

Mice Data Management System

Group 3

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Outline

- Background
- Method
- Demo
- Future work

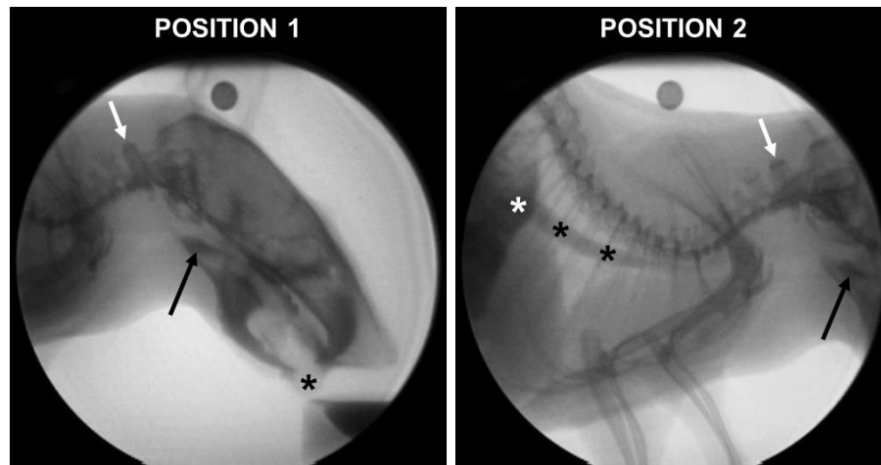
Introduction

- **Amyotrophic lateral sclerosis (ALS)** is a progressive neurodegenerative disease that affects nerve cells in the brain and the spinal cord
- Videofluoroscopic swallowing study (VFSS) method -> tons of videos



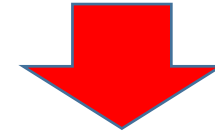
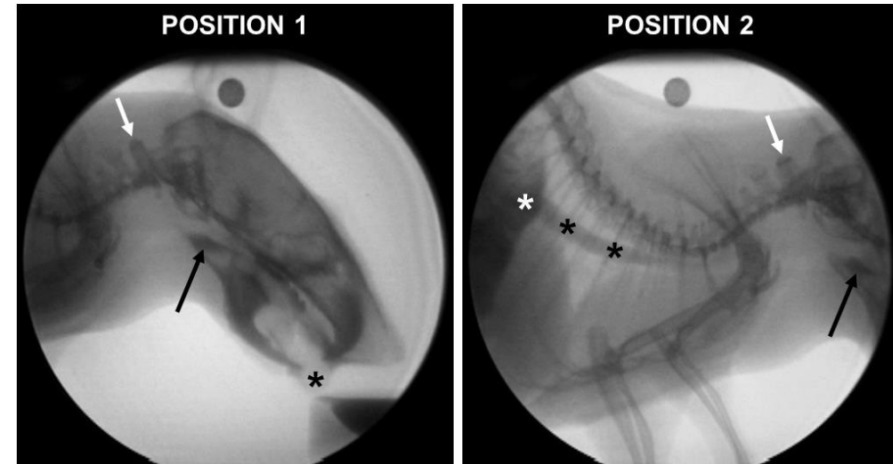
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Raw Data Collection

- Mouse behavior recorded under X-ray conditions.
- Behavior data were manually collected by reviewing videos(Time frame).
- Double reviewed and then confirmed by consensus members.

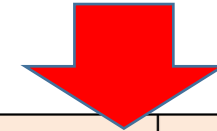


Mouse ID # _____ **Cage #** _____ **Test Date:** _____ **Study Name:** _____
DOB: _____ **Sex:** _____ M _____ F _____ **Chronological Age:** _____ years _____ months _____ days
Colony: _____ C57 _____ SOD1-HCN _____ SOD1-LCN _____ OPMD _____ Pax7-DTA _____ Other: _____
Fiducial marker implants: _____ No _____ Yes _____
Test item: _____
_____ Thin Liquid, administered by: _____ peg-bowl _____ spout _____ Food (dry, crunchy) _____ Other: _____
Reviewer #1: Name: _____ Date: _____ **Reviewer #2:** Name: _____ Date: _____
Consensus Members: _____ Date: _____

Data Extraction

- Extract consented records and do some calculations in excel
- Raw data were calculated using excel and input into SPSS.

