

P. H. Torkkeli - publications

A) Refereed Journals (62)

Frolov R., Immonen E.-V., Saari P., **Torkkeli P.H.**, Liu H. & French A.S. 2018: The limits of phenotypic plasticity in *Periplaneta americana* photoreceptors. Submitted to *J. Neurosci.*

Sukumar V., Liu H., Meisner S., French A.S. & **Torkkeli P.H.** 2018: Multiple biogenic amine receptor types modulate spider, *Cupiennius salei*, mechanosensory neurons. Submitted to *Cellular and Molecular Life Sciences*

Saari P., Immonen E.-V., French A.S., **Torkkeli P.H.**, Liu H., Heimonen K. & Frolov R. 2018: Knock-down of *Periplaneta americana* opsins reveals anomalous spectral sensitivity of green-sensitive photoreceptors and ephaptic interactions in bright light. Submitted ?l.

Fabian-Fine R., Anderson C., Roush M., Johnson, J.A.G. Liu H., French A.S. & **Torkkeli P.H.** 2017: The distribution of cholinergic neurons, and their co-localization with FMRFamide in central and peripheral neurons of the spider *Cupiennius salei*. *Cell and Tissue Res.* 370:71-88.

Immonen E.-V., French A.S., **Torkkeli P.H.**, Liu H., Vähäsöyrinki M., & Frolov R. 2017: EAG-based channelomes of microvillar photoreceptors are unsuited to diurnal vision. *J Physiol.* 595:5465-5479.

Saari P., French A.S., **Torkkeli P.H.**, Liu H., Immonen E.-V. Frolov RV 2017: Distinct roles of light-activated channels TRP and TRPL in photoreceptors of *Periplaneta Americana*. *J. Gen. Physiol.* 149: 455-464.

Liu H., French A.S & **Torkkeli P.H.** 2017: Expression of Cys-loop receptor subunits and acetylcholine binding protein in the mechanosensory neurons, glial cells and muscle of the spider *Cupiennius salei*. *J. Comp. Neurol* 525:1139-1154.

Torkkeli P.H., Liu H. & French A.S. 2015: Transcriptome analysis of the central and peripheral nervous systems of the spider *Cupiennius salei* reveals multiple putative Cys-loop ligand gated ion channel subunits and an acetylcholine binding protein. *Plos One* 10(9): e0138068. DOI: 10.1371/journal.pone.0138068

French A.S. & **Torkkeli P.H.** 2015: Some recent advances in spider sensory physiology. *Physiology News* 99: 34-37 (invited contribution)

French A.S., Meisner S., Liu H., Weckström M. & **Torkkeli P.H.** 2015: Transcriptome analysis and RNA interference of cockroach phototransduction indicate three opsins and suggest a major role for TRPL channels. *Frontiers of Physiology* doi: 10.3389/fphys.2015.00207

Fabian-Fine R., Meisner S., **Torkkeli P.H.** & Meinertzhagen I.A. 2015: Co-localization of gamma-aminobutyric acid and glutamate in neurons of the spider central nervous system. *Cell*

and *Tissue Research* 362: 461-479

French A.S., Li A.W., Meisner S. & **Torkkeli P.H.** 2014: Upstream open reading frames and Kozak regions of assembled transcriptome sequences from the spider *Cupiennius salei*. Selection or chance? *Gene* **539**: 203–208.

French A.S., Meisner S., Su C.-Y. & **Torkkeli P.H.** 2014: CO₂ and fruit odor transduction in *Drosophila* olfactory neurons. What controls their dynamic properties? *PLOS One* 9(1):e86347 doi: 10.1371/journal.pone.008634

Torkkeli P.H., Meisner S., Pfeiffer K. & French A.S. 2012: GABA and glutamate receptors have different effects on excitability and are differentially regulated by calcium in spider mechanosensory neurons. *Eur. J. Neurosci.* 36: 3602-3614.

Schmitz J., Höger U., **Torkkeli P.H.** & French A.S. 2012: Calcium buffering and clearance in spider mechanosensory neurons. *J.Comp. Physiol A.* 198: 477-483.

Pfeiffer K., **Torkkeli P.H.** & French A.S. 2012: Activation of GABA_A receptors modulates all stages of mechanoreception in spider mechanosensory neurons. *J. Neurophysiol.* 107: 196-204.

Torkkeli P.H., Panek I. & Meisner S. 2011: Ca²⁺/calmodulin dependent protein kinase II mediates the octopamine-induced increase in sensitivity in spider VS-3 mechanosensory neurons. *Eur. J. Neurosci.* 33: 1186-1196.

