Figure S1. Resting membrane potential of 12 PD neurons does not change after 8 hr. of impalement with two microelectrodes, Related to Figure 2. Each line shows the membrane potential measurement of a single neuron at the start of the experiment in TTX (t=0) and then after 8 hr. of two-electrode voltage clamp (t=8). *P* value generated using a two-tailed paired t test.

Activity-Dependent Correlations	p values			Pearson's *r*		
Same slope (Figure 3A)	Control	Silent	TEVC	Control	Silent	TEVC
IH vs. BKKCa	0.003	0.280	0.001	0.805	0.358	0.836
IRK vs. CaV2	0.022	0.717	0.005	0.678	-0.132	0.746
NALCN vs. CaV2	0.006	0.804	0.002	0.737	0.090	0.801
IH vs. SKKCa	0.033	0.142	0.013	0.643	0.473	0.691
Shaw1 vs. Shaker	<0.0001	0.301	<0.0001	0.879	0.344	0.933
Shaw2 vs. CaV2	0.001	0.610	0.041	0.849	-0.198	0.596
IRK vs. NALCN	0.015	0.153	0.045	0.705	-0.462	0.586
Shaw2 vs. IRK	0.001	0.630	0.041	0.864	-0.174	0.596
Shaw2 vs. Shaw1	0.019	0.478	0.015	0.691	0.254	0.680
SKKCa vs. Shaker	0.003	0.068	0.001	0.772	0.569	0.822
Shal vs. IH	0.007	0.070	0.001	0.790	0.566	0.846
Shab vs. NALCN	0.036	0.255	0.012	0.607	0.375	0.696
Shaw2 vs. Shaker	0.041	0.315	0.003	0.622	-0.354	0.780
BKKCa vs. SKKCa	0.033	0.127	0.003	0.615	0.490	0.801
Different slope (Figure 3B)						
NALCN vs. Shaker	<0.0001	0.059	0.009	0.871	0.585	0.712
NALCN vs. SKKCa	0.001	0.182	0.021	0.838	0.434	0.654
Shaker vs. IRK	0.019	0.942	0.003	0.691	-0.025	0.769
Shaw1 vs. IRK	0.007	0.456	0.001	0.758	0.251	0.821
Shaw1 vs. CaV2	0.015	0.417	<0.0001	0.855	0.289	0.927
NALCN vs. Shaw1	<0.0001	0.831	0.003	0.843	-0.073	0.772
Shaker vs. CaV2	0.018	0.102	<0.0001	0.666	0.547	0.918

Table S1. Correlated patterns of gene expression that arise due to voltage activity of the membrane, Related to Figure 2 and Figure 3.

Feedback-Independent Correlations (Figure 2C$_2$)	p values			Pearson's r		
	Control	Silent	TEVC	Control	Silent	TEVC
BKKCa vs. NaV	0.028	0.033	0.041	0.686	0.643	0.652
Shab vs. CaV2	0.011	0.026	<0.0001	0.701	0.695	0.932
NaV vs. Shal	0.014	0.010	0.023	0.775	0.735	0.673
Shab vs. SKKCa	0.021	0.010	0.002	0.653	0.737	0.786
Shaw1 vs. SKKCa	0.004	0.027	0.002	0.756	0.660	0.792
Shaw1 vs. Shab	0.001	0.006	<0.0001	0.820	0.764	0.923
Shal vs. BKKCa	0.024	0.024	0.007	0.672	0.671	0.757
Shab vs. Shaker	0.001	0.030	<0.0001	0.814	0.650	0.922

Activity-Independent Correlations	p values			Pearson's r		
	Control	Silent	TEVC	Control	Silent	TEVC
Same Trend as Figure 2C$_3$						
CaV2 vs. CaV1	<0.0001	0.376	0.234	0.857	0.315	0.391
IRK vs. CaV1	0.004	0.793	0.310	0.783	-0.090	0.338
Shaw1 vs CaV1	0.015	0.071	0.549	0.680	0.564	0.203
Shaw2 vs. CaV1	<0.0001	0.840	0.995	0.945	0.074	0.003

Activity-Restricted Correlations	p values			Pearson's r		
	Control	Silent	TEVC	Control	Silent	TEVC
Same Trend as Figure 2C$_4$						
SKKCa vs. CaV1	0.418	<0.0001	0.816	0.258	0.894	-0.080
NaV vs. CaV1	0.186	0.013	0.696	0.455	0.716	-0.142
Shab vs CaV1	0.177	0.036	0.555	0.417	0.635	0.200
NaV vs. IH	0.378	0.014	0.302	0.335	0.710	0.342
Shal vs. CaV1	0.765	0.041	0.286	-0.102	0.622	-0.354

Table S2. Correlated patterns of gene expression that arise as a result of factors other than the naturalistic waveform activity of PD, Related to Figure 2. *Feedback-Independent Correlations:* Correlated patterns of gene expression that arise independent of voltage activity of the membrane and chemical feedback. *Activity-Independent Correlations:* Correlated relationships that are present in the control group, but eliminated in both TTX (silent) and TTX+Activity (TEVC) groups. A*ctivity-Restricted Correlations:* Correlated relationships that are present only when activity was suppressed.

