x=(ZAP1T + ZAP2T)/2;	get average of z scores for theta from channels 1 and 2
	x=Rng(ZCOA, 1, 0);	has value 1 when Alpha Coherence Z Score is between -1 and +1
	x=Zor1((Rng(ZCOT,1,0)+Rng(ZCOA,1,0)+Rng(ZCOB,1,0))/3);	has value 1 when Theta, Alpha, and Beta Coherence Z Scores are all between -1 and +1
Standard controls for Flash Games		

	x=THETA/TTHR;	example for Event 1 - shows ratio of low "stop" inhibit to its threshold
	x=LOBETA/LTHR;	example for Event 2 - shows ratio of "go" component to its threshold
	x=HIBETA/HTHR;	example for Event 3 - shows ratio of low "stop" inhibit to its threshold
	x=POINTS/100;	example for Event 4 - shows points / 100 for Flash game indicator
	x=ALLOK;	example for Event 5 - indicates that all components meet criteria, and Flash game can "move" or proceed