Final Progress Report for Research Projects Funded by Health Research Grants

Instructions: Please complete all of the items as instructed. Do not delete instructions. Do not leave any items blank; responses must be provided for all items. If your response to an item is "None", please specify "None" as your response. "Not applicable" is not an acceptable response for any of the items. There is no limit to the length of your response to any question. Responses should be single-spaced, no smaller than 12-point type. The report **must be completed using MS Word**. Submitted reports must be Word documents; they should not be converted to pdf format. Questions? Contact Health Research Program staff at 717-783-2548.

1. **Grantee Institution:** The Pennsylvania State University

2. **Reporting Period (start and end date of grant award period):** 1/1/2009 – 12/31/2012

3. **Grant Contact Person (First Name, M.I., Last Name, Degrees):** John Anthony, MPA

4. **Grant Contact Person's Telephone Number:** 814-935-1081

5. **Grant SAP Number:** # 4100047645

6. **Project Number and Title of Research Project:** 26 - Novel Multielectrode Recording Techniques for Assessment of Taste Functions in the Brain

7. **Start and End Date of Research Project:** 7/8/2009-6/30/2010

8. **Name of Principal Investigator for the Research Project:** Andras Hajnal, M.D. Ph.D.

9. **Research Project Expenses**.

   9(A) Please provide the total amount of health research grant funds spent on this project for the entire duration of the grant, including indirect costs and any interest earned that was spent:

   $ $46,530

   9(B) Provide the last names (include first initial if multiple individuals with the same last name are listed) of **all** persons who worked on this research project and were supported with health research funds. Include position titles (Principal Investigator, Graduate Assistant, Post-doctoral Fellow, etc.), percent of effort on project and total health research funds expended for the position. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name	Position Title	% of Effort on Project	Cost
Acharya	Res. Technologist III	50%	$19,054.38

9(C) Provide the names of **all** persons who worked on this research project, but who *were not* supported with health research funds. Include position titles (Research Assistant, Administrative Assistant, etc.) and percent of effort on project. For multiple year projects, if percent of effort varied from year to year, report in the % of Effort column the effort by year 1, 2, 3, etc. of the project (x% Yr 1; z% Yr 2-3).

Last Name	Position Title	% of Effort on Project
Hajnal	Associate Professor	5%

9(D) Provide a list of **all** scientific equipment purchased as part of this research grant, a short description of the value (benefit) derived by the institution from this equipment, and the cost of the equipment.

Type of Scientific Equipment	Value Derived	Cost
Computer	Data recording and analysis for electrophys.	1,816

10. Co-funding of Research Project during Health Research Grant Award Period. Did this research project receive funding from any other source during the project period when it was supported by the health research grant?

Yes_____ No___X_____

If yes, please indicate the source and amount of other funds:

11. Leveraging of Additional Funds

11(A) As a result of the health research funds provided for this research project, were you able to apply for and/or obtain funding from other sources to continue or expand the research?

Yes_____X____ No_____

If yes, please list the applications submitted (column A), the funding agency (National Institutes of Health—NIH, or other source in column B), the month and year when the application was submitted (column C), and the amount of funds requested (column D). If you have received a notice that the grant will be funded, please indicate the amount of funds to be awarded (column E). If the grant was not funded, insert "not funded" in column E.

Do not include funding from your own institution or from CURE (tobacco settlement funds). Do not include grants submitted prior to the start date of the grant as shown in Question 2. If you list grants submitted within 1-6 months of the start date of this grant, add a statement

below the table indicating how the data/results from this project were used to secure that grant.

A. Title of research project on grant application	B. Funding agency (check those that apply)	C. Month and Year Submitted	D. Amount of funds requested:	E. Amount of funds to be awarded:
Neural Systems of Ingestive Behavior (Competing Renewal: R01 DC000240)	X NIH ☐ Other federal (specify:_____) ☐ Nonfederal source (specify:_)	3/1/2010	$1,938,750	$1,647,940

11(B) Are you planning to apply for additional funding in the future to continue or expand the research?

Yes_____ No___X_____

If yes, please describe your plans:

12. Future of Research Project. What are the future plans for this research project?

We are going to apply this method (chronic multielectrode recording in the pons) in future applications such as rat models of dietary and genetic obesity, and further develop technology to adapt to mice.

13. New Investigator Training and Development. Did students participate in project supported internships or graduate or post-graduate training for at least one semester or one summer?

Yes____X_____ No_____

If yes, how many students? Please specify in the tables below:

	Undergraduate	Masters	Pre-doc	Post-doc
Male	1			
Female				
Unknown				
Total	**1**			

	Undergraduate	Masters	Pre-doc	Post-doc
Hispanic				
Non-Hispanic	1			
Unknown				
Total	**1**			

	Undergraduate	Masters	Pre-doc	Post-doc
White				
Black	1			
Asian				
Other				
Unknown				
Total	**1**			

14. Recruitment of Out-of–State Researchers. Did you bring researchers into Pennsylvania to carry out this research project?

Yes_____ No___X_____

If yes, please list the name and degree of each researcher and his/her previous affiliation:

15. Impact on Research Capacity and Quality. Did the health research project enhance the quality and/or capacity of research at your institution?

Yes____X_____ No_____

If yes, describe how improvements in infrastructure, the addition of new investigators, and other resources have led to more and better research.

NIH R01 Grant was successfully renewed for 5 years partially because of the preliminary data collected using the novel multielectrode recordings. This funding has provided substantial growth to the continuing research ensuring high quality, i.e. meeting national and international standards as a result of NIH reviewing/reporting and through future peer-reviewed publications.

16. Collaboration, business and community involvement.

16(A) Did the health research funds lead to collaboration with research partners outside of your institution (e.g., entire university, entire hospital system)?

Yes_____ No_____X_____

If yes, please describe the collaborations:

16(B) Did the research project result in commercial development of any research products?

Yes_____ No_____X_____

If yes, please describe commercial development activities that resulted from the research

project:

16(C) Did the research lead to new involvement with the community?

