

# CURRICULUM VITAE

## Christopher B. Brown, Ph.D.

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Franklin, TN 37064  
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### Academic Appointments:

2017-present Assistant Professor, Department of Pharmaceutical Social and Administrative Sciences, College of Pharmacy, Belmont University (Tenure track)  
2017-present Adjunct Faculty, Department of Pharmacology, Vanderbilt University  
2009-2016 Assistant Professor of Pediatrics and Pharmacology, Vanderbilt University (Research track)  
2003-2009 Assistant Professor of Pediatrics and Pharmacology, Vanderbilt University (Tenure track)

### Postgraduate Training:

1999-2003 Postdoctoral fellow. Division of Cardiology. University of Pennsylvania, Philadelphia, Pennsylvania. Laboratory of Jonathan A. Epstein M.D.  
1997-1998 Postdoctoral fellow. Division of Cardiology. Vanderbilt University Medical Center, Nashville, Tennessee. Laboratory of Joey V. Barnett PhD.

### Education:

1992-1997 Ph.D., Vanderbilt University, Nashville, Tennessee (Pharmacology).  
1990-1992 M.S. student, Auburn University, Auburn Alabama (Zoology).  
*Transferred after acceptance to PhD program At Vanderbilt University*  
1986-1990 B.S., Auburn University, Auburn, Alabama (Microbiology).

### Research Experience:

1999-2003 Postdoctoral fellow in the Division of Cardiology. University of Pennsylvania, Philadelphia, Pennsylvania. Laboratory of Jonathan A. Epstein M.D. Studied transcriptional regulation and signalling systems governing cardiac neural crest cell mediated septation of the outflow tract during heart development in mouse transgenic model systems.

- 1998-1999 Postdoctoral fellow in the Division of Cardiology. Vanderbilt University, Nashville, Tennessee. Laboratory of Joey V. Barnett Ph.D. Studied the role of TGF $\beta$  receptors in regulating and localizing endothelial to mesenchymal transformation (EMT) during cardiac valve formation in the chicken model system.
- 1992-1997 Graduate Student, Department of Pharmacology. Vanderbilt University, Nashville, Tennessee. Research Project, "The role of the Type II and Type III TGF $\beta$  receptors in atrioventricular cushion transformation" (Preceptor: Joey V. Barnett Ph.D.).
- 1990-1992 Graduate Student in M.S. program, Department of Zoology and Wildlife Science. Auburn University, Auburn, Alabama. Research Project: "Effects of alcohol on HL-60 cell differentiation." Degree not completed in favor of Ph.D. program at Vanderbilt.
- 1990 Graduate Student in M.S. program, Department of Animal and Dairy Science. Auburn University, Auburn, Alabama. "Microbial and nutritional properties of broiler litter as an alternate bovine food source". Switched to M.S. Program in Zoology and Wildlife science to pursue interests and learn techniques in molecular biology.
- 1989-1990 Undergraduate Research Assistant, Department of Animal and Dairy Science. Auburn University, Auburn, Alabama. "Microbial and nutritional properties of broiler litter as an alternate bovine food source"

**Teaching Experience:**

- 2017 GND 1015 First Year Seminar, Belmont University.
- 2017 PHM 6120 Human Anatomy & Physiology for Pharmacy, Belmont University. College of Pharmacy
- 2017 PHM 6260 Professional and Technical Writing, Belmont University. College of Pharmacy
- 2017 PHM 6150 Microbiology and Immunology, Belmont University. College of Pharmacy
- 2016 Biochemistry I, Fisk University. "Serine/threonine receptor kinase signaling" Guest lecturer
- 2016 Targets, systems and Drug Action PHAR 8320. "Smooth muscle" lecturer
- 2013-present 9th floor research group journal club Faculty Mentor
- 2007 "Neural Crest" lecture in Cell Bio 320 (Cancer and Embryonic Development)
- 2005-2006 Pharmacology student seminar Faculty mentor
- 2004-2005 Pharmacology student seminar Faculty mentor
- 1990-1992 Genetics Laboratory Teaching Assistant (graduate)
- 1990 Food Microbiology Laboratory Teaching Assistant (graduate)
- 1990 Animal Physiology Laboratory Teaching Assistant (undergraduate)
- 1989 Animal Biology Laboratory Teaching Assistant (undergraduate)

