

Curriculum Vitae

Vit Ferdinand Drga, Ph.D.

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Objectives and Work History

My long-term objective is to pursue a research or academic career in mathematical psychology, psychophysics, distributed detection and decision making.

- 2008-present. Research consultant in waveform analysis, statistics, technical writing, and computer programming for otoacoustic emission system development and psychoacoustics.
- 2004-2007. Research Fellow at the University of Newcastle upon Tyne and the University of St Andrews, U.K., with Prof. Julie Harris on a project on binocular distance perception.
- 2000-2003. Senior Research Officer at the University of Essex, U.K., with Dr. Christopher Plack on psychophysical measurement of basilar membrane response characteristics.
- 2000. Awarded Ph.D. from Victoria University of Wellington, New Zealand, for developments on the effects of noisy decision making in psychophysical discrimination tasks.
- 1990-1999. Contract lecturer, teaching assistant, and tutor for the School of Psychology at Victoria University.
- Before 1990. Part-time or short-term research assistant for several employers.

Research Skills and Experience

My post-doctoral and doctoral research involved psychophysical experimentation, data analysis, modelling, and much software development. I have gained valuable experience and skills, including:

- mathematical, computational, and statistical modelling of sensory and decision processes,
- advanced skills in mathematics, probability and statistics, including statistical decision theory, information theory, and the algebra of random variables,
- designing and implementing psychoacoustical experiments involving normal-hearing and hearing-impaired listeners, and developing psychophysical experiments in stereovision,
- computer programming for acoustical and visual stimulus synthesis and analysis, data analysis, and simulation,
- real-time experimental control, using both digital and analog equipment,
- developing new analyses to reduce the effects of inconsistency in experimental data and allow the estimation of asymptotic error-free performance,
- technical writing and graphics skills,
- familiarity with reviewing psychophysical, engineering, physiological, and statistical literature,
- giving lectures, seminars, laboratory classes, and tutorials,
- presenting conference talks and poster presentations.

My research interests include error-reducing techniques in experimentation and data analysis, psychophysical theory and methodology, sensory systems, decision making in the face of uncertainty, medical decision making, information theory, Bayesian analyses, performance measures, and multiple-event analyses.

Computer Skills

I use computers extensively, both for work and recreation, and have experience using a wide variety of operating systems and programs. I am a confident computer user, and am quick to learn new applications.

OPERATING SYSTEMS: I am comfortable using Windows, Linux, DOS, HPL, and Macintosh systems.

LANGUAGES: C, Delphi, Pascal, Basic and Postscript. I have written programs for data analysis, signal analysis, synthesis, and production, real-time experimental control, file maintenance, graphics production, sensory process simulations, and Monte Carlo simulations.

PACKAGES: Matlab, Octave, LaTeX, Gnuplot, GNU utilities, bash, Office programs and other assorted packages.

Organisational Skills

As a doctoral and post-doctoral researcher, I was responsible for organising, running, and analysing data for large multiple-replication, multiple-participant experiments. These usually involved tens of thousands of trials per experiment run over the course of weeks or months. As a teaching assistant, I was responsible for the administration of the laboratory component of two undergraduate courses. This involved preparation of course materials, running laboratory sessions, and the development of new laboratory classes. I was also the administrative assistant to the course lecturer. In New Zealand flying disc sports I ran national and regional tournaments, coaching sessions and school programs. My work involved liaising with players, schools, local councils, and national and international sporting bodies.

Teaching Skills

I taught undergraduate psychology from 1991-1998, as a contract lecturer, teaching assistant, and tutor. My responsibilities involved giving lectures, laboratory classes and small group tutorials, designing new laboratory classes, marking, course administration and student counselling.

The topics covered in these courses included: probability, statistics, calculus, information theory, decision theory, signal detection, signal analysis and synthesis, psychophysics, psychoacoustics, neurophysiology, psychophysiology, cellular automata, Turing Machines, genetic algorithms, cybernetics, delayed auditory feedback, vibrotactile discrimination, and operant conditioning of humans, rats, and pigeons.

Teaching Experience

LECTURER (Aug-Sept, 1997-1998, School of Psychology, Victoria University, Wellington, New Zealand)

I lectured in Psych 323: Sensory Systems, covering about 20% of the course material each year.

TEACHING ASSISTANT (Feb 1995-Nov 1997, July-Nov 1998, School of Psychology, Victoria University)

I tutored in Psych 223: Information and Control in Organisms, and Psych 323: Sensory Systems. I was responsible for the laboratory component of both courses, which amounted to 50% of the course assessment. As well as in-course teaching, I also prepared demonstrations for university open days.