Yes_____ No___X_____

If yes, please describe involvement with community groups that resulted from the research project:

17. Progress in Achieving Research Goals, Objectives and Aims.

List the project goals, objectives and specific aims (as contained in the grant agreement). Summarize the progress made in achieving these goals, objectives and aims for the period that the project was funded (i.e., from project start date through end date). Indicate whether or not each goal/objective/aim was achieved; if something was not achieved, note the reasons why. Describe the methods used. If changes were made to the research goals/objectives/aims, methods, design or timeline since the original grant application was submitted, please describe the changes. Provide detailed results of the project. Include evidence of the data that was generated and analyzed, and provide tables, graphs, and figures of the data. List published abstracts, poster presentations and scientific meeting presentations at the end of the summary of progress; peer-reviewed publications should be listed under item 20.

This response should be a DETAILED report of the methods and findings. It is not sufficient to state that the work was completed. Insufficient information may result in an unfavorable performance review, which may jeopardize future funding. If research findings are pending publication you must still include enough detail for the expert peer reviewers to evaluate the progress during the course of the project.

Health research grants funded under the Tobacco Settlement Act will be evaluated via a performance review by an expert panel of researchers and clinicians who will assess project work using this Final Progress Report, all project Annual Reports and the project's strategic plan. After the final performance review of each project is complete, approximately 12-16 months after the end of the grant, this Final Progress Report, as well as the Final Performance Review Report containing the comments of the expert review panel, and the grantee's written response to the Final Performance Review Report, will be posted on the CURE Web site.

There is no limit to the length of your response. Responses must be single-spaced below, no smaller than 12-point type. If you cut and paste text from a publication, be sure symbols print properly, e.g., the Greek symbol for alpha (α) and beta (ß) should not print as boxes (□) and include the appropriate citation(s). DO NOT DELETE THESE INSTRUCTIONS.

Project Overview

Obesity is a global pandemic, and poses extreme concerns for individuals and the society in the United States. According to recent health statistics, in the U.S., two-thirds of the adult population are overweight, and more than 25% are clinically obese. Although the etiology of obesity is complex and includes various environmental and also genetic factors, most obesity is caused by chronic overeating. The project made use of a currently available animal model of dietary obesity to study the role taste palatability plays in guiding excessive food intake resulting in obesity. The project employed behavioral and neurophysiological techniques to test whether taste function is altered in obesity and affects the central neural code that is responsible for the hedonic or palatability attribute of sensory information derived from peripheral chemoreceptors. The actual experiments tested the hypotheses that 1) high energy high fat diet-induced obese rats express reduced neural responses to lower concentrations of sucrose whereas taste neurons respond more vigorously to high concentrations compared with lean rats, and 2) satiation has blunted effect to alter neural code for sweet in obese rats. To test these hypotheses, the across-neuron code for sucrose concentrations and the effects of refeeding (satiation) following an over-night food restriction was studied using novel multielectrode recording techniques. The findings showed that the neural taste responses paralleled behavioral observations that not only appetite was increased in obese subjects but the effect of satiation to reduce the feeling of pleasantness of sweet was also blunted. This information will help us understand maladaptive changes in the brain that influence the taste and stimulatory effects of certain foods, making them less easily controlled in obese individuals. A competing renewal of an NIH grant application supported by the findings of this project and the successful demonstration of feasibility of chronic multielectrode recording was submitted during the project period and has been funded for 5 years.

The Specific Aim of the project was to test whether taste function is altered in obesity and affects the central neural code that is responsible for the hedonic or palatability attribute of sensory information derived from peripheral chemoreceptors. The project tested the hypotheses that 1) high energy high fat diet-induced obese rats express reduced neural responses to lower concentrations of sucrose whereas taste neurons respond more vigorously to high concentrations compared with lean rats, and 2) station has blunted effect to alter neural code for sweet in obese rats. To address these hypotheses, the across-neuron code for sucrose concentrations and the effects of refeeding (satiation) following an over-night food restriction were studied using novel multielectrode recording techniques.

During the report period, we have made substantial progress with addressing both hypotheses and also with development and testing chronic electrophysiological techniques to record from the pontine parabrachial taste relays (PBN). Actually, the progress has exceeded our initial plans and expectations in many aspects. Specifically, we have run two behavioral studies and several iterations of semi-chronic and chronic recording tests in naïve rats and also select subjects of the behavioral tests. In this latter experiment we have employed various designs of multielectrode and single electrode microdrives in order to determine which would work the best for our purpose in terms of durability, longevity in a chronic setting as well as signal quality required for across neuron pattern analysis. Experiment 1 was designed to test effects of various obesogenic (high energy, high palatability) diets for their efficiency to develop a) obesity and b) to alter taste perception of sweet. This study has been completed and all data are analyzed, thus ready for

publication. Experiment 2 aimed at investigating the effects of satiation on neural coding for sweets in a genetic obese strain, the Otsuka Long Evans Fatty (OLETF) rat. The rationale for starting neural recording in this obese strains and not immediately in dietary obese (DIO) rats was twofold. First, we have previously characterized pontine taste coding in the OLETF rats (Kovacs and Hajnal, Journal of Neurophysiology, 2008). Thus we identified the variables that intestinal satiation may affect, whereas in DIO rats a similar study has not been done. Second, the behavioral experiments with different diets (Experiments 1 and 2 , above) revealed larger individual variations in terms of the obesogenic and taste effects in the outbred Sprague Dawley male rats we used for developing DIO compared with the OLETF rats. Nevertheless, we have completed a similar electrophysiology study in DIO rats based on the initial data from the OLETF rats. The following narrative will give a brief summary of the results from the two studies including chronic recording data and the view of one of our microdrive design which has been tested in these studies successfully.

Experiment 1. Obesigenic effects of high energy high fat and high energy high carbohydrate diets. Coupled with reduced physical activity, the most common cause of overweight and obesity is a chronic overeating of highly palatable high energy foods rich in carbohydrates and fats. In a widely used rat model of dietary induced obesity (DIO), it has been found that only about one-half of Sprague Dawley rats (DIO-prone rats) become obese if rats are fed with a moderately high fat (~ 30 kcal%), and high carbohydrate (~ 50 kcal%), high energy (HE) diet. In contrast, other studies showed that all rats significantly gain weight – irrespective to their genetic background - if they are fed with diets that contain similar calories but more fat (~ 60 kcal%) and less carbohydrates (~ 20 kcal%). Furthermore, it has been proposed that switching from an isocaloric low fat diet to one with higher fat content, that body fat mass will increase. These observations together with data on additional effects of chronic fat intake on the brain mechanisms suggest that high-fat diets may alter energy homeostasis and motivational control of food intake – at least partially – independent of its caloric effects. To test this hypothesis and to establish a rat model that is relevant to human obesity we compared the short term (8 weeks) effects of two high caloric obesogenic diets shown in Table 1 on food intake, the body weight, body composition and glucose tolerance in 24 adult male Sprague Dawley rats.

