Considerations for Choosing Techniques

	FDA & fPCA	SPM
Smallest analysis entity	1D Curve	1D Curve
Exploration and description	✓	×
Requires temporal registration	?	✓
Hypothesis testing	✓ Uses *f*PC scores	✓ Uses Random Field Theory
Hypothesis testing for "regions of interest"	×	✓
Programming needed?	Yes Matlab, R	Little / Some Matlab, Python
Availability of code	✓ http://www.psych.mcgill.ca/misc/fda/index.html	✓ www.spm1d.org
Supporting documentation and examples	?	✓

Suitability based on the desired outcome

- For comparison of differences in ensemble curves (SPM or SPnM is very effective)
- Statistical comparisons of groups: either approach will work but SPM/SPnM may be easier
- For exploratory analysis and linking patterns to individual participants (FDA may be more effective)
- Sample size, especially small sample sizes can be challenging for all methods, but especially for permutation methods (FDA t test & SnPM), and perhaps even more difficult for *f*PCA

Limitations

- *f*DA and *f*PCA

- SPM

  Requires data registration

  Requires “smooth” data – e.g. not raw EMG

- *Both methods have the same limitations as other methods*

  Non-random sampling

  Non-blind experimentation

  Non-homologous data….

Considerations for Choosing Techniques

FDA and *f*PCA

- In FDA The smallest data entity is the curve (considers curve as a whole)
- Can be used for exploratory analysis or descriptive analysis (no specific hypothesis)
- The *f*PC scores *describe* the curves
  - The scores can be linked to individual curves
- FDA uses *f*PC scores for statistical analyses (e.g. hypotheses tests, discriminant analysis, effect sizes
- Code, some resources and links can be found at http://www.psych.mcgill.ca/misc/fda/index.html

