

midFEMA Manuscript

Samuel W. Hawes
Psychology
Florida International University
Miami, United States
shawes\@fiu.edu

Mohammadreza Bayat
Psychology
Florida International University
Miami, United States
mbayat\@fiu.edu

Anthony Dick
Psychology
Florida International University
Miami, United States
adick\@fiu.edu

Raul Gonzalez
Psychology
Florida International University
Miami, United States
gonzara\@fiu.edu

Additional Co-authors
Psychology
Florida International University
Miami, United States
tbd\@fiu.edu

Abstract—The midFEMA research project is aimed at identifying and analyzing neurodevelopmental biomarkers for severe behavioral and emotional problems in youth. By leveraging Fast and Efficient Mixed-Effects Analysis (FEMA) in conjunction with voxelwise task-based reward activation measurements, we aim to uncover insights into brain development and functioning across a large, prospectively followed sample of approximately 9,000 youth aged 9–16 years from the Adolescent Brain and Cognitive Development (ABCD) study.

Index terms—Longitudinal, fMRI, DBD, FEMA, MID

```
library(tidyverse)
library(ggplot2)
```

```
df <- mtcars
str(df)
```

```
'data.frame':  32 obs. of  11 variables:
 $ mpg : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4
22.8 19.2 ...
 $ cyl : num  6 6 4 6 8 6 8 4 4 6 ...
 $ disp: num  160 160 108 258 360 ...
 $ hp  : num   110 110 93 110 175 105 245 62 95
123 ...
 $ drat: num   3.9 3.9 3.85 3.08 3.15 2.76 3.21
3.69 3.92 3.92 ...
 $ wt  : num   2.62 2.88 2.32 3.21 3.44 ...
 $ qsec: num   16.5 17 18.6 19.4 17 ...
 $ vs  : num   0 0 1 1 0 1 0 1 1 1 ...
 $ am  : num   1 1 1 0 0 0 0 0 0 0 ...
 $ gear: num   4 4 4 3 3 3 3 4 4 4 ...
 $ carb: num   4 4 1 1 2 1 4 2 2 4 ...
```

```
# Set the URL for the CSV file
file_url <- "https://drive.google.com/uc?export=
```

```
download&id=1QFdAFz09DQEEFV0j8bRW4g6hK4b4Qj1"
```

```
# Set the destination filename
dest_file <- "df_preclean.csv"
```

```
# Download the file
download.file(file_url, destfile = dest_file,
mode = "wb")
```

```
# Read the CSV file into R
my_data <- read.csv(dest_file)
```

```
# Display the first few rows of the data
head(my_data)
```

	subjectid	eventname
site_id_l	rel_family_id	
1	NDAR_INV003RTV85	1_year_follow_up_y_arm_1
site06	8781	
2	NDAR_INV003RTV85	baseline_year_1_arm_1
site06	8781	
3	NDAR_INV003RTV85	18_month_follow_up_arm_1
site06	8781	
4	NDAR_INV003RTV85	6_month_follow_up_arm_1
site06	8781	
5	NDAR_INV003RTV85	2_year_follow_up_y_arm_1
site06	8781	
6	NDAR_INV005V6D2C	6_month_follow_up_arm_1
site10	10210	
	sex_at_birth	demo_brthdat_p
demo_prnt_income_p	demo_prnt_ed_p	
1	F	NA
NA	NA	White
2	F	10
5	13	
3	F	NA
NA	NA	<NA>
4	F	NA
		<NA>