Never Correlated	Became correlated with TTX and TTX + TEVC	Only correlated with TTX+ TEVC
BKKCa vs. CaV1	*Shab vs. BKKCa*	*CaV2 vs. BKKCa*
BKKCa vs. Shaw 2	*NaV vs. CaV2*	*IRK vs. BKKCa*
IH vs. CaV1	*Shal vs. NALCN*	*NALCN vs. BKKCa*
NACLN vs. CaV1	*SKKCa vs. NALCN*	*Shaker vs. BKKCa*
Shaker vs. CaV1	*SKKCa vs. Shal*	*Shaw1 vs. BKKCa*
IH vs. CaV2	*Shaker vs. Shal*	*SKKCa vs. CaV2*
Shal vs. CaV2	*NaV vs. SKKCa*	*Shab vs. IRK*
IH vs. IRK	*Shab vs. NaV*	*NaV vs. NALCN*
IH vs. NALCN	*Shaker vs. NaV*	*Shaw1 vs. Shal*
IH vs. Shab		*Shaw2 vs. Shal*
IH vs. Shaker		*Shaw1 vs. NaV*
IH vs. Shaw1		*Shaw2 vs. NaV*
IH vs. Shaw2		*Shaw2 vs. Shab*
Shal vs. IRK		
SKKCa vs. IRK		
NaV vs. IRK		
Shaw2 vs. BKKCa		
Shab vs. Shal		
Shaw2 vs. SKKCa		

Table S3. Channel pairs that were never correlated, became with either TTX or TTX+TEVC, or were only correlated with TTX+TEVC, Related to Figure 2.

Became correlated with TTX and TTX + TEVC	Significant difference between slopes?	ANCOVA *p* value
Shab vs. BKKCa	No	0.299
NaV vs. CaV2	Yes	0.044
Shal vs. NALCN	No	0.560
SKKCa vs. Shal	Yes	0.021
Shaker vs. Shal	No	0.109
NaV vs. SKKCa	No	0.225
Shab vs. NaV	No	0.227
Shaker vs. NaV	No	0.146

Table S4. ANCOVA results for correlations that emerged after loss of inputs with or without activity, Related to Figure 2.

Target	Forward Primer	Reverse Primer	Probe	Labeling	Efficiency
NALCN	TCGCTTCCACGGTGTACATTC	GCGGTGCCTTTGTTCTCAG	TCTTCGTCTTCCTTGGCTGCATGA	FAM-BHQ1	97.1
IRK	TACAGTGGCGTTGGACTCTAC	TCCACCACACCAAGGCAAATAG	TCGTGTTCGCTATGTCATTCATCAGC	CAL Fluor Red 610-BHQ2	93.9
IH	TCGGTGCCACTAGACTACATC	GACCCGCGTGGAGAATCTG	TCCTCATCTTCAACCAGGACTTCAGC	Quasar 670-BHQ2	95.9
SKKCa	GCATCGGAGCATTGAACAGAA	GCCCGGACAGATAGTCATCAG	CAACTTCAACACTCGGTTTGTCCTCAA	Quasar 705-BHQ2	96.1

Target	Forward Primer	Reverse Primer	Probe	Labeling	Efficiency
Shaw1	CGCGTCACTCCTCAGGACTT	CCCAGCACCAGGAAGAACAC	TGATACAGACTTTCCGTGCATCCGC	Quasar 705-BHQ2	87.4
Shaw2	GAACGCCATCAAGCACTATCATC	ATGGCGCCCGACAGCTTAG	TGGCTTGAAGGACGGTCTCACA	Quasar 670-BHQ2	91.5
CbNaV	TCAACGGGAGGTACCATAAGTG	TCGCTGTTCACCCAAGAGTAG	CGGAGGGATTGAAGCTCAACGCA	CAL Fluor Red 610-BHQ2	81
Shaker	GAGGCTCAGAAGACCAGTCAAC	TGGCGATATCACCGAGCTCAT	CACTCGATGTCTTCGCGGAGGAGAT	CAL Fluor Gold 540-BHQ1	90.7
Shab	GAGCCGGACAGACAGGAAC	TGCGCCTCCTTCTGTAGTC	AAGAACCACGAACACCACATGGGTC	FAM-BHQ1	93.5

Target	Forward Primer	Reverse Primer	Probe	Labeling	Efficiency
CaV1	CCAGGCCTTCTACTGGCTCATT	GCTGGCGATAGTGCTCACTG	TGTGCTCGTCTTCCTCAACACGG	FAM-BHQ1	96
CaV2	ATCCGGCGGACAGTAAAGC	GTTCGGCAGCAACACAAAC	TGGTTCTACTGGTTCGTCATCATACTTGT	CAL Fluor Gold 540-BHQ1	97.9
Shal	GACACCACCTTCACCTCCATTC	GAACCATGTCGCCGTATCCTA	CGGCGTTTTGGTACACCATTGTCAC	Quasar 670-BHQ2	110.7
BKKCa	GCTCAAACTCGGCTTCATTG	CTGCGTGTCTGGAGAAGTTT	AGAATCCCGGCGCTAAACATGACT	Quasar 705-BHQ2	96

Target	Forward Primer	Reverse Primer	Probe	Labeling	Efficiency
vGluT	GCGTTCGTGGACCTTCTAC	TCAGCCACCCTGTAATGGAA	ATCACAGCCAACCTACTTCAGCGAG	CAL Fluor Gold 540-BHQ1	95.3
ChAT	GGACCGCCTGGCTAAGTAC	TCGCGGAGTCCCATAAGG	AGGCGGCGCTCAAGCTTCAGAC	CAL Fluor Red 610-BHQ2	93.1
vAChT	GCGTCAGCTGCTTCTTCCT	CAGCAGTGCCGTGTCTATGAG	TTCGCCAGCAACTACTGGGTGTT	Quasar 670-BHQ2	92.8
ACHE	GGGCAACATGGGCATGTAC	GGTCACCACCGAAGAATTCAATG	AGGCGCTGGCCATCAAGTGGATAC	Quasar 705-BHQ2	94.2

Table S5. Primers and probes used for multiplex qRT-PCR, Related to STAR Methods.
Each box in the table represents a group of genes that were multiplexed in a single PCR run.