In addition, we investigated the effects of the very high-fat diet (DIO-VHF) on the body weight in conditions when the rats were pair-fed, i.e., received it in a restricted amount isocaloric to the daily intake of their controls receiving a balanced normocaloric chow diet.

Our results showed that rats fed with the DIO-VHF- but not with the DIO-HE diet had significantly increased body weight and body fat content during the 8 weeks of the study period (Figure 1A, B). This difference was not related to energy intake, but it was rather a consequence of the different composition and fat content of the two DIO diets (Figure 1C). Supporting this notion is our analysis revealing that the same energy content in the DIO-VHF diet was more effective in increasing the body weight than the equivalent energy content in the CHOW or in the DIO-HE diet (Figure 1D). In concert with this, we observed that the DIO-VHF diet potently increased weight gain even when intake amount was calorically restricted to normal levels (Figure 2). These findings collectively suggest that increased consumption of dietary fat may result in increased weight gain and body fat content even within a short period of time by mechanisms that appear to be partially independent of total energy intake.

Experiment 2. Effects of satiety from increased blood glucose levels on neural taste coding for sweet in obese compared to lean rats. We recently investigated sucrose coding in the second central taste relay, the pontine parabrachial nuclei (PBN) of obese Otsuka Long Evans Tokushima Fatty (OLETF) rats. These rats express deficits in satiation and prefer sweet tastants. Compared with lean controls (LETO), obese OLETF rats have reduced neural responses to lower concentrations of sucrose and exaggerated responses to higher concentrations. To investigate potential underlying mechanisms by which taste stimulation from sweets may override satiety signals to halt overeating of sweet meals; we compared the effects of acute changes in blood glucose levels on concurrent gustatory activity in the PBN of prediabetic, obese OLETF and lean LETO rats. We used semi-chronic and chronic extracellular single neuron recording while stimulating the tongue with various taste solutions. The analysis included taste responses from 47 neurons, before and after peripheral administration of dextrose (1.25g/5ml, i.p.), following an overnight fasting. For chronic recording – so far producing 17 neurons many of them for a period over 10 days – we used a PCB board microdrive filled with a single electrode or one tetrode electrode assembly (Figure 3).

The results showed that whereas dextrose overall increased taste responses as a function of concurrent blood glucose levels, the magnitude of the effects and the across neuron pattern was significantly different in obese and lean rats (Figures 4 and 5). The overall effect from these changes in taste code was that acute surges of blood glucose reduced neural responses for sucrose relative to NaCl in lean but not in obese rats. These findings demonstrate that satiety from increased blood glucose affects taste processing in the PBN, suggesting a role for across neuron code for sweet taste in the altered sensitivity to this satiety signal in obese rats. In order to determine whether such effect (altered taste coding to blood glucose in obese rats) was due to the obesity or could also be influenced by dietary history we conducted a study to record taste activity by chronically implanted electrodes in normal (non-genetic) obese Sprague Dawley rats receiving different high energy diets identical to those tested and discussed in Experiment 1.

In addition to the result supporting our hypotheses, the technical progress on developing the chronic recording helped substantially in renewal of an R01 grant (DC000240, PI: Hajnal).

Table 1. Composition and energy content of the applied diets.

	CHOW	DIO-HE	DIO-VHF
	Teklad Global 2018	Research Diets D12266B	Research Diets D12492
Carbohydrate (kcal %)	60	51	20
Fat (kcal %)	17	32	60
Protein (kcal %)	23	17	20
Energy (kcal/g)	3.4	4.41	5.24