1989                    General Biology Laboratory Teaching Assistant (undergraduate)

**Professional Societies:**

American Heart Association  
Society for Developmental Biology

**Professional Activities:**

2005-2009            American Heart Association Board member (Nashville affiliate)

**University and Departmental Committees:**

July 2005            Department of Pharmacology strategic planning group

July 2006            Pharmacology preliminary-examination committee

**Journal Reviewership:**

Ad hoc reviewer for:  
Developmental Biology  
Developmental Dynamics  
Genesis  
Pediatric Research

**Awards and Honors:**

2000                    Individual National Research Service Award, "Somite specific expression of Pax3 in transgenic mice."

1996                    Attended summer course, "Embryology: cell differentiation and gene expression in early development," at Marine Biological Laboratories, Woods Hole, Massachusetts.

1996                    Ph.D. Dissertation Enhancement Award, Vanderbilt University Graduate School.

1996                    Dan May Summer Fellowship, Department of Medicine, Vanderbilt University.

**Trainee Committee Membership:**

2015-2017            Cami Johnson, PhD Candidate (Biomedical Engineering), Vanderbilt University

2010-2017            Jeffrey Bylund, PhD Candidate (Committee Chair)(Pharmacology), Vanderbilt University

2010-2014            Bryan Fioret, PhD (committee chair)(Pharmacology), Vanderbilt University

2010-2015            Joe Chen, PhD (Biomedical Engineering)Vanderbilt University

2009-2014            Mary-Katherine Sewell-Lofton, PhD (Biomedical Engineering), Vanderbilt University

2007-2011            Nora Sanchez, PhD (Pharmacology), Vanderbilt University

2007-2011            Josh Barnett, PhD (Pharmacology), Vanderbilt University

2007-2010            Erin McArdle, PhD (Pharmacology), Vanderbilt University

2006-2007            Brian Culbreath, MS (Pharmacology), Meharry University

2006-2012 Cyndi (Hill) Clark, PhD (Pharmacology), Vanderbilt University  
2006-2008 Todd Townsend, PhD (Pharmacology), Vanderbilt University  
2006-2007 Patrick O'Mara MD, Clinical Fellow (Neonatology), S.O.C.

**Trainees:**

2006-2009 **Cynthia (Hill) Clark, PhD.** Pharmacology (completed degree with Joey Barnett PhD). Currently, Research Assistant Professor of Biomedical Engineering. Vanderbilt University  
2005-2007 **Diego Porras, MD.** Postdoctoral Fellow, Cardiologist, Instructor in Pediatrics, Harvard Medical School, Boston Children's Hospital  
2005-2007 **Nathan Mundell, PhD.** Pharmacology (completed degree with Patricia Labosky PhD). Research Fellow (Genetics), Harvard  
2005-2006 **Qing Cai PhD.** Switched to Molecular Physiology and Biophysics and completed degree in 2012.  
2004-2005 **Kennita Ferguson PharmD.** David Lipscomb University. Was a PhD candidate from Meharry Medical College before pursuing Pharmacy degree.

**University Outreach:**

May 15, 2015 Cardiovascular development and disease presentation for Vanderbilt "Aspirnaut" program  
June 6, 2014 Cardiovascular development and disease presentation for Vanderbilt "Aspirnaut" program  
June 1, 2012 Cardiovascular development and disease presentation for Vanderbilt "Aspirnaut" program

**Research Program**

**Publications:**

Chen J, Ryzhova LM, Sewell-Loftin MK, Brown CB, Huppert SS, Baldwin HS, Merryman WD. Notch1 mutation leads to valvular calcification through enhanced myofibroblast mechanotransduction. *Arterioscler Thromb Vasc Biol.* 2015 May 28

Hill CR, Jacobs BH, Brown CB, Barnett JV, Goudy SL. Type III transforming growth factor beta receptor regulates vascular and osteoblast development during palatogenesis. *Dev. Dyn.* 2015 Feb;244(2): 122-123.

Sewell-Lofton MK, Delaughter DM, Peacock JR, Brown CB, Baldwin HS, Barnett, JV, Merryman WD. Myocardial contraction and hyaluronic acid mechanotransduction in epithelial-to-mesenchymal transformation of endocardial cells. *Biomaterials.* 2014 Mar; 35(9) 2809-15.