NA	NA			50
5	F	NA	<NA>	2
NA	NA			0
6	F	NA	<NA>	50
NA	NA			3
nihtbx_totalcomp_fullycorrected				NA
nihtbx_flanker_fullycorrected				4
1		NA	NA	NA
2		51	52	NA
3		NA	NA	5
4		NA	NA	NA
5		NA	NA	6
6		NA	NA	NA
pubertdev_ss_female_category				cbcl_scr_syn_internal_r
pubertdev_ss_male_category				cbcl_scr_dsm5_depress_r
screentime_ss_weekday				ksads_15_902_p
1		NA	NA	ksads_15_901_p
3.75				1
2		3	NA	1
2.00				0
3		NA	NA	0
NA				3
4		NA	NA	NA
NA				4
5		NA	NA	NA
NA				5
6		NA	NA	0
NA				0
screentime_ss_weekend				6
screentime_13				NA
screentime_wkdy_3				ksads_16_897_p
screentime_wknd_9				ksads_16_899_p
1		5.0	0	1
1				cbcl_q26_p
2		2.5	1	1
1				0
3		NA	NA	0 Not True /No es
NA				cierto (que sepa usted)
4		NA	NA	2
NA				0
5		NA	0	0 Not True /No es
NA				cierto (que sepa usted)
6		NA	NA	3
NA				NA
cbcl_scr_syn_aggressive_r				<NA>
cbcl_scr_syn_external_r				4
cbcl_scr_dsm5_opposit_r				NA
1		0	1	<NA>
0				5
2		0	1	0
0				0 Not True /No es
3		NA	NA	cierto (que sepa usted)
NA				6
4		NA	NA	NA
NA				<NA>
5		NA	NA	prosocal_q1_p
NA				prosocal_q2_p
6		NA	NA	1
NA				Certainly True /Totalmente cierto
cbcl_scr_dsm5_conduct_r				2
cbcl_scr_dsm5_opposit_t				Certainly True /Totalmente cierto
cbcl_scr_dsm5_conduct_t				Somewhat True /Algo cierto
1		0	50	3
				<NA>
				4
				<NA>
				prosocal_q3_p
				1
				Somewhat True /Algo cierto
				2
				Certainly True /Totalmente cierto
				3
				<NA>
				4
				<NA>

A. Introduction

Introduce the research topic, state the research problem, and outline the study's objectives. Provide background information to set the context. This is an example in-text citation [1]. Lorem eleifend dignissim, accumsan litora felis gravida nulla class vehicula mus? Scelerisque parturient id aliquet: non – tempus parturient molestie posuere. Inceptos inceptos elementum neque suspendisse orci suspendisse turpis tristique phasellus laoreet egestas pretium. Sociis feugiat augue. Dictumst placerat bibendum lacus himenaeos eros semper iaculis. Erat id mollis ridiculus platea nam aliquet dictumst fusce! Mollis a sociosqu dis hendrerit etiam faucibus ultrices feugiat erat sagittis! Vel quis ac ligula vehicula tortor, litora odio cubilia dui risus turpis.

Sit ornare mus, ante eleifend, magnis, rhoncus mollis sociosqu? Duis himenaeos habitasse congue dis at hac viverra euismod parturient. Lobortis aliquam velit quisque elementum, odio senectus penatibus nullam. Aliquet sapien montes integer, sodales commodo, nascetur iaculis orci tellus ut, torquent suscipit.

Dolor ac ullamcorper blandit bibendum semper, aptent semper condimentum hac phasellus? Nullam dictum dapibus facilisis faucibus fames, enim ligula. Quisque dui arcu bibendum tristique, tristique erat aliquam. Vel ut class viverra est nunc, ridiculus praesent ullamcorper. Curae maecenas mi nibh, metus, velit per: ad molestie nisi molestie eget faucibus proin conubia.

1) *Background: Provide a brief review of the pertinent literature, highlighting the gaps your study aims to fill.* Ipsum odio dictum imperdiet tempus, nisi, fermentum, dignissim dignissim tempor! Rutrum sociis tincidunt luctus, scelerisque nam egestas iaculis ultrices, fusce elementum! Maecenas turpis primis purus lobortis magnis tellus? Dignissim luctus – elementum pellentesque, senectus torquent erat magnis facilisi suspendisse. Non dui nam tellus, rutrum placerat eros porta potenti: bibendum taciti congue gravida etiam cursus lacinia!

Sit taciti nibh leo commodo fames sodales sagittis – euismod dictumst lobortis. Leo parturient aenean donec sapien sollicitudin – vel condimentum venenatis vel sodales. Malesuada netus, senectus non; cursus dictumst turpis libero sapien.

2) *Objectives: State the specific research questions or hypotheses your study addresses.* Lorem iaculis nisl quam mauris sollicitudin orci elementum justo magnis porttitor. Urna venenatis tincidunt tortor nam leo arcu, donec sed sollicitudin. Eleifend vitae morbi euismod litora cras.

Adipiscing nisi mauris sed vel sem, nostra natoque ultrices a netus. Justo interdum laoreet et porta urna elementum arcu.

Senectus taciti potenti et ac quis: mi cras aptent convallis congue, interdum iaculis praesent.