French A.S., **Torkkeli P.H.** & Schuckel J. 2011: Dynamic characterization of *Drosophila* antennal olfactory neurons indicates multiple opponent signalling pathways in odor discrimination. *J. Neurosci.* 31: 861-869.

Höger U., **Torkkeli P.H.** & French A.S. 2010: Feedback modulation of transduction by calcium in a spider mechanoreceptor. *Eur. J. Neurosci.* 32: 1473-1479.

Schuckel J., **Torkkeli P.H.** & French A.S. 2009: Two interacting olfactory transduction mechanisms have linked polarities and dynamics in *Drosophila melanogaster* antennal basiconic sensilla neurons. *J. Neurophysiol.* 102: 214-223.

Pfeiffer K., Panek I., Höger U., French A.S. & **Torkkeli P.H.** 2009: Random stimulation of spider mechanosensory neurons reveals long-lasting excitation by GABA and muscimol. *J. Neurophysiol.* 101:54-66.

Höger U., Meisner S., **Torkkeli P.H.** & French A.S. 2008: Regional distribution of calcium elevation during sensory transduction in spider mechanoreceptor neurons. *Neurosci. Res.* 62: 278-285.

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Schuckel J., Meisner S., **Torkkeli P.H.** & French A.S. 2008: Dynamic properties of *Drosophila* olfactory electroantennograms. *J. Comp. Physiol. A.* 194:483-489.

French A.S. & **Torkkeli P.H.** 2007: The power law of sensory adaptation: Simulation by a simple model of excitability in spider mechanoreceptor neurons. *Ann. Biomed. Eng.* 36: 153-161.

Höger U., **Torkkeli P.H.** & French A.S. 2007: Ratiometric calcium concentration estimation by LED excitation during mechanotransduction in single sensory neurons. *J. Neurosci. Methods.* 164: 255-260.

French A.S., Panek I. & **Torkkeli P.H.** 2006: Shunting versus inactivation: simulation of GABAergic inhibition in spider mechanoreceptors suggests that either is sufficient. *Neurosci. Res.* 52: 189-196.

Widmer A., Panek I., Höger U., Meisner S., French A.S. & **Torkkeli P.H.** 2006: Acetylcholine receptors in spider peripheral mechanosensilla. *J. Comp. Physiol.* 192: 85-95.

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Panek I. & **Torkkeli P.H.** 2005: Inhibitory glutamate receptors in spider peripheral mechanosensory neurons. *Eur. J. Neurosci.* 22: 636-646.

Widmer A., Höger U., Meisner S., French A.S. & **Torkkeli P.H.** 2005 Spider peripheral mechanosensory neurons are directly innervated and modulated by octopaminergic efferents. *J. Neurosci.* 25: 1588-1598.

Clark J., Meisner S. & **Torkkeli P.H.** 2005: Immunocytochemical localization of choline acetyltransferase and muscarinic ACh receptors in the antenna during development of the sphinx moth *Manduca sexta*. *Cell Tissue Res.* 320: 163-173.

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Gingl E., French A.S., Panek I., Meisner S & **Torkkeli P.H.** 2004: Dendritic excitability and localization of GABA mediated inhibition in spider mechanoreceptor neurons. *Eur. J. Neurosci.* 20: 59-65.

French A.S. & **Torkkeli P.H.** 2004: Mechanotransduction in spider slit sensilla. *Can. J. Physiol. Pharmacol.* 82: 637-644.

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spider peripheral mechanosensilla. *J. Neurophysiol.* 90: 2571-2580.

French A.S., Höger U., Sekizawa S.-i. & **Torkkeli P.H.** 2003: A context free data compression approach to measuring information transmission by action potentials. *BioSystems.* 69: 55-61.

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Panek I., French A.S., Seyfarth E.-A., Sekizawa S.-i. & **Torkkeli P.H.** 2002: Peripheral GABAergic inhibition of spider mechanosensory afferents. *Eur. J. Neurosci.* 16: 96-104.

Torkkeli P.H. & French A.S. 2002: Simulation of different firing patterns in paired spider mechanoreceptor neurons: The role of Na⁺ channel inactivation. *J. Neurophysiol.* 87: 1363-1368.

French A.S., **Torkkeli P.H.** & Seyfarth E.-A. 2002: From stress and strain to spikes: mechanotransduction in spider slit sensilla. *J. Comp. Physiol. A.* 188: 739-752.