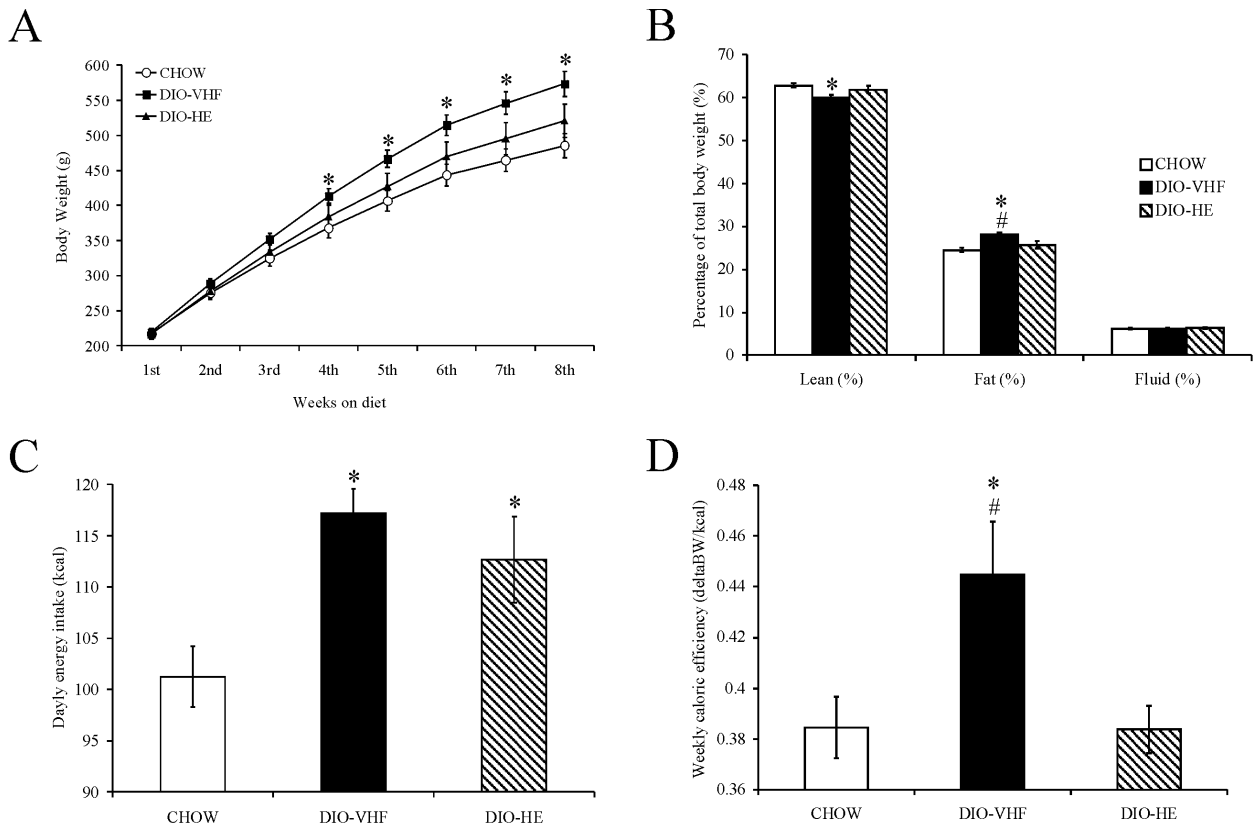

Fig. 1. The effects of two different obesogenic (DIO) diets on (A) body weight, (B) body composition, (C) daily energy intake, and (D) caloric efficiency in adult Sprague Dawley male rats. DIO-VHF: very high fat diet ; DIO-HE: high energy diet; CHOW: standard lab chow. Posthoc LSD tests: * = $p < 0.05$ compared to CHOW; # = $p < 0.05$ compared to DIO-HE.

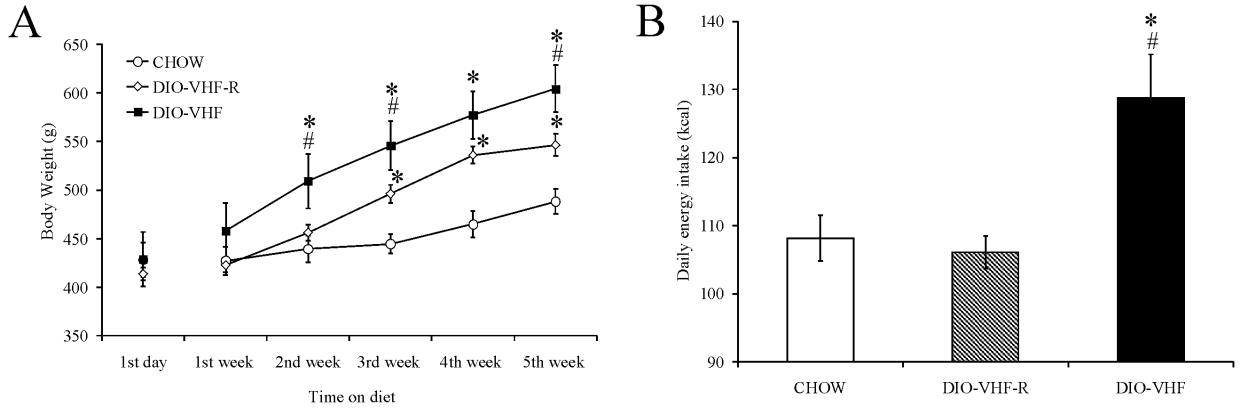

Fig. 2. Effects of restricted and ad libitum access to DIO-VHF diet on the (A) body weight, (B) daily energy intake of Sprague Dawley rats. DIO-VHF-R: very high fat diet restricted access – isocalorically pair-fed with the CHOW group; DIO-VHF: very high fat diet unrestricted access; CHOW: standard lab chow. Posthoc LSD tests: * = $p < 0.05$ compared to CHOW; # = $p < 0.05$ compared to DIO-VHF-R.

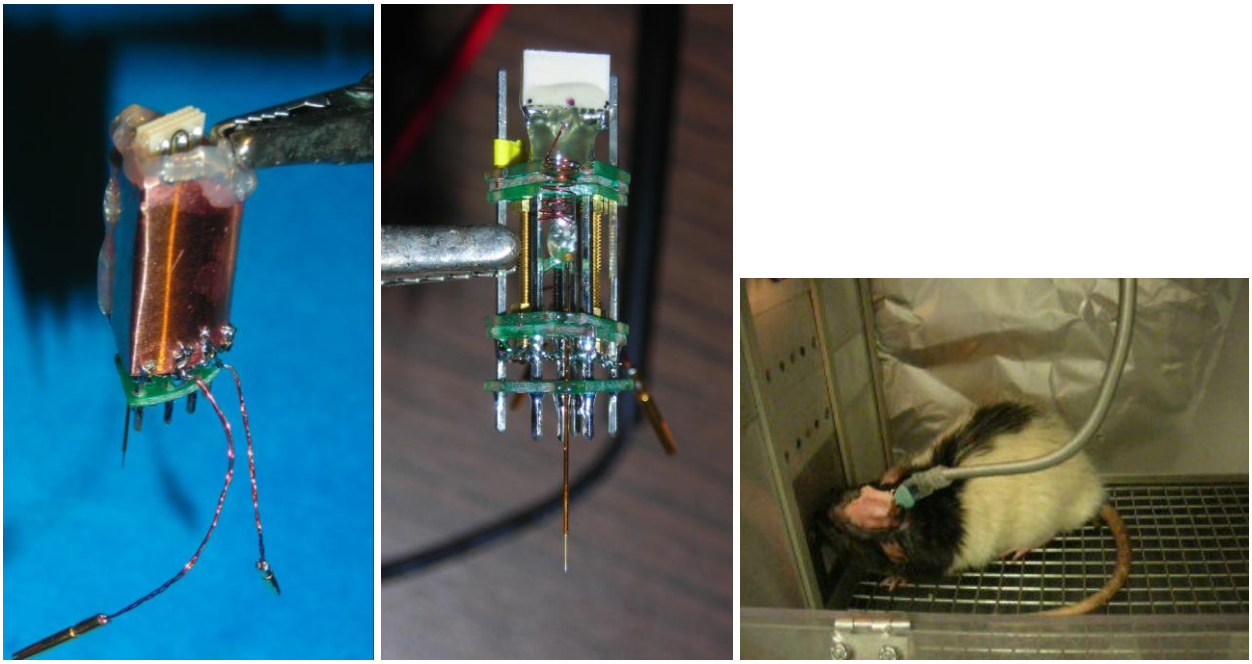

Fig. 3. Our smallest PCB microdrive can move one single tungsten electrode or one tetrode (Left, Center). It is uniquely designed for recordings from PBN taste neurons in freely moving rats during sucrose licking (Right).