Position 1	File #	Swallow onset frame	PTT end frame	Pharyngeal residue (Y/N)	2 nd Swallow onset frame	Tongue cycles per swallow	Jaw cycles per swallow	2 sec from swallow onset frame
1	R1							
	R2	X						
	C	X						
2	R1							
	R2	X						
	C	X						
3	R1							
	R2	X						
	C	X						
4	R1							
	R2	X						
	C	X						
5	R1							
	R2	X						
	C	X						



Thin Liquid	Swallow Delay	ISI	PTT	Tongue Cycles per swallow	Jaw Cycles per swallow	Swallow Rate	Lick Rate	Jaw Rate
POSITION 1	Time sec	Time sec	Time sec	# LICK Cycles	# JAW Cycles	# swallows in 2 seconds	# lick cycles/30 seconds	# jaw cycles/30 seconds
		0.00	0.00		0	0		0
		0.00	0.00		0	0		0
		0.00	0.00		0	0		0
		0.00	0.00		0	0		0
		0.00	0.00		0	0		0
Average		0.00	0.00	#DIV/0!	0.00	0.00	#DIV/0!	0.00

Objective

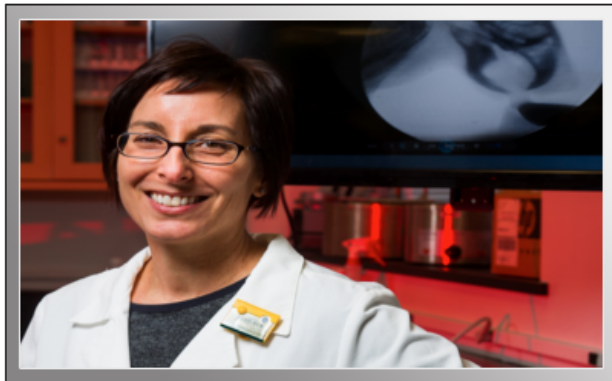
- Design a robust database performing good management various types of data and future extension.
 - Raw time frame data
 - Raw video recordings
 - Consensus confirmation
 - Historical data of management
 - Extension availability.
- Developed a user-friendly webpage for easily data browsing, analyzing and managing.

Mice Data Management

[Mice Datamanagement](#)[Home](#)[Search](#)[Data Collection](#)[Video Upload](#)[Data Management](#)[Data Input](#)[Data Analysis](#)[Logout](#)[Send Mail](#)

Mice Data Management

This is the web for data search and collection



This study adapted human videofluoroscopic swallowing study (VFSS) methods for use with murine disease models for the purpose of facilitating translational dysphagia research.

[Read more](#)

Welcome to our WEBSITE!

Our lab investigates dysphagia in amyotrophic lateral sclerosis (ALS), predominantly