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Torkkeli P.H., Sekizawa S.-i. & French A.S. 2001: Inactivation of voltage-activated Na⁺ currents contributes to different adaptation properties of paired mechanosensory neurons. *J. Neurophysiol.* 85: 1595-1602.

French A.S., Sekizawa S.-i., Höger U. & **Torkkeli P.H.** 2001: Predicting the responses of mechanoreceptor neurons to physiological inputs by nonlinear system identification. *Ann. Biomed. Eng.* 29: 187-194.

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Sanders E.J., **Torkkeli P.H.** & French A.S. 1997: Patterns of cell death during gastrulation in chick and mouse embryos. *Anat. Embryol.* 195: 147-154.

Höger U., **Torkkeli P.H.**, Seyfarth E.-A. & French A.S. 1997: The ionic selectivity of mechanically-activated channels in spider mechanoreceptor neurons. *J. Neurophysiol.* 78: 2079-2085.

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Torkkeli P.H. & French A.S. 1994: Characterization of a transient outward current in a rapidly adapting insect mechanoreceptor neuron. *Pflügers Arch.* 429: 72-78.

McKay R.R., Miller K., Weckström M., **Torkkeli P.**, Järvilehto M. & Shortridge R.D. 1994: The *rpa* (receptor potential absent) visual mutant of the blowfly (*Calliphora erythrocephala*) is deficient in phospholipase C in the eye. *J. Neurogenet.* 9: 177-187.

French A.S. & **Torkkeli P.H.** 1994: The basis of rapid adaptation in mechanoreceptors. *News in Physiological Sciences* 9: 158-161.

French A.S. & **Torkkeli P.H.** 1994: The time course of sensory adaptation in the cockroach tactile spine. *Neurosci. Lett.* 178: 147-150.

French A.S., Sanders E.J., Duszyk E., Prasad S., **Torkkeli P.H.**, Haskins J. & Murphy R.A. 1993: Immunocytochemical localization of sodium channels in an insect central nervous system using a site-directed antibody. *J. Neurobiol.* 24: 939-948.

Torkkeli P.H. & French A.S. 1993: Mapping extracellular excitability in an insect mechanoreceptor neuron. *Brain Res.* 632: 317-320.

Zhang B.G., **Torkkeli P.H.** & French A. S. 1992: Octopamine selectively modifies the slow component of sensory adaptation in an insect mechanoreceptor. *Brain Res.* 591: 351-355.

Torkkeli P., Weckström M. & Järvilehto M. 1991: Membrane maintenance and electrical properties of photoreceptors of wild type and *rpa*-mutant (receptor potential absent) blowflies (*Calliphora erythrocephala*). *Cell Tissue Res.* 266: 97-106.

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Torkkeli P. & Järvilehto M. 1989: Fotoreseptorien elinehto: Kalvoston uusiutuminen. *Solubiologi* 3:11-16.

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B) Book Chapters (7)

French A.S. & **Torkkeli P.H.** 2012: Sensory receptors and mechanotransduction. In: Sperelakis N., (Ed.) Cell Physiology Source Book. Academic Press, San Diego, London, Boston, New York, Sydney, Tokyo, Toronto. 4th edition. Pp.633-647 (Invited contribution).

French A.S. & **Torkkeli P.H.** 2009: Mechanoreception (touch, sensillar structure). In: Resh V.H. and Carde R. (Eds.) Encyclopaedia of Insects. 2nd edition. Academic Press. Pp. 610-611.

French A.S. & **Torkkeli P.H.** 2009: Mechanoreceptors. In: Squire L. (Ed.). Encyclopaedia of Neuroscience. Elsevier 5: 689-695.

French A.S. & **Torkkeli P.H.** 2007: Mechanosensitive ion channels of spiders: Mechanical coupling, electrophysiology and synaptic modulation. In: Current topics in Membranes. Vol. 59. Mechanosensitive Ion Channels. Part B. Hamill O.P.(Ed.) Elsevier. pp. 1-20

French A.S. & **Torkkeli P.H.** 2003: Mechanoreception (touch, sensillar structure). In: Resh V.H. and Carde R. (Eds.) Encyclopaedia of Insects. Academic Press. Pp. 689-690.

Panek I. & **Torkkeli P.H.** 2002: A strategy for survival: Modulation of spider mechanosensation. In: Konopinska D. (Ed.) Arthropods: Chemical, Physiological and Environmental Aspects. Wydawnictwo Uniwersytetu Wroclawskiego. Pp. 223-227.