Sewell-Loftin, M.K., Brown, C.B., Baldwin, H.S., Merryman, D.W. Novel technique for quantifying mouse heart valve leaflet stiffness with atomic force microscopy. *J. Valv. Dis.* 2012 Jul;21(4):513-20.

- Hill CR, Sanchez NS, Love JD, Arieta JH, Hong CC, Brown CB, Austin AF, Barnett JV. BMP2 signals loss of epithelial character in epicardial cells but requires the Type III TgfB receptor to promote invasion. *Cell Signal*. 2012 May;24(5):1012-22.
- Sánchez NS, Hill CR, Love JD, Soslow JH, Craig E, Austin AF, Brown CB, Czirok A, Camenisch TD, Barnett JV. The cytoplasmic domain of TGF $\beta$ R3 through its interaction with the scaffolding protein, GIPC, directs epicardial cell behavior. *Dev Biol*. 2011 Oct 15;358(2):331-343.
- Angel PM, Nusinow D, Brown CB, Violette K, Barnett JV, Zhang B, Baldwin HS, Caprioli RM. Networked-based characterization of extracellular matrix proteins from adult mouse pulmonary and aortic valves. *J Proteome Res*. 10(2):812-23. 2011
- Nie X, Brown CB, Wang Q, Jiao K. Inactivation of Bmp4 from the Tbx1 expression domain causes abnormal pharyngeal arch artery and cardiac outflow tract remodeling. *Cells Tissues Organs*. 193(6):393-403. 2011.
- Goudy, S., Law, A. Sanchez, G, Baldwin HS. and Brown, C.B. Tbx1 is Necessary for Palatal Elongation and Elevation. *Mech Dev*.127(5-6):292-300. 2010
- Levin, M.D., Lu, M-M, Petrenko, N.B., Hawkins, B.J., Gupta, T.H., Lang, D., Buckley, P.T., Jochems, J.J., Liu, F., Spurney, C.F., Yuan, I.J., Jacobson, J.T., Brown, C.B., Huang, L., Beermann, F., Margulies, K.B., Muniswamy, M., Eberwine, J.H., Epstein, J.A., Patel, V.V. Melanocyte-like cells in the heart and pulmonary veins contribute to atrial arrhythmia triggers. *JCI*, 119(11) 3420-3436. 2009
- Austin, A.F., Compton, L.A., Love, J.D., Brown, C.B. and Barnett, J.V. Primary and Immortalized Mouse Epicardial Cells Undergo Differentiation in Response to TgfB. *Dev. Dyn*. 237:366-376, 2008.
- Porras, D., Brown, C.B. Temporal-Spatial Ablation of Neural Crest in the Mouse Results in Cardiovascular Defects. *Developmental Dynamics*. 237:153-162, 2008
- Compton, L.A., Potash, D.A., Brown, C.B., Barnett, J.V. Coronary Vessel Development is Dependent on the Type III Transforming Growth Factor Beta Receptor. *Circ. Res*; 101, 784-791. 2007.
- Jiao, K., Langworthy, M., Batts, L., Brown, C.B., Moses, H.L., Baldwin, H.S. TGF $\beta$  signaling is required for atrioventricular cushion mesenchyme remodeling during in vivo cardiac development. *Development*. 133, 4585-4593, 2006.
- Brown, C.B., Engleka, K.A., Wenning, J.M., Lu, M-M., and Epstein, J.A. Identification of an hypaxial somite enhancer element regulating Pax3 expression in migrating myoblasts and characterization of hypaxial muscle Cre transgenic mice. *Genesis*. 41, 202-9. 2005
- Brown, C.B., Wenning, J.M., Lu, M-M., Epstein, D.J., Meyers, E.N., and Epstein, J.A. Cre mediated excision of *Fgf8* in the *Tbx1* expression domain reveals a critical role for Fgf8 in cardiovascular development in the mouse. *Developmental Biology* 267, 190-202. 2004
- Milewski, R., Chi, N., Brown, C.B., Lu, M-M, and Epstein J. Identification of minimal enhancer elements sufficient for Pax3 expression in neural crest and implication of TEAD-2 as a regulator of Pax3. *Development* 131, 829-837. 2004
- Lang, D., Brown, C.B., Milewski, R., Jiang, Y-Q, Lu, M-M, and Epstein J. Distinct enhancers regulate neural expression of *Pax 7*. *Genomics*. 82(5): 553-560.2003
- Marlow, M.S., Brown, C.B., Barnett, J.V. and Krezel, A.M. Solution structure of the Chick Type II Receptor Ligand-binding domain. *J. Mol. Biol*. 326, 989-997. 2003.