Latest News

Website development

- LAMP
 - Linux
 - Apache
 - MySQL
 - PHP
 - Javascript
 - Json

Data Browsing

Data Analyzing

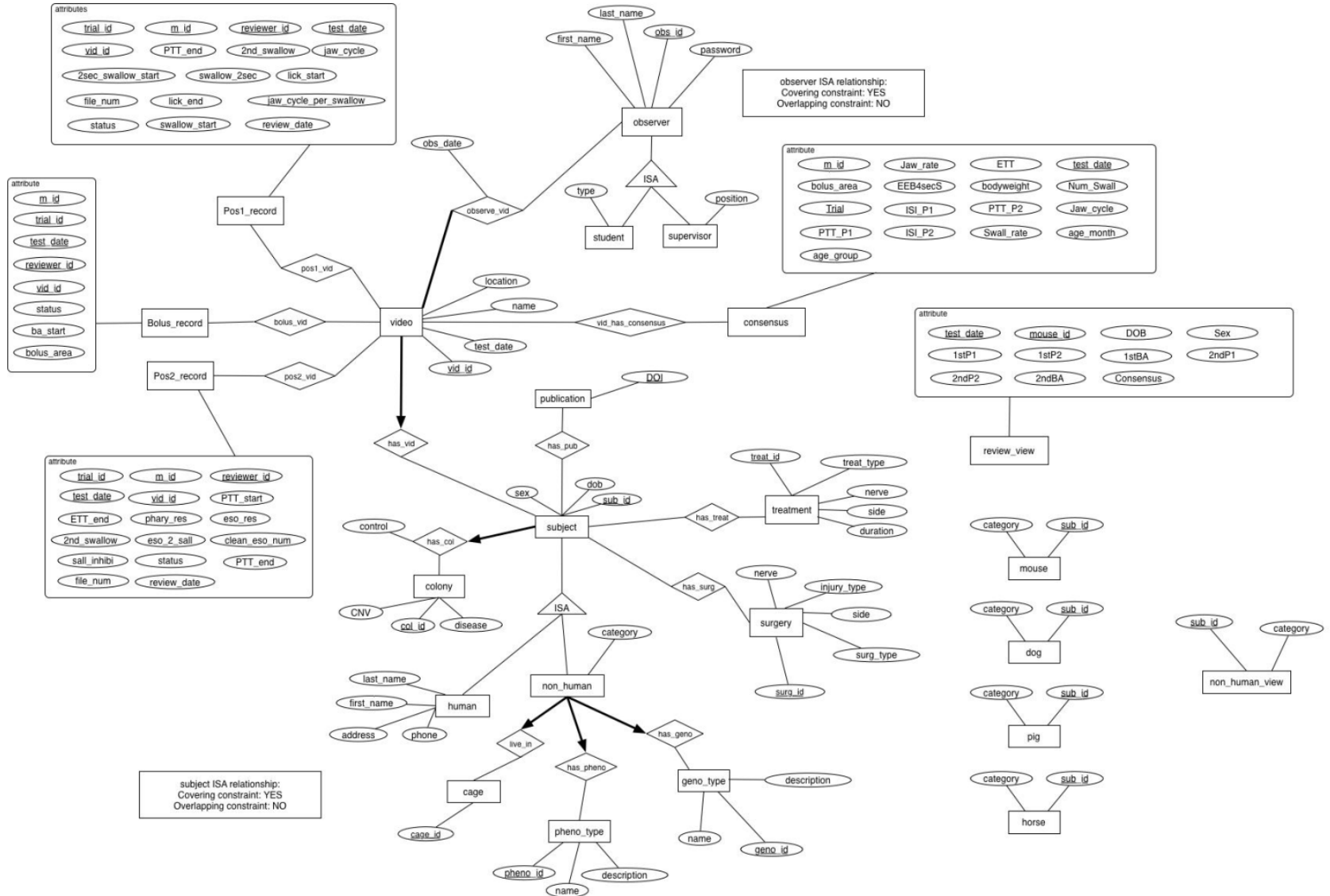
Data Management

[URL: cs4380-group3.centralus.cloudapp.azure.com/lever/](https://cs4380-group3.centralus.cloudapp.azure.com/lever/)

Design

- There are 3 main components in our system:
 - Data collection (data input and upload)
 - Data management (data processing, consensus)
 - Data analytics (queries, study progress, visualizations)

ERD



Normalization

- Our client's "paper-based" database has redundancy issues

Mouse ID # _____ Cage # _____ Test Date: _____ Study Name: _____

DOB: _____ Sex: ____M ____F Chronological Age: ____years ____months ____days

Colony: ____C57 ____SOD1-HCN ____SOD1-LCN ____OPMD ____Pax7-DTA ____Other: _____

Fiducial marker implants: ____No ____Yes

Test item:

____Thin Liquid, administered by: ____peg-bowl ____spout ____Food (dry, crunchy) Other: _____

Reviewer #1: Name: _____ Date: _____ Reviewer #2: Name: _____ Date: _____

Consensus Members: _____ Date: _____

- FDs:
 - Mouse ID -> Cage #,
 - Mouse ID -> DOB,
 - Mouse ID -> Sex,
 - Mouse ID -> Colony type,
 - Mouse ID, Test Date -> Age

Decompose into BCNF



MySQL
Tables

Indexing

The reason for the slow search speed can be reduced to 'order by', 'group by', '>,<,<=', 'like', 'is null' clause. Thus, we contains some indexes in our database to speed up.