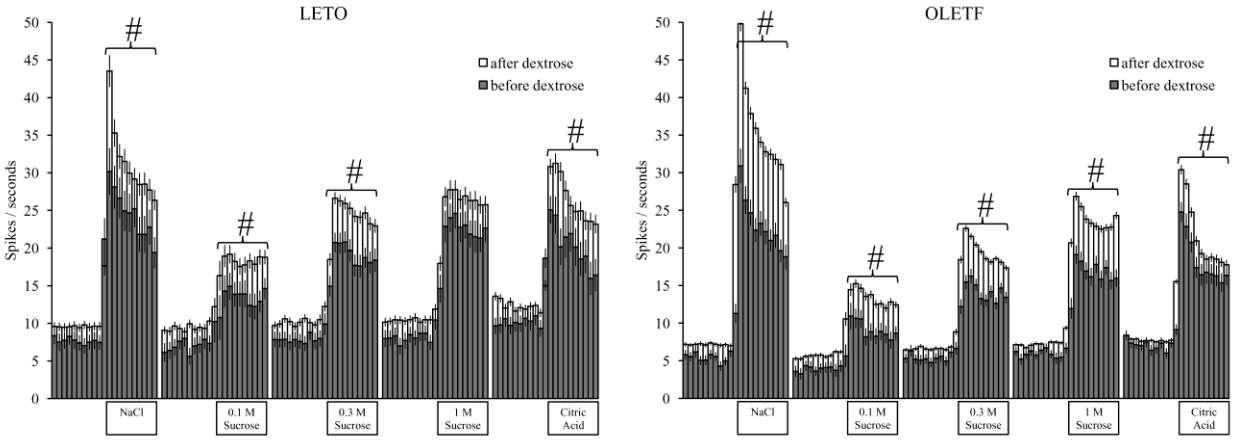

Fig. 4. Systemic dextrose augmented neuronal taste responses in the PBN to oral NaCl, sucrose and citric acid in both LETO and OLETF rats; however the magnitude of the effect for sucrose was reduced in obese rats. Mean (± SEM) neuronal responses to oral taste stimulation in the PBN of 10 LETO and 10 OLETF (20 and 27 neurons, respectively). # $p < 0.05$ compared to before dextrose (poststimulus 0-10 s mean taste response magnitudes).

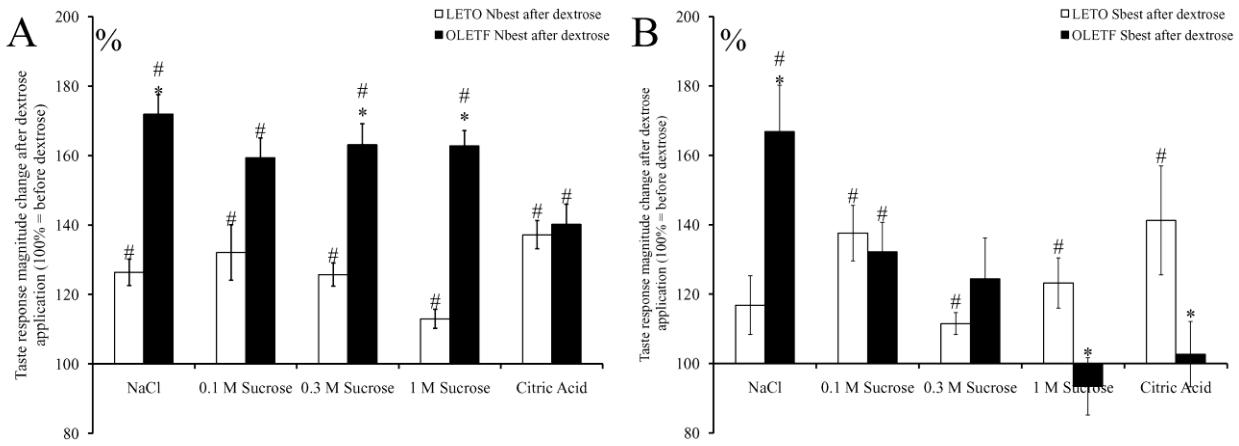

Fig. 5. The across neuron pattern of taste evoked activity following dextrose infusions was significantly different in obese and lean rats. A) Taste response magnitude changes in the N-best population; B) Taste response magnitude changes in the S-best neuronal class. * $p < 0.05$ compared to LETO, or # $p < 0.05$ compared to baseline. The NaCl-best neurons displayed significantly larger responses to NaCl and to 0.3- and 1 M concentrations of sucrose but not to citric acid in obese compared with lean rats (Fig. 6/A; +72% vs. +25%; +60% vs. +35%; +39% vs. +38%, respectively). In contrast, sucrose-best units in obese rats responded more vigorously only to NaCl (+68% vs. +18%), but showed no increase to 1.0M sucrose (-6% vs. +23%).

Conference and meeting presentations related to the project:

1. Kovacs P, **Hajnal A**. Acute surges of blood glucose affect pontine taste processing differentially in lean and obese rats. Abstracts of the 17th Annual Meeting of the Society for the Study of Ingestive Behavior, July 28- Aug 1, 2009, Portland, OR. *Appetite* 52(3): 842. 2009.
2. Pritchett CE, Kovacs P, **Hajnal A.** Parabrachial taste responses to sucrose, fructose and Polycose in the rat. Abstracts from the Thirty-second Annual Meeting of the Association for Chemoreception Sciences. *Chemical Senses* 35(7): 627-644. 2010.

18. Extent of Clinical Activities Initiated and Completed. Items 18(A) and 18(B) should be completed for all research projects. If the project was restricted to secondary analysis of clinical data or data analysis of clinical research, then responses to 18(A) and 18(B) should be "No."