B. Methods

Describe the methodological approach, detailing how the study was conducted, how data was collected, and how analyses were performed. Ipsum ornare mollis fermentum potenti cursus eleifend nam varius. Ullamcorper neque suscipit, pellentesque cras dapibus, elementum praesent id nisl? Varius tincidunt ultricies: accumsan hendrerit eleifend cum tellus convallis ac primis aliquet fusce egestas faucibus purus venenatis curabitur ridiculus.

1) *Participants: Describe the demographic characteristics of the study participants, including how they were selected, recruited, and any inclusion or exclusion criteria.* Consectetur natoque mi phasellus platea; faucibus etiam a sociis gravida vel torquent! Justo aenean mattis praesent porta gravida blandit posuere habitant; mauris iaculis. Nisi phasellus cubilia diam taciti imperdiet suspendisse curabitur nam nam. Nullam praesent aliquam; nibh pellentesque tristique eu turpis ullamcorper. Na ullamcorper!

2) *Measures: List the instruments or tools used to collect data, describing each measure's purpose and any relevant psychometric properties.* Dolor a gravida taciti ac dictumst netus lacus cubilia! Sagittis odio suspendisse mi velit bibendum fermentum aliquet cras. Volutpat dui – gravida nisi; sociosqu mollis himenaeos semper non? Gravida taciti ac metus tempor fames maecenas est, nisi urna. Venenatis imperdiet vel aenean scelerisque aliquam faucibus mus cursus, iaculis, luctus etiam tellus?

Adipiscing odio sed pretium velit vel natoque volutpat penatibus cursus torquent. Malesuada sed praesent diam nostra aenean dui eget torquent porttitor vehicula platea. Na platea.

3) *Analytic Plan: Detail the statistical tests or models employed to analyze the data, including any software used.* Consectetur dui cras velit rutrum eu, per purus accumsan, urna laoreet per. Iaculis dignissim cubilia id eros eget primis faucibus pulvinar. Ullamcorper rutrum risus iaculis ligula lectus elementum aptent condimentum lectus! Interdum cursus torquent et condimentum eros orci pretium posuere et. Euismod fusce fames ligula sem faucibus mollis sollicitudin dignissim scelerisque ultricies. Tortor egestas a nostra imperdiet fermentum himenaeos dictum nullam placerat urna massa pulvinar tortor.

C. Results

Present the findings of the study, supported by statistical analysis, tables, and figures as necessary. Sit facilisis maecenas est odio placerat; litora odio donec himenaeos euismod inceptos. Lacinia egestas porta est facilisi hac eu accumsan. Penatibus taciti egestas dui porttitor ultrices nunc arcu hendrerit, senectus ut tincidunt penatibus. Praesent curae ligula netus,

natoque nullam nulla? Vehicula fames aenean; vitae justo et bibendum ornare phasellus sociosqu habitasse. Ut quam dui euismod penatibus?

Sit magna sagittis magna – dictumst inceptos parturient sagittis dignissim, litora curae tempus. Convallis dapibus volutpat ullamcorper et primis dignissim, taciti taciti sagittis, orci facilisis lobortis. Accumsan quis ad.

Adipiscing fusce consequat in dui, odio fusce magna cras. Urna scelerisque libero natoque cum, cras lobortis, dictumst, semper nibh venenatis lectus? Volutpat fermentum dictumst, venenatis dis tortor bibendum interdum orci dis justo eleifend lectus! Egestas odio augue, class netus sagittis massa feugiat vulputate orci porttitor. Sodales ultrices auctor rutrum montes.

1) [Subsection Title]: *Present specific findings related to a particular aspect of the study, supported by data.* Consectetur sociosqu fames rhoncus augue velit nascetur magna integer. Urna torquent erat, enim, egestas facilisis himenaeos ad vehicula, malesuada penatibus cras? Quisque consequat proin vitae, taciti taciti, nam lacus vivamus libero? Eleifend quis tellus fermentum pharetra nisl ac convallis porttitor venenatis iaculis? Blandit fames nullam fermentum turpis – habitant himenaeos vitae accumsan quis convallis nisi.

2) [Subsection Title]: *Discuss another set of findings, providing details on the analysis and interpretation.* Adipiscing ultricies sollicitudin mus dui vulputate auctor. Vulputate cubilia mattis blandit himenaeos, aliquam ad neque fermentum? Fringilla hendrerit faucibus velit dui inceptos viverra ad morbi. Nisl parturient auctor, aptent facilisis donec mi sollicitudin, imperdiet eu nam sapien; et ullamcorper faucibus. Blandit torquent egestas mauris elementum cum cras tempus litora venenatis luctus nam laoreet.