- `CREATE INDEX rate_id_index ON consensus (Jaw_rate,m_id);`

Reason:

```
SELECT DISTINCT(m_id), count(*) FROM consensus
WHERE Jaw_rate IS NULL GROUP BY (m_id);
```

Indexing

- CREATE INDEX test_date_index ON consensus (test_date);

Reason:

```
SELECT COUNT(*)  
,MONTH(test_date),YEAR(test_date) FROM  
consensus GROUP BY  
YEAR(test_date),MONTH(test_date) ORDER BY  
YEAR(test_date) ASC;
```

Indexing

- CREATE INDEX tdate_dob_index ON review_record(test_date, DOB);

Reason:

```
SELECT mouse_id FROM review_record WHERE  
abs(DATEDIFF(test_date, DOB))<105 AND  
abs(DATEDIFF(test_date, DOB))>75  
AND mouse_id NOT IN  
(SELECT mouse_id FROM review_record WHERE  
abs(DATEDIFF(test_date, DOB))<195 AND  
abs(DATEDIFF(test_date, DOB))>165);
```

Query AND Analysis

In this part, I use some sql sentences contains:

- ABS, DATEDIFF, COUNT(*), AVG, ROUND, MONTH, YEAR, is NULL.
- NOT IN, LEFT JOIN, NATURAL JOIN, GROUP BY, ORDER BY, DISTINCT.
- Nested Query, 'AS' sentences

Show entries Search:

test_date	Mouse#	DOB	Sex	R1.P1	R1.P2	R1.BA	R2.P1	R2.P2	R2.BA	Consensu
2014-09-01	L124	2014-04-17	Female							NO
2014-10-05	L124	2014-04-17	Female	3	3	3				NO
2014-11-02	L124	2014-04-17	Female	3	3	3	4	4	4	NO
2015-01-10	L124	2014-04-17	Female	3	3	3	4	4	4	YES
2015-12-12	H601	2014-03-27	Male	12		12			11	YES
2016-05-01	L28	2013-08-29	Female							NO

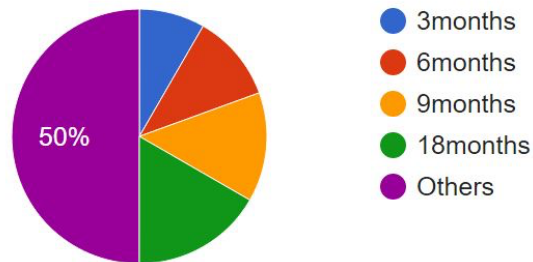
Showing 1 to 9 of 9 entries Previous 1 Next

Query AND Analysis

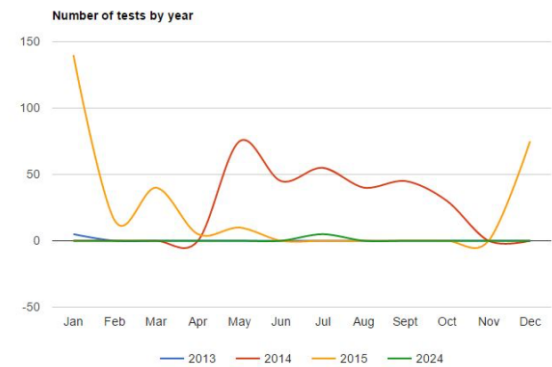
- The weight of number of mice tested in different time periods
- Help their lab to control the tests frequency and times on different years and months, let them have a visual understanding

Analysis

How Much Mice have tested in different periods



Analysis

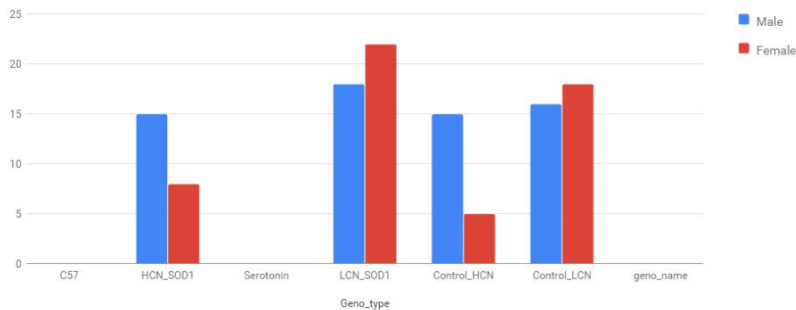


Query AND Analysis

- Number of mice in different gender and different geno type.
- Analyze gender, age, geno type's effects on the Jaw rate.