French A.S. & **Torkkeli P.H.** 2001: Sensory receptors and mechanotransduction. In: Sperelakis N., (Ed.) Cell Physiology Source Book. Academic Press, San Diego, London, Boston, New York, Sydney, Tokyo, Toronto. 3rd edition. Pp. 761-773. (Invited contribution).

C) Abstracts (77)

Johnson J.A.G., Liu H., French A.S & **Torkkeli P.H.** 2018: Is Piezo Protein the mechanotransduction channel in spider mechanosensilla? 1st Dalhousie University Bachelors of Medicine Honor's Research Day.

Torkkeli P.H., Johnson J.A.G., Liu H., Sivapalan K. & French A.S. 2018: Is Piezo protein the mechanotransduction channel in spider *Cupiennius salei* mechanosensilla? 13th International Congress of Neuroethology.

Torkkeli P.H., Liu H., Johnson J.A.G., DePalma A. & French A.S. 2017: Transcriptome-based investigation of transmitters and receptors involved in synaptic modulation of spider mechanotransduction. The 16th International Meeting of Invertebrate Sound and Vibration.

Johnson J.A., Liu H., Fabian-Fine R. & French A.S., **Torkkeli P.H.** 2017: Localization of cholinergic markers in the central nervous system of the spider, *Cupiennius salei*. 10th Dalhousie University Department of Physiology and Biophysics Graduate Student Research Day.

Torkkeli P.H., Sukumar V., Meisner S., Panek I. & French A.S. 2015: Spider, *Cupiennius salei*,

mechanosensory neurons have multiple biogenic amine receptor types, including constitutively active receptors. *Soc. Neurosci. Abstr.* 2015.

French A.S., **Torkkeli P.H.**, Meisner S., Liu H., Immonen E.-V., Frolov, R. & Weckström M. 2015: Molecular and functional characterization of opsins and TRP channels in compound eyes of the cockroach, *Periplaneta americana*. *Soc. Neurosci. Abstr.* 2015.

Torkkeli P.H. and French A.S. 2014: The cys-loop ligand-gated ion channel gene family of the spider *Cupiennius salei* nervous system. *11th International Congress of Neuroethology*.

French A.S., Li A.W., Meisner S & **Torkkeli P.H.** 2014: The transcriptome of the spider *Cupiennius salei* peripheral nervous system – identifying genes involved in mechanosensation. *11th International Congress of Neuroethology*.

Sukumar V., French A.S. & **Torkkeli P.H.** 2014: Tyramine effects on spider (*Cupiennius salei*) mechanosensory neurons. 7th Department of Physiology and Biophysics Graduate Student Research Day.

Torkkeli P.H. Li A.W., Meisner S. & French A.S. 2013: Several octopamine receptor subtypes are involved in modulation of spider mechanosensory neurons. *The 14th International Meeting of Invertebrate Sound and Vibration*.

French A.S., Höger U. Schmitz J. & **Torkkeli P.H.** 2013: Calcium ions modulate transduction, and are strongly buffered in spider mechanosensory neurons. *The 14th International Meeting of Invertebrate Sound and Vibration*.

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French A.S., Meisner S, Lowe J. & **Torkkeli P.H.** 2012: Dynamic characterization of carbon dioxide transduction in *Drosophila melanogaster* antennal olfactory sensilla. *Soc. Neurosci. Abstr.* 2012

Torkkeli P.H., Panek I. & Meisner S. 2011: Octopamine-induced increase in sensitivity in spider VS-3 mechanosensory neurons is mediated by Ca²⁺/calmodulin dependent protein kinase II. *8th IBRO World conference in Neuroscience*. C270

Schuckel J., **Torkkeli P.H.** & French A.S. 2011: Dynamic properties of multiple olfactory neurons in *Drosophila* antennal basiconic sensilla. *8th IBRO World conference in Neuroscience*. C222

Pfeiffer K., **Torkkeli P.H.** & French A.S. 2011: Information transmission is limited by entropy in spider mechanoreceptors. 9th *Göttingen meeting of the German neuroscience Society*

Morris B.J., Meisner S. & **Torkkeli P.H.** 2010: Immunocytochemical labeling of the mechanotransduction channel in the slit sensilla of the spider, *Cupiennius salei*. 24th Annual Cameron Conference for Biology & Marine Biology Honours Students. Department of Biology, Dalhousie University.