18(A) Did you initiate a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

_____Yes
__X__ No

18(B) Did you complete a study that involved the testing of treatment, prevention or diagnostic procedures on human subjects?

_____Yes
___X__No

If "Yes" to either 18(A) or 18(B), items 18(C) – (F) must also be completed. (Do NOT complete 18(C-F) if 18(A) and 18(B) are both "No.")

18(C) How many hospital and health care professionals were involved in the research project?

_____Number of hospital and health care professionals involved in the research project

18(D) How many subjects were included in the study compared to targeted goals?

_____Number of subjects originally targeted to be included in the study
_____Number of subjects enrolled in the study

Note: Studies that fall dramatically short on recruitment are encouraged to provide the details of their recruitment efforts in Item 17, Progress in Achieving Research Goals, Objectives and Aims. For example, the number of eligible subjects approached, the number that refused to participate and the reasons for refusal. Without this information it is difficult to discern whether eligibility criteria were too restrictive or the study simply did not appeal to subjects.

18(E) How many subjects were enrolled in the study by gender, ethnicity and race?

Gender:
_____Males
_____Females
_____Unknown

Ethnicity:
_____Latinos or Hispanics
_____Not Latinos or Hispanics
_____Unknown

Race:
_____American Indian or Alaska Native
_____Asian
_____Blacks or African American
_____Native Hawaiian or Other Pacific Islander
_____White
_____Other, specify:_____
_____Unknown

18(F) Where was the research study conducted? (List the county where the research study was conducted. If the treatment, prevention and diagnostic tests were offered in more than one county, list all of the counties where the research study was conducted.)

19. Human Embryonic Stem Cell Research. Item 19(A) should be completed for all research projects. If the research project involved human embryonic stem cells, items 19(B) and 19(C) must also be completed.

19(A) Did this project involve, in any capacity, human embryonic stem cells?
_____ Yes
___X_ No

19(B) Were these stem cell lines NIH-approved lines that were derived outside of Pennsylvania?
____ Yes
____ No

19(C) Please describe how this project involved human embryonic stem cells:

20. Articles Submitted to Peer-Reviewed Publications.

20(A) Identify all publications that resulted from the research performed during the funding period and that have been submitted to peer-reviewed publications. Do not list journal abstracts or presentations at professional meetings; abstract and meeting presentations should be listed at the end of item 17. **Include only those publications that acknowledge the Pennsylvania Department of Health as a funding source** (as required in the grant agreement). List the title of the journal article, the authors, the name of the peer-reviewed publication, the month and year when it was submitted, and the status of publication (submitted for publication, accepted for publication or published.). Submit an electronic copy of each publication or paper submitted for publication, listed in the table, in a PDF version 5.0.5 (or greater) format, 1,200 dpi. Filenames for each publication should include the number of the research project, the last name of the PI, the number of the publication and an abbreviated research project title. For example, if you submit two publications for PI Smith for the "Cognition and MRI in Older Adults" research project (Project 1), and two publications for PI Zhang for the "Lung Cancer" research project (Project 3), the filenames should be:

Project 1 – Smith – Publication 1 – Cognition and MRI
Project 1 – Smith – Publication 2 – Cognition and MRI
Project 3 – Zhang – Publication 1 – Lung Cancer
Project 3 – Zhang – Publication 2 – Lung Cancer

If the publication is not available electronically, provide 5 paper copies of the publication.

Note: The grant agreement requires that recipients acknowledge the Pennsylvania Department of Health funding in all publications. Please ensure that all publications listed acknowledge the Department of Health funding. If a publication does not acknowledge the funding from the Commonwealth, do not list the publication.

Title of Journal Article:	Authors:	Name of Peer-reviewed Publication:	Month and Year Submitted:	Publication Status (check appropriate box below):
1. Gastric bypass surgery alters behavioral and neural taste functions for sweet taste in obese rats	Andras Hajnal, Peter Kovacs, Tamer Ahmed, Katia Meirelles, Christopher J. Lynch, and Robert N. Cooney	**American Journal of Physiology**, Gastrointestinal and Liver Physiology 299:967-979, 2010	Feb 2010	☐Submitted ☐Accepted XPublished

20(B) Based on this project, are you planning to submit articles to peer-reviewed publications in the future?

Yes_____X____ No_____

If yes, please describe your plans:

A manuscript has been written up and circulated among the authors that contains data partially collected using the method developed with this CURE grant support. Accordingly, the partial funding will be acknowledged.

21. Changes in Outcome, Impact and Effectiveness Attributable to the Research Project. Describe the outcome, impact, and effectiveness of the research project by summarizing its impact on the incidence of disease, death from disease, stage of disease at time of diagnosis, or other relevant measures of outcome, impact or effectiveness of the research project. If there were no changes, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None

22. Major Discoveries, New Drugs, and New Approaches for Prevention Diagnosis and Treatment. Describe major discoveries, new drugs, and new approaches for prevention, diagnosis and treatment that are attributable to the completed research project. If there were no major discoveries, drugs or approaches, insert "None"; do not use "Not applicable." Responses must be single-spaced below, and no smaller than 12-point type. DO NOT DELETE THESE INSTRUCTIONS. There is no limit to the length of your response.

None

23. Inventions, Patents and Commercial Development Opportunities.

23(A) Were any inventions, which may be patentable or otherwise protectable under Title 35 of the United States Code, conceived or first actually reduced to practice in the performance of work under this health research grant? Yes_____ No___X_____

If "Yes" to 23(A), complete items a – g below for each invention. (Do NOT complete items a - g if 23(A) is "No.")

a. Title of Invention:

b. Name of Inventor(s):

c. Technical Description of Invention (describe nature, purpose, operation and physical, chemical, biological or electrical characteristics of the invention):

d. Was a patent filed for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____

If yes, indicate date patent was filed:

e. Was a patent issued for the invention conceived or first actually reduced to practice in the performance of work under this health research grant?
Yes_____ No____
If yes, indicate number of patent, title and date issued:
Patent number:
Title of patent:
Date issued:

f. Were any licenses granted for the patent obtained as a result of work performed under this health research grant? Yes_____ No____

If yes, how many licenses were granted?_____

g. Were any commercial development activities taken to develop the invention into a commercial product or service for manufacture or sale? Yes___ No____

If yes, describe the commercial development activities:

23(B) Based on the results of this project, are you planning to file for any licenses or patents, or undertake any commercial development opportunities in the future?