Considerations for Choosing Techniques

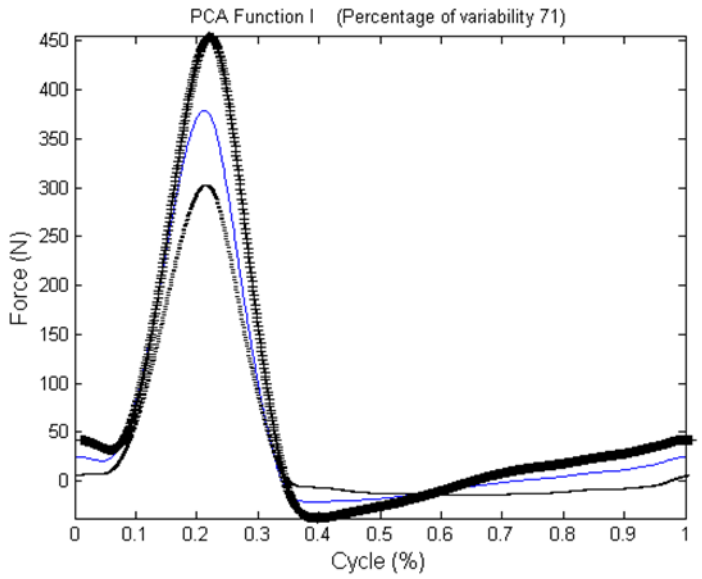
SPM & SnPM

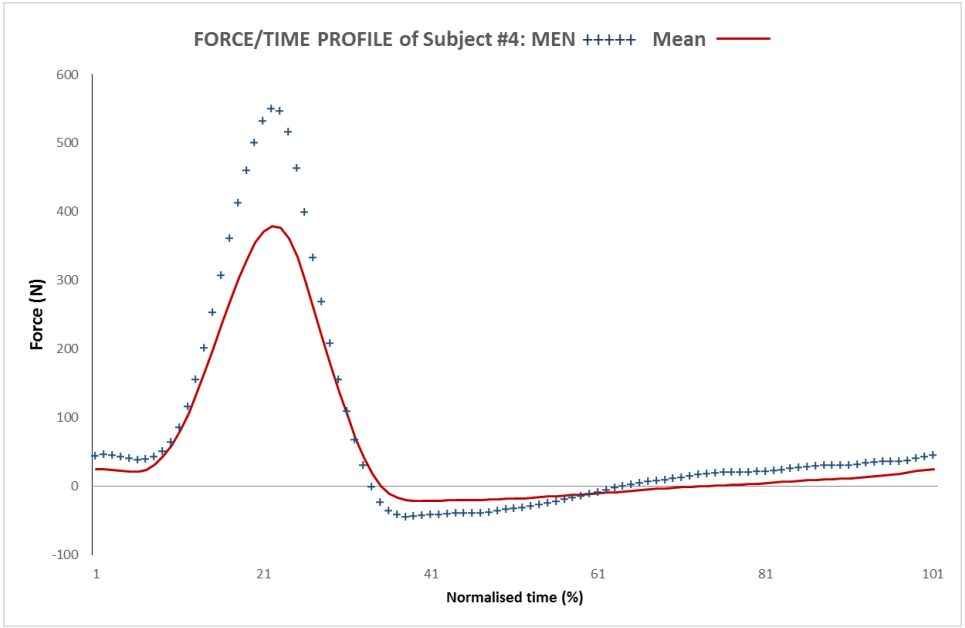
- In SPM the smallest data entity is the curve (considers curve as a whole)
- Tests specific hypotheses
- Requires temporal (or spatial) normalisation
- Code and supporting documentation available at www.spm1d.org
- Requires some programming ability but not extensive
- SPM can identify parts of curves that differ and limit hypotheses to “regions of interest” e.g. 0-25% stance

Considerations for Choosing Techniques

- Functional t-test can identify portions of curves that are different
- Similar outcome to SPM and SPnM t test
- FDA routines is not easily accessible to non-programmers
  - Steep learning curve to select apply routines
  - Need to invest considerable time to understand FDA concepts
- SPM/SPnM has better accessibility in Biomechanics applications than FDA
  - Availability of code
  - Accessibility of supporting documentation

fPC1 and mean force function for subject #4





fPC1: high scorers represented by +marks; low scorers by - marks

fPC scores relate to real subjects:
Male subject #4 has highest fPC1 score

fPC scores and real subjects

	fPC1	fPC2	fPC3
Male	2.134078	-28.8862	14.40326
	29.6124	1.449802	-3.05844
	8.108196		
	45.63799	-6.45741	-1.82911
	32.86823		
Female	-9.00321		-2.72248
	-29.8595	-2.47577	-13.1602
	-35.9693	-20.343	-5.75385
	-15.4052	15.00169	4.344112
	-28.1237	13.72799	8.307957
t-test male v female	***p=0.001***	*p=0.580*	*p= 0.524*

fPC scores relate to real subjects:

- **Male subject #4 has highest fPC1 score**

fPC scores male vs female

	fPC1	fPC2	fPC3
Male	2.134078	-28.8862	14.40326
	29.6124	1.449802	-3.05844
	8.108196	17.53892	6.56476
	45.63799	-6.45741	-1.82911
	32.86823	1.898835	-7.09603
Female	-9.00321	8.545193	-2.72248
	-29.8595	-2.47577	-13.1602
	-35.9693	-20.343	-5.75385
	-15.4052	15.00169	4.344112
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	45.63799	-6.45741	[illegible]
	32.86823	1.898835	-7.09603
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	-29.8595	-2.47577	-13.1602
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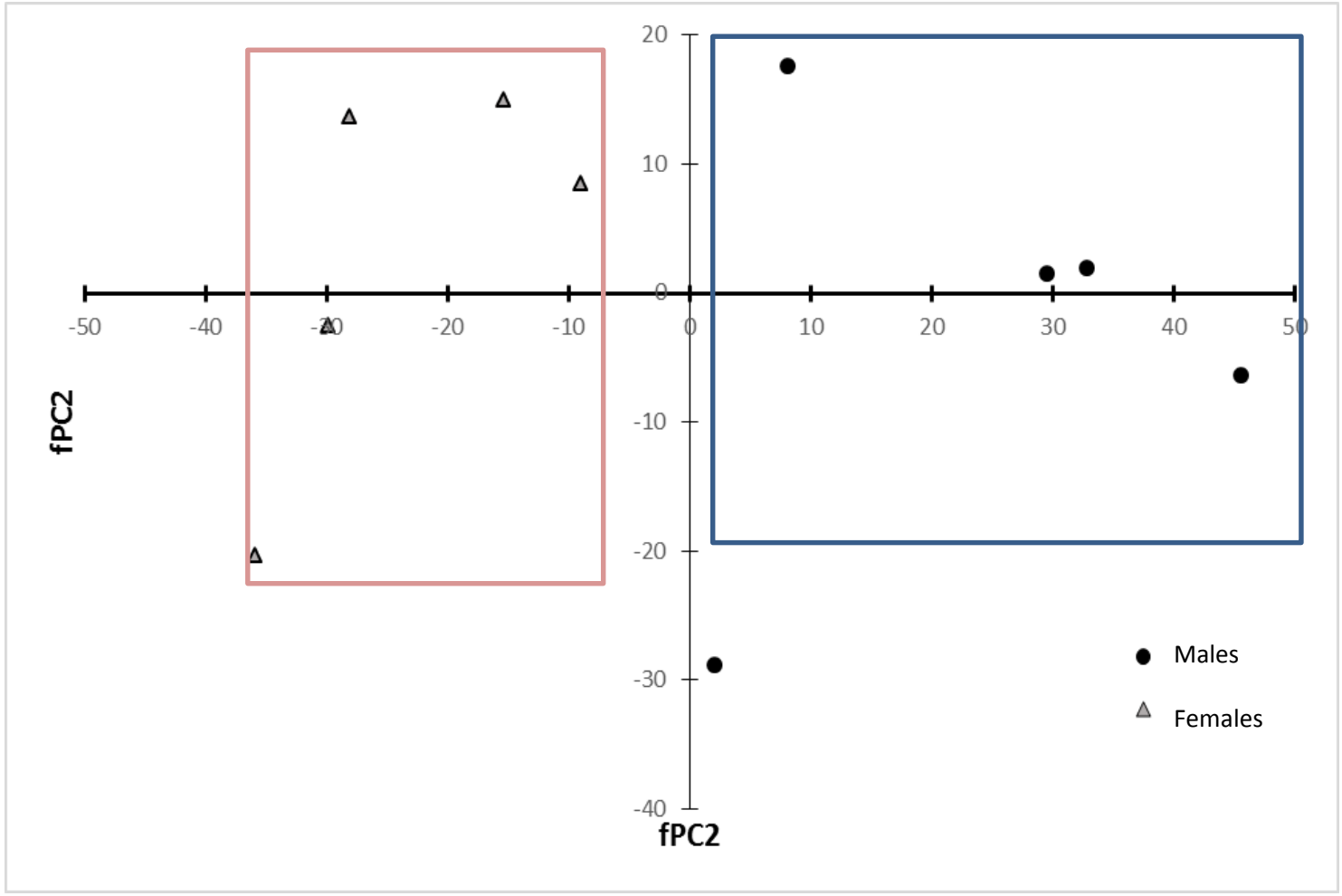
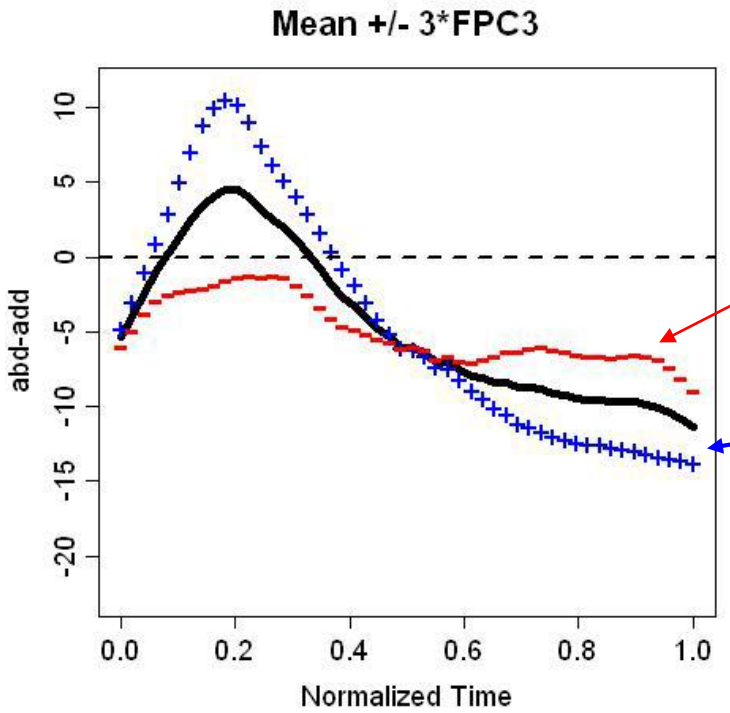
	-15.4052	15.00169	4.344112
	-28.1237	13.72799	8.307957
t-test male v female	*p=0.001*	*p=0.580*	*p= 0.524*