TUTOR (Feb 1991-Jun 1998; Jul-Oct, 1999; School of Psychology and Department of Mathematics, Victoria University)

I tutored in Psych 122: Experimental Psychology 1991-1994 and 1999, Psych 222: Learning 1992-1998, Psych 323: Sensory Systems 1991 and 1993, Math 103: Introduction to Calculus Jul-Oct, 1991-1992.

SEMINAR PARTICIPANT (School of Psychology, Victoria University) Seminar presentation and guest participation in 4th-year Honours courses: Psych 406: Psychophysics (1990, 1996, 1998), and Psych 401: Theory and History of Psychology (1987, 1993, 1997, 1998).

SPORTS COACH (1984-2003) I coached flying disc skills at schools, universities, and teachers colleges, public displays, and also at training camps for national representative squads and local club teams. The school work included formal assessment as part of the physical education syllabus at senior high school level.

Research Consultant (2008-present)

I am currently a self-employed research consultant, providing services in waveform analysis, statistics, psychophysics, technical writing, and computer programming. My clients include Mimosa Acoustics (otoacoustic emission and middle-ear power analysis system testing and manual writing), Dr Judi Lapsley Miller (statistical analysis of the medial-olivocochlear reflex as measured with otoacoustic emissions, spectral analysis of otoacoustic emissions), and Dr Ifat Yasin at the UCL Ear Institute (providing ongoing research discourse and advice on papers, and upgrading Matlab software for psychoacoustical testing).

Research at the University of Newcastle upon Tyne and University of St Andrews on Stereovision

Overview: People are poor at judging distances and depths in the environment based on stereovision information. In the 1970s and 1980s, J. Foley showed that there were interactions of distance judgements when more than one target appeared in the visual scene, which complicates models of visual geometry. The purpose of this research project was to further investigate how the human visual system combines binocular vergence and disparity information to arrive at estimates of distances within grasping range, especially with regards to the previously found interactions.

In conjunction with Prof. J. Harris, the projects I was involved with were:

Interactions of distance judgements under various conditions: In a series of experiments involving pairs of virtual targets presented to observers, we investigated the role of vertical target separation, blur, and judgment type on distance judgements. We found that vertical target separation had little effect either within or across observers, and that blur had some effect within observers but no systematic effect across observers. Data analysis and modelling revealed two main results not found in Foley's earlier work: (1) that an observer's scaling of relative disparity changed depending on the magnitude of the relative disparity (Foley had assumed a constant scalar), which partly accounts for the distance interactions, and (2) how disparity was scaled differed depending on how distances were indicated, either manually or verbally. A paper has been submitted to Vision Research.

Using Visual Direction to Estimate Three-dimensional Motion: This set of experiments investigated the use of binocular information to estimate motion in depth for trajectories of targets heading towards and to the side of an observer. We found that for the same lateral target displacement, extent in depth had no effect on the apparent trajectory, meaning that observers were not using motion in depth information to judge trajectory angles. Rather, it seemed that visual direction (as viewed from the cyclopean eye) was the key quantity being used. Results were published in Nature Neuroscience.

Research at the University of Essex on Basilar Membrane (BM) Compression

Overview: How well people hear sounds is determined, in part, by the mechanical response of the BM in the cochlea. In particular, a compressive, nonlinear response associated with an active feedback mechanism is crucial to normal hearing, while a loss of compression is associated with some types of hearing loss. Procedures developed at the University of Essex and elsewhere provide psychoacoustical estimates of basilar membrane compression in humans, leading to better modelling and understanding of the peripheral hearing system in both normal-hearing and hearing-impaired listeners.

In conjunction with Prof. C. Plack and others, the projects I was involved with at Essex were:

Basilar Membrane Compression Estimation Using Additivity of Forward Masking (AFM): BM compression has been demonstrated psychoacoustically at mid-range frequencies using temporal masking curves. This approach requires a linear off-frequency masking effect, which applies to higher (2-8 kHz) but not lower (< 500 Hz) characteristic frequencies. The AFM approach works at both low and high frequencies. Compression values are inferred from the excess masking provided by the nonlinear combination of two forward maskers relative to how a linear system should respond. A set of experiments using the AFM approach showed evidence for compression in normal-hearing and hearing-impaired listeners at both 250 Hz as well as at 4 kHz. Papers were published in the Journal of Neuroscience and the Journal of the Acoustical Society of America.

Basilar Membrane