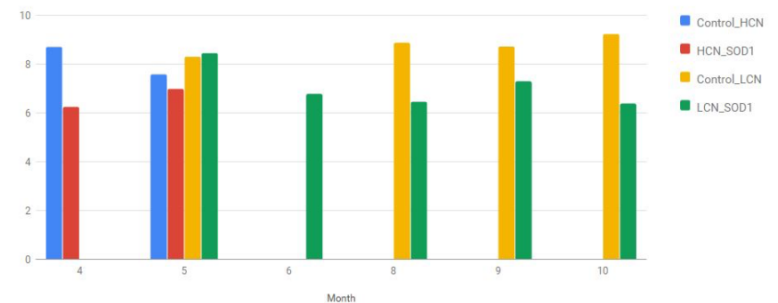
Analysis

Number of mice with different geno type and gender



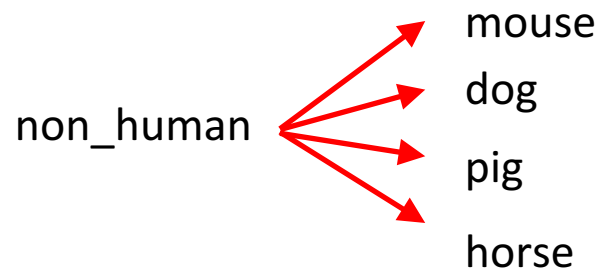
Analysis

Average Jawrate of mice with different geno type and age



Optimization and Tuning

- Besides mouse, our client has other types of animal models, such as dog, pig, and horse
- Most of the experiments use mice and only a few are done on other animal models
- Querying the records for models other than mouse will be inefficient
- Non-human subject table (sub_id, category) is horizontally decomposed into sub-tables
- The sub-tables are masked by a view non_human_view




Security

- Discretionary access control mechanism is used
- Two types of account: supervisor and student

Name	Account Type	Privileges	Other Privileges
Teresa	Supervisor	All	Create User, Grant Option
Kate	Supervisor	All	
Peng	Student	Select, Insert in data collection tables	
Siman	Student	Select, Insert in data collection tables	

- Dr. Lever can keep control of everything
- Students are not allowed to create their own accounts

Security

- Students are allowed to insert on raw data tables
- Reviewer 2 should not have access to reviewer 1's record  Students are not allowed to select on raw data tables (Pos1_record, Pos2_record, Bolus_record)
- Students are not allowed to delete or update on any tables to ensure data safety and research ethics
- Students are not allowed to select on “student”, “supervisor”, “observer” tables because these tables contain other group member's information and only supervisors can access these tables

Security

- Students can select on other remaining tables
- The following view can show the progress of the project while hiding details of each underlying tables

test_date ▲	Mouse# ◆	DOB ◆	Sex ◆	R1.P1 ◆	R1.P2 ◆	R1.BA ◆	R2.P1 ◆	R2.P2 ◆	R2.BA ◆	Consensus
2014-09-01	L124	2014-04-17	Female							NO
2014-10-05	L124	2014-04-17	Female	3	3	3				NO
2014-11-02	L124	2014-04-17	Female	3	3	3	4	4	4	NO
2015-01-10	L124	2014-04-17	Female	3	3	3	4	4	4	YES

- Everyone can access this view to know the progress

Triggers

- Archive old information
- E.g., If a student graduates and leaves Dr. Lever's group, his/her information and privileges will be deleted and revoked. The student's information should be saved into a data archiving table
- Triggers can automatically save the deleted data into data archiving tables

DEMO

[http://cs4380-
group3.centralus.cloudapp.azure.com/lever/index.php](http://cs4380-group3.centralus.cloudapp.azure.com/lever/index.php)

Future work

- Add more features to our client's experiments setting.
- Data mining and pattern detection.
- Database extension on other species.