fPC scores can be compared by group using
t-tests or ANOVA etc..

Scatterplot of fPC1 vs fPC2

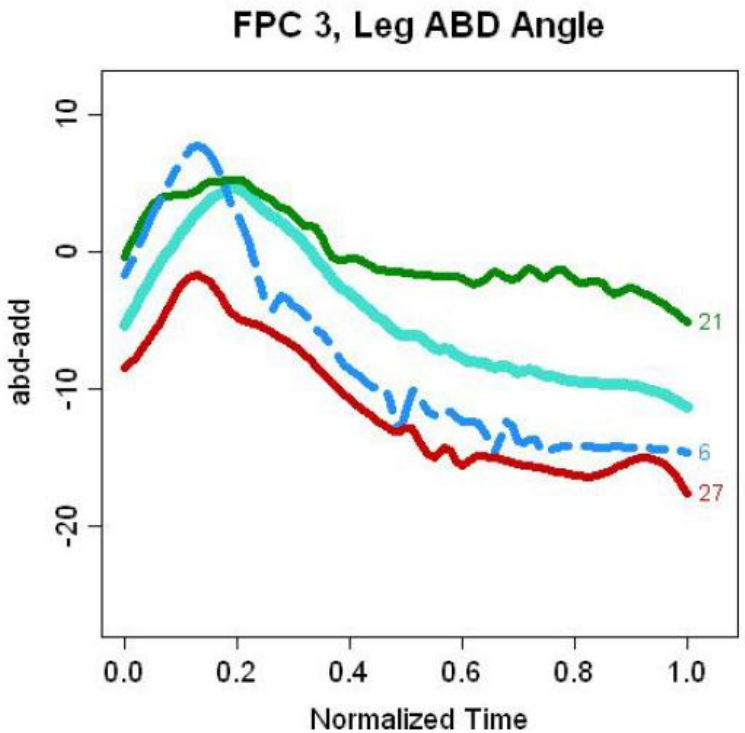




Low scorer on *f*PC3

High scorer on *f*PC3

Subject	FPC 1	FPC 2	FPC 3
23	3.0502	-3.3871	-0.1296
17	7.6099	-0.9098	-0.0030
28	-13.2772	-1.1054	-0.4858
15	5.0255	2.1885	0.3120
21	4.5706	1.3409	-1.6725
19	-2.9107	0.4518	0.8848
24	-1.9652	1.6254	-0.0518
26	2.4018	-0.4971	0.5116
14	-0.9837	-2.1859	0.9669
6	-3.8834	2.5169	1.2048
27	-6.7618	0.1459	-1.2579
22	7.1241	-0.1842	-0.2795



Curve #6 Looks similar shape to high scorer in *f*PC3