Feiner, L., Webber, A.L., Brown, C.B., Lu, M.M., Jia, L., Feinstein, P., Mombaerts, P., Epstein, J.A., and Raper, J.A. Targeted disruption of Semaphorin 3C leads to persistent truncus arteriosus and aortic arch interruption. *Development* 128, 3061-3070, 2001.

Brown, C.B., Feiner, L., Lu, M.M., Li, J., Ma, X., Webber, A.L., Jia, L., Raper, J.A., and Epstein, J.A. PlexinA2 and semaphorin signaling during cardiac neural crest development. *Development* 128, 3071-3080, 2001.

Epstein, J.A., Li, J., Lang, D., Chen, F., Brown, C.B., Jin, F., Lu, M.M., Thomas, M., Liu, E-C.J., Wessels, A., Lo, C.W. Migration of cardiac neural crest cells in *Spotch* embryos. *Development* 127 (9), 1869-78, 2000.

Marlow, M.S., Chim, N., Brown, C.B., Barnett, J.V, and Krezel, A.  $^1\text{H}$ ,  $^{13}\text{C}$ , and  $^{15}\text{N}$  backbone assignments of the ligand binding domain of TGF $\beta$  type II receptor. *Journal of Biomolecular NMR* 17: 349-350, 2000.

Lai, Y-T., Beason, K.B., Brames, G.P., Desgrosellier, J.S., Shaw, M.V., Brown, C.B., Barnett, J.V. Activin receptor like kinase 2 (ALK2) is required for atrioventricular cushion transformation. *Developmental Biology* 222: 1-11, 2000.

Brown, C.B., Drake, C.J., Barnett, J.V. Antibodies directed against the chicken Type II TGF $\beta$  receptor identify endothelial cells in the developing chicken and quail. *Developmental Dynamics*, 215:79-85, 1999.

Brown, C.B., Boyer, A., Runyan, R.B., Barnett, J.V., Requirement of the Type III TGF $\beta$  Receptor for Endocardial Cell Transformation in the Heart. *Science*, 283:2080-2082, 1999.

Brown, C.B., Boyer, A., Runyan, R.B., Barnett, J.V., Antibodies to the Type II TGF $\beta$  receptor block cell activation and migration. *Developmental Biology* 174:248-257, 1996.

### **Book Chapters:**

Lang, D., Brown, C.B., Epstein, J.A. *Neural Crest Formation and Craniofacial Development in Molecular Basis of Inborn Errors of Development*, Charles Epstein, Robert Erickson and Anthony Wynshaw-Boris eds. Oxford University Press, San Francisco, CA., 2004.

### **Review Articles:**

Brown CB, Baldwin HS. Neural Crest Contribution to the Cardiovascular System. *Adv. Exp Med. Biol.* 589, 134-154, 2006.

Gitler, A., Brown, C.B., Kochilas, L., Li, J and Epstein, J.A. Neural Crest Migration and Mouse Models of Congenital Heart Disease. *Cold Spring Harbor Symposia on Quantitative Biology*. 67. 2002.

### **Published Abstracts:**

Lai, Y-T., Beason, K.B., Brames, G.P., Brown, C.B., Barnett, J.V. An atypical Type I transforming growth factor beta receptor signals atrioventricular cushion transformation. *Circulation* 98 (Supp. 1): I-58, 1998.

Brown, C. B., Boyer, A., Runyan, R.B., Barnett, J.V., Type III TGF $\beta$  receptor antibodies block cell activation and migration during cardiogenesis. *Circulation* 94 (Supp. 1): I-11, 1996.

Brown, C.B., Boyer, A., Runyan, R.B., Barnett, J.V., Type II TGF $\beta$  receptor antibodies block cell activation and migration during cardiogenesis. *Circulation* 92 (Supp. 1): I-118, 1995.