Yes_____ No___X_____

If yes, please describe your plans:

24. Key Investigator Qualifications. Briefly describe the education, research interests and experience and professional commitments of the Principal Investigator and all other key investigators. In place of narrative you may insert the NIH biosketch form here; however, please limit each biosketch to 1-2 pages. *For Nonformula grants only – include information for only those key investigators whose biosketches were not included in the original grant application.*

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors in the order listed on Form Page 2.
Follow this format for each person. **DO NOT EXCEED FOUR PAGES.**

NAME	POSITION TITLE
Hajnal, Andras	Professor
eRA COMMONS USER NAME (credential, e.g., agency login) AHAJNAL	

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
University Medical School Pecs, Hungary	M.D. (s.c.l.)	1989	Medicine
University Medical School Pecs, Hungary	Ph.D.	1996	Neuroscience
Princeton University, Princeton, NJ	Postdoc.	1993, 1994	Neurochemistry
PennState Univ., Coll. Med., Hershey, PA	Postdoc.	1997-1999	Neurophysiology

Positions and Honors

07/01/2012 - Professor, Dept. of Neural and Behavioral Sciences, Dept. of Surgery
07/01/2007 – Present, Associate Professor, Dept. of Neural and Behavioral Sciences, PSU-COM
01/01/2008 – Present, Associate Professor, Dept. of Surgery, PSU-COM, (secondary appointment)
2003 – 2007 Assistant Professor (Tenure track); Dept. of Neural and Behavioral Sciences, PSU-COM
1999 – 2003 Assistant Professor (Non-tenure); Dept. of Behavioral Science, PSU-COM
1996 – 1997 Visiting Assistant Professor; Dept. of Behavioral Neuroscience, OHSU, Portland, OR
1995 – 1999 Res. Associate and Academic Advisor; Dept. of Physiology, Univ. Med. School, Pécs, Hungary
2009 Hinkle Society Mid-Career Translational Research Award (Penn State Univ., College of Medicine)
1997 Young Investigator Award of the Hungarian Academy of Sciences
1995 Környey Memorial Award in Experimental Neurology
1992 Endre Grastyán Award in Behavioral Neuroscience
1992 “Pro Scientia” Mentor Award of the Hungarian Academy of Sciences
1989 “Pro Scientia” Young Investigator Award of the Hungarian Academy of Sciences
1988 Research Award of the Hungarian Society of Nutrition
1988 Research Award of the Hungarian EEG Society

Academic Affiliations: The PennState Hershey Diabetes and Obesity Institute
The Huck Institutes of the Life Sciences
The Nutritional Neuroscience Center of Excellence
The PennState Hershey Neuroscience Institute

Teaching Affiliations: M.D. Program PSU-COM, 1999 - Present
The PennState Graduate School, 1999 - Present
Neuroscience Graduate Program (COM), 1999- Present,
Nutritional Sciences Graduate Program, 2005 - Present
Physiology Graduate Program, 2009 – Present
MD-PhD Program, 2010 – Present

Past and Current Mentoring: Fellows and Residents (3), including current OBGYN Fellow (Dr. Mezei)
Postdoctoral Trainees (10 individuals),
Ph.D. Thesis Advisor (4 individuals),
Ph.D., M.S., M.D.-Ph.D. Degree Committee Member (17 individuals),
Undergraduate Interns (11 individuals),
High School Research Mentor (2 individuals)

Academic and Professional Services:

2011-	Committee on Fellowships and Awards (PSU Graduate Council) 2011-12 Chair
2011-	Ad Hoc Member, NIH Study Section, Neurobiology of Motivated Behavior Study Section [NMB]
2010-	Ad Hoc Member, NIH Study Section, Integrative Physiology of Obesity and Diabetes [IPOD]
2010-	Penn State University Graduate Council - Member
2010-2011	Committee on Academic Standards - Member (PSU Graduate Council)
2010-	College of Medicine's Conflict of Interest Review Committee, Member (PSU-COM)
2009-	College of Medicine's Scientific Review Committee, Member (SRC)
2009-	Editorial Board Member, Journal of Obesity
2008-	Promotion & Tenure Committee - Member (Dept. of Neural and Behavioral Sciences)
2008-	Course Director – Systems Neuroscience Graduate Course (NEURO 521)
2003-2004	General Clinical Research Center Grant Review Committee, Member (PSU-COM)
2000-	Medical Student Admission Interviewer

Publications most relevant to the current application (Selected from 60 peer-reviewed publications)

Hajnal A, Norgren R. Accumbens dopaminergic mechanisms in sucrose intake. ***Brain Research*** 9 04(1) 76-84, 2001. PMID: 11516413

Hajnal A, Smith GP, and Norgren R. Oral sucrose stimulation increases accumbens dopamine in the rat. ***American Journal of Physiology (Regul Integr Comp Physiol)*** 286:R31-R37, 2004. PMID:12933362

Hajnal A and Norgren R. Taste pathways that mediate accumbens dopamine release by sapid sucrose. ***Physiology & Behavior*** 84(3):363-369, 2005. PMID: 15763573

Anderzhanova E, Covasa M, and **Hajnal A.** Altered basal and stimulated accumbens dopamine release in obese OLETF rats as a function of age and diabetic status. ***American Journal of Physiology (Regul Integr Comp Physiol.)*** 293:R603-611, 2007. PUBMED CID: 17553848

Hajnal A, Acharya NK, Grigson PS, Covasa M, Twining RC. Obese OLETF rats exhibit increased operant performance for palatable sucrose solutions and differential sensitivity to D2 receptor antagonism. ***American Journal of Physiology (Regul Integr Comp Physiol.)*** 293(5):R1846-54, 2007. PUBMED CID: 17804583

Grigson PS, and **Hajnal A.** Once is too much: Conditioned changes in accumbens dopamine following a single saccharin-morphine pairing. ***Behavioral Neuroscience*** 121(6): 1234-1242, 2007.