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Schuckel J., **Torkkeli P.H.** & French A.S. 2009: Different fruit odors produce widely divergent dynamic responses in *Drosophila* antennal olfactory receptor neurons. 8th *Göttingen meeting of the German neuroscience Society*

Höger U., Meisner S., **Torkkeli P.H.** & French A.S. 2009: Mechanically induced regional changes in free intracellular Ca²⁺, and the effect of intracellular Ca²⁺ on mechanotransduction in spider sensory neurons. 8th *Göttingen meeting of the German neuroscience Society*.

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Höger U., Meisner S., **Torkkeli P.H.** & French A.S. 2008: Regional calcium changes in spider mechanoreceptors during sensory transduction. *Soc. Neurosci. Abstr.* 38.

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Schuckel J., Meisner S., **Torkkeli P.H.** & French A.S. 2008: Controlled dynamic stimulation of *Drosophila* olfactory receptors. *Canadian Physiological Society Winter meeting, Lake Louise Alberta*

Pfeiffer K., Höger U., French A.S. & **Torkkeli P.H.** 2008: Membrane depolarization and excitatory action of GABA and muscimol in spider mechanosensory neurons. *Canadian Physiological Society Winter meeting. Lake Louise Alberta*

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Panek I., Höger U., French A.S. & **Torkkeli P.H.** 2007: Effects of voltage-gated conductances and intracellular calcium on the GABA response of spider mechanosensory neurons. *7th IBRO World conference in Neuroscience*. 383

Höger U., **Torkkeli P.H.** & French A.S. 2007: Ratiometric measurements of calcium concentration during sensory transduction in spider mechanoreceptors. *7th IBRO World conference in Neuroscience*. 147.

Widmer A., Höger U., Meisner S., French A.S. & **Torkkeli P.H.** 2005: Spider peripheral mechanosensory neurons are directly innervated and modulated by octopaminergic efferents. *9th European Symposium for Insect Taste and Olfaction*. P. 59.

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Panek I. & **Torkkeli P.H.** 2001: GABA induced presynaptic inhibition of spider cuticular mechanosensory neurons. *Acta Neurobiol. Exp. (Warsz.)* 61(3): p. 248.

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Sekizawa S.-i., French A.S. & **Torkkeli P.H.** 1999: Calcium currents in spider mechanosensory neurons. *Soc. Neurosci. Abstr.* 25: 726.

Sekizawa S.-i., French A.S., Höger U. & **Torkkeli P.H.** 1998: Contributions of voltage-activated currents to adaptation properties in two types of spider mechanoreceptor neurons. *Physiology*

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Höger U., **Torkkeli P.H.**, Seyfarth E.-A & French A.S. 1997: The ionic basis of the transduction current in spider slit-sense organ mechanoreceptor neurons. *Proc. 25 Göttingen Neurobiology Conference*. Georg Thieme Verlag. 25 Vol II: 253.

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D) GenBank Accession numbers:

23. KT183364 *Cupiennius salei* Glutamate-gated Cl⁻ channel
22. KT183363 *Cupiennius salei* ACh bindin protein
21. KT183362 *Cupiennius salei* Nicotinic ACh receptor α
20. KY074556 *Cupiennius salei* Vesicular amine transporter
19. KX892709 *Cupiennius salei* Choline acetyltransferase
18. KY074555 *Cupiennius salei* FMRF-amide
17. KY074554 *Cupiennius salei* FMRF-amide
16. KX966397 *Cupiennius salei* Vesicular ACh transporter
15. KX892708 *Cupiennius salei* Carnitine O-palmitoyltransferase
14. KX892707 *Cupiennius salei* Carnitine O-acetyltransferase

13. KT183361 *Cupiennius salei* Nicotinic ACh receptor non- α
12. KT363688 *Cupiennius salei* Histamine-gated Cl⁻ channel
11. KX714078 *Periplaneta americana* K⁺ KCNQ channel
10. KF010813 *Periplaneta americana* K⁺ EAG channel
9. KP981367 *Periplaneta americana* green opsin
8. KP941115 *Periplaneta americana* UV opsin
7. KP861985 *Periplaneta americana* green opsin
6. GBFC01000001 to GBFC01000102 *Cupiennius salei* leg hypodermis transcriptome
(Next 102 sequences)
5. GAKT01000001 to GAKT01000155 *Cupiennius salei* leg hypodermis transcriptome
(First 155 sequences)
4. KF010814 *Periplaneta americana* antennal EAG ion channel
3. KF010813 *Periplaneta americana* retinal EAG ion channel
2. KC329816 *Periplaneta americana* retinal TRP ion channel
1. KC292630 *Periplaneta americana* retinal TRPL ion channel