### **Abstracts and Presentations at National Meetings:**

- May 4, 2012 Brown CB, Qu X, Violette, K, Sewell M-K, Merryman WD, Zhou B and Baldwin HS. "Tie1 is Required for Semilunar Valve Form and Function". (Platform talk) Weinstein Cardiovascular Development conference 2012
- Oct. 16, 2011 Brown CB, Baldwin HS. "Endocardium: The Ignored Cardiovascular Progenitor". Progenitor Cell Biology Consortium Meeting Boston 2011 (Platform talk representing Vanderbilt Research Hub)
- April 2, 2011 Brown CB, Baldwin HS. "The Importance of Endocardial Cell Heterogeneity in Valve Form and Function" Syscode Bi-annual meeting Boston.
- Oct. 21, 2010 Brown CB, Misfeldt A, Tompkins KL, Baldwin HS. Delineating the Role of Endocardial Cell Differentiation as a Vehicle to Enhance Myocardial Regeneration. Progenitor Cell Biology Consortium Meeting Seattle 2010 (Poster)
- May 15, 2008 Austin, AF, Compton, LA, Love, JD, Brown CB, Barnett, JV. Transforming Growth Factor -B stimulates smooth muscle differentiation in epicardial cells lacking the Type III Receptor. Weinstein Cardiovascular conference 2008. (Poster)
- May 10, 2007 Austin, AF, Compton, LA, Love, JD, Brown, CB, Barnett, JV. Immortalized mouse epicardial cells serve as a model of epicardial differentiation *in vitro*. Weinstein Cardiovascular conference 2007 (Poster)
- May 10, 2007 Culbreath, Brian C, Brown, CB, Barnett, JV. Tgfb3 null mice have increased atrioventricular cushion volume. Weinstein Cardiovascular conference 2007 (Poster)
- May 10, 2007 Hill CR, Brown CB. Semaphorin 3C regulation of cell adhesion in an *in vitro* assay of smooth muscle differentiation. Weinstein Cardiovascular conference 2007 (Poster)
- May 10, 2007 Porras D, Brown CB. Mechanisms of aortic arch interruption in the Semaphorin 3C null mouse. Weinstein Cardiovascular conference 2007 (Poster)
- May10, 2007 Porras D, Brown CB. Cardiovascular Defects in a Murine Model of Neural Crest Ablation. Weinstein Cardiovascular conference 2007 (Poster)
- May 10, 2007 Austin AF, Compton LA, Love JD, Brown CB, and Barnett JV. Immortalized mouse epicardial cells serve as a model of epicardial differentiation *in vitro*. Weinstein Cardiovascular conference 2007 (Poster)
- Nov. 4, 2006 American Heart Association Scientific Sessions 2006, Chicago, Illinois. 2006. Porras D, Brown, CB. Temporal Ablation of Neural Crest in the Mouse Results in Cardiovascular Defects. (Platform presentation)
- July 18, 2001 Society for Developmental Biology meeting, Seattle, WA. Pax3 hypaxial muscle expression is regulated by unique and separable enhancer elements.(Poster)
- May 17, 2001 Weinstein Cardiovascular Development Conference, Dallas, TX. Analysis of the murine Pax3 promoter reveals unique and separable hypaxial muscle enhancer elements.(Poster)
- May 17, 2001 Weinstein Cardiovascular Development Conference, Dallas, TX. Platform Talk Regulation of Pax3 expression and Cardiac neural crest function.
- June 8, 2000 Weinstein Cardiovascular Development Conference, St. Louis, MO. Plexin-A2 is a marker of Cardiac neural crest in the mouse (Poster).

- May 28, 1998 Weinstein Cardiovascular Development Conference, Nashville, TN. Role of the Type II and Type III TGF $\beta$  receptors in atrioventricular cushion transformation (Poster).
- June 5, 1997 Weinstein Cardiovascular Development Conference, Cincinnati, OH. Antibodies directed against the chicken Type II TGF $\beta$  receptor delineate cells of the endothelial lineage during early embryogenesis in quail (Poster).
- Nov. 10, 1996 American Heart Association Meeting, New Orleans, Louisiana. Type III TGF $\beta$  receptor antibodies block cell activation and migration during cardiogenesis. Oral presentation at the 69th American Heart Association Meeting, New Orleans, Louisiana (1996).
- Nov. 13, 1995 American Heart Association Meeting, Anaheim, California. Type II TGF $\beta$  receptor antibodies block cell activation and migration during cardiogenesis. Oral presentation at the 68th American Heart Association Meeting, Anaheim, California (1995).
- June 2, 1995 Weinstein Cardiovascular Development Conference, Rochester, New York. Type II TGF $\beta$  receptor antibodies block cell activation and migration during cardiogenesis. (Poster).