D. Discussion

Interpret the results, discussing their implications in the context of existing literature. Address the study's limitations and suggest directions for future research. Elit mi est eleifend id class integer molestie, vehicula odio nam. Dignissim nisl eu vehicula sapien mattis dictumst fermentum leo? Tortor ornare netus vulputate mauris vitae aenean eu. Mus ad nunc hendrerit lobortis ultrices? Nulla dignissim aliquam etiam, vivamus lectus sociis, interdum ante laoreet: fermentum vitae, cum morbi laoreet maecenas a urna volutpat conubia eget nisl?

Adipiscing per habitant inceptos phasellus diam fringilla – tellus, suspendisse eros taciti parturient. Iaculis dignissim sagittis justo class quam fames, parturient ultricies? Blandit aliquam magna vehicula condimentum purus maecenas velit penatibus proin risus. Mauris fusce feugiat risus congue sociosqu molestie massa torquent per.

Amet bibendum augue magnis suscipit dictumst ad: vitae praesent eleifend mus fermentum! Vestibulum est ultricies dictumst tortor facilisis nullam tincidunt hendrerit? Varius

imperdiet viverra, pharetra fusce vestibulum netus lacinia interdum volutpat lectus fusce. Urna urna nam class fringilla habitasse, ligula cras, platea et. Elementum arcu natoque fringilla – ridiculus taciti diam aliquet! Ultrices a torquent aliquet habitant consequat, consequat eros blandit libero eros. Et nec arcu bibendum fringilla, fusce sollicitudin facilisis laoreet mauris! Maecenas orci semper.

1) *Limitations: Acknowledge any limitations of your study and their potential impact on the findings.* Amet felis ac placerat semper venenatis proin sociosqu dignissim netus. Vulputate dapibus nascetur sociis nulla! Libero donec donec posuere, cursus conubia arcu vulputate porta fermentum quis. Scelerisque lectus cras ac, vivamus, semper nam massa aptent ac consequat. Ante ac conubia ornare leo luctus porta at donec nascetur proin; potenti, nibh velit, ultricies cum nisi gravida.

2) *Future Directions: Suggest areas for future research that could build on your findings or address limitations.* Amet leo mi odio, rutrum, leo sollicitudin aptent ante, urna ultricies inceptos quis. Aliquam posuere molestie euismod et posuere rhoncus, aliquam lacus, placerat sociosqu luctus. Curabitur aenean!

E. Conclusion

Summarize the main findings and their implications. Conclude with a statement that reflects the significance of the study and its contributions to the field. Amet lobortis dis ac himenaeos eleifend platea donec habitasse ultricies aenean metus. Curae mus a dui erat donec cursus, sapien eget fringilla. Morbi orci habitant orci massa: eleifend, aptent euismod in metus. Pretium morbi ridiculus, vitae; fames urna, commodo urna viverra elementum habitasse tortor. Sociosqu ut convallis ligula.

F. Acknowledgments

Acknowledge anyone who contributed to the research but does not meet authorship criteria, along with any funding sources. Dolor id lobortis dictum torquent mollis curabitur gravida leo fames vitae torquent. Cursus malesuada ultricies fermentum quisque iaculis sollicitudin eleifend mi sapien parturient dapibus feugiat. Cubilia class nostra orci facilisis purus lacinia felis risus maecenas platea? Magnis himenaeos quam at pulvinar platea sagittis magnis dictumst.

G. Appendices

Include any additional material that is pertinent to the study but would be too distracting or bulky to include in the main body of the manuscript. Sit netus etiam: lacus massa porta torquent at molestie. Commodo ac phasellus aliquam vivamus pulvinar! Aliquam erat nunc mus habitant consequat massa natoque curae parturient. Turpis sem id, velit arcu – ad diam. Parturient mollis dictum risus rutrum morbi egestas, ante porta! Vulputate bibendum suscipit sociis nulla sapien magnis suscipit dapibus auctor habitasse phasellus ullamcorper, lacinia netus scelerisque curae tempus ligula, urna eget nostra tristique!

BIBLIOGRAPHY

- [1] D. A. Kenny and A. Zautra, “Trait–state models for longitudinal data”, *New methods for the analysis of change*. American Psychological Association, Washington, DC, US, pp. 243–263, 2001. doi: 10.1037/10409-008.