Kovacs P, and **Hajnal A**. Altered pontine taste coding in a rat model of obesity. ***Journal of***

Neurophysiology 100(4):2145-57. 2008. PUBMED CID: 18550724

Hajnal A, Norgren R, Kovacs P. Parabrachial coding of sapid sucrose: Relevance to reward and obesity. ***Annals of the New York Academy of Sciences*** 1170: 347-364. 2009. PUBMED CID: 19686159

Bello, NT, **Hajnal A**. Dopamine and binge eating behaviors. ***Pharmacology, Biochemistry and Behavior*** 97(1):25-33. 2010. PUBMED CID: 20417658

Hajnal A, Kovacs P, Ahmed TA, Meirelles K, Lynch CJ, Cooney RN. Gastric bypass surgery alters behavioral and neural taste functions for sweet taste in obese rats ***American Journal of Physiology (Gastrointest Liver Physiol.)*** 299(4):G967-79. 2010. PMID: 20634436

Pritchett CE, and **Hajnal A**. Glucagon-like peptide-1 (GLP-1) regulation of carbohydrate intake is differentially affected by obesogenic diets. ***Obesity*** (Silver Spring) 20(2):313-7, 2012. PMID: 22134200

Pritchett CE, Hajnal A. Obesogenic diets may differentially alter dopamine control of sucrose and fructose intake in rats. Physiology & Behavior 104(1):111-6. 2011.

Geraedts MCP, Takahashi T, Vigues S, Markwardt ML, Nkobena A, Cockerham RE, **Hajnal A**, Dotson CD, Rizzo MA, Munger SD. Transformation of post-ingestive glucose responses after deletion of sweet taste receptor subunits or gastric bypass surgery. ***American Journal of Physiology*** **(Endocrinology and Metabolism)** in press. PMID:22669246

Hajnal A, Zharikov A, Polston JE, Fields MR, Tomasko J, Rogers AM, Volkow ND, Thanos PK. Alcohol reward is increased after Roux-en-Y gastric bypass in dietary obese rats with differential effects following ghrelin antagonism. ***PLOS One*** 7(11): e49121. doi:10.1371/journal.pone.0049121, 2012. Epub 2012 Nov 7. PMID: 23145091

Thanos PK, Subrize M, Delis F, Cooney RN, Culnan D, Sun M, Wang GJ, Volkow ND, **and Hajnal A.** Gastric bypass increases ethanol and water consumption in dietary obese rats. ***Obesity Surgery*** Obes Surg. 2012 Dec; 22(12):1884-92. PMID: 22976430

Research Grants

ACTIVE GRANTS

5 R01 DC000240-29 Hajnal (PI) NIH/NIDCD 04/01/2010 – 03/31/2015
Neural Systems of Ingestive Behavior
The main objective of this project is the electrophysiological, neurochemical, anatomical, and behavioral investigations of gustatory control of ingestive behavior in rats.
Role: PI

1 R01 DK080899-03 Hajnal (PI) NIH/NIDDK 04/01/2009-03/31/2013
Gastric bypass surgery alters the regulation of food reward
The main objective of this project is to investigate behavioral and neural food reward functions following gastric bypass surgery in animal models of obesity.
Role: PI

F31DC011671 (PI: Pritchett) NIH/NIDCD 08/01/2011 – 07/31/2013
Central Effects of Glucagon-Like Peptide-1 on Gustatory Reward
This project is aimed at studying taste and reward correlates of CNS GLP-1 in lean and obese rats.
Role: Sponsor/Mentor

R01DK084428-01 Lynch (PI) NIH/NIDDK 09/01/2010 - 08/30/2014
Mechanisms of drug side effects related to obesity and diabetes
This project is aimed at determining the role of induced metabolic inflexibility in the development of obesity and diabetes in response to antipsychotic medications, and developing assays to predict the likelihood of metabolic side effects in novel agents.
Role: Co- Investigator

No number Rogers (PI) SAGES 04/01/2011 – 03/31/2013
Functional MRI Studies in Roux-en-Y Gastric Bypass Patients To Study Alteration in Taste Functions After Surgery
The goal of this translational clinical study is to study effects of Roux-en-Y gastric bypass surgery on taste-elicited brain activation.
Role: Co-Investigator

COMPLETED GRANTS (as PI/Mentor only):
1 R01 DK080899-A02-W1 Hajnal (PI) NIH/NIDDK ACC-Supplement 08/01/2009-6/30/2010
Gastric bypass surgery alters the regulation of food reward
This award is used to purchase equipment to expedite progress on the parent grant.
Role: PI

No number Hajnal (PI) PA Dept of Health Tobacco Settlement Grant 07/01/2009 -06/30/2010
Novel multielectrode recording techniques for assessment of taste functions in the brain.
The major goal of this project is to develop novel electrophysiological recording techniques for assessment of taste functions in the brain.
Role: PI

R01 DK065709 Hajnal (PI) NIH/NIDDK 01/01/2004 -12/31/2009
Dopamine mechanisms in development of type-2 diabetes
The main objective of this application is to characterize dopaminergic correlates of type-2 diabetes in the CCK-1 receptor deficient OLETF rats.

No number: Hajnal (PI) PSU-COM 07/01/2006 – 06/30/2007
Penn State Diabetes Center Seed Grant
Neural insulin sensitivity in type-2 diabetes before and after weight reduction
To develop electrophysiological methods for investigation of effects of weight reduction on neural alterations in diabetic rat models.

No number: Dean's Feasibility Grant, Hajnal (PI) PSU-COM 07/01/2005 – 06/30/2006
Effects of gastric bypass surgery on taste sensitivity and food preference in rat models of obesity
The objective of this project is to characterize taste functions in obese rat models before and after bariatric surgery using behavioral and electrophysiological methods.

F31 NS 046872 Bello (PI) Sponsor/Mentor: Hajnal NIH/NINDS 01/01/2004 – 02/28/2006
Effects of insulin on the mesoaccumbens dopamine system
The goal of this project is to characterize role of the forebrain in mediating insulin's effects.

R03 DC 04751 Hajnal (PI) NIH/NIDCD 01/01/2001 – 12/31/2003
Gustatory Reward and Dopamine in the Nucleus Accumbens
The major goal of this project is to investigate orosensory effects of sucrose on activation of the reward pathways.