**Active Support**

None

**Completed Research Support**

1R01 HL118386-01 Baldwin (PI) 6/01/2013- 12/31/2016

NIH / NHLBI

"TIE TEK Modulation of Cardiac Development"

The goal of this project is to understand how the receptor tyrosine kinases Tie and Tek regulate endocardial growth and cardiovascular development.

Role: Co-Investigator

1R01 HL-115103-01A1 Merryman (PI) 07/01/2013-12/31/2016

NIH/ NHLBI

"Serotonergic Receptor Targeted Therapy for Degenerative Aortic Valve Disease"

The goal of this project is to understand how serotonergic signaling through the 5HT-2B receptor mediates the dysmorphology and calcification of the aortic valve during development and disease.

Role: Co-Investigator

1U01 HL100398-01 Hatzopoulos (PI) 9/30/2009 – 6/30/2016

NIH / NHLBI

"Optimizing Cardiovascular Stem Cells for Cardiac Repair and Regeneration"

Role: Co-Investigator

NIH P30 ES000267 04/01/2012 - 03/31/2013

Center in Molecular Toxicology Pilot Project

" NFATc1, a Potential Mediator of TCDD Induced Developmental Vascular Defects"

Role: Co-Investigator

U54 RR 024358 Maas (PI) 09/30/2007-06/30/2012

NIH [1RL1 HL092551]



"Syscode:Systems based Consortium of Organ Design and Engineering"  
Multi-institutional (Harvard, MIT, Vanderbilt) program for organ design  
Project 3 "Heart Valve Design and Engineering"  
Role: Collaborator

R01 HL085708 Barnett, (PI) 02/01/2008-01/31/2012  
NIH/NHLBI

"Type III transforming growth factor beta receptor in coronary vessel development"  
Role of growth factor signaling in coronary development  
Role: Co-Investigator

5P30 DK079341-02 Harris (PI) 09/01/2008 - 08/30/2013  
NIH / NIDDK

Vanderbilt O'Brien Mouse Kidney Physiology and Disease Center  
"Modulation of renal ischemia reperfusion injury by NFATc1"  
Role: Co-Investigator

5R01 HL086964-02 Baldwin (PI) 07/01/2008 - 5/31/2012  
NIH / NHLBI

"The Role of NDRG4 in Myocardial Development"  
Role: Co-Investigator

Predoctoral fellowship Mundell 07/01/2006-6/30/2008  
American Heart Association

"Semaphorin Regulation of Cardiac Neural Crest Development"  
"To determine the mechanism of Semaphorin 3C Regulation of Cardiac Neural Crest Cell Function."  
Role: Pre-doctoral sponsor

F32 HL082101 Diego Porras MD 07/19/2005-7/18/2007  
NIH/NHLBI (NRSA)

"The Secondary Heart Field in Outflow Tract Remodeling"  
To determine the contribution of Tbx1 expressing cells to outflow tract development and remodeling.  
Role: Post-doctoral sponsor

Scientist Development Grant(0430085N) 1/01/2004-12/31/2007  
American Heart Association

"Tbx1 Regulation of Cardiovascular Development and Morphogenesis"  
To determine the cell-autonomous and cell non-autonomous functions of Tbx1 in patterning and morphogenesis of the cardiovascular system.  
Role: PI

Basil O'Connor Starter Scholar Research Award 02/01/2005-12/31/07  
March of Dimes Birth Defects Foundation

"Semaphorin 3C Signaling in Cardiac Neural Crest Development"  
"To determine the role of Semaphorin 3C signaling in the cardiac neural crest during pharyngeal arch and conotruncal patterning in the mouse."  
Role:PI

F32 AR08584-03 Brown (PI) 02/01/2000-1/31/2003  
NIH/NIAMS NRSA

"Somite specific expression of Pax3 in transgenic mice."  
"To determine the molecular regulation of Pax3 expression in the somite and muscle precursors."  
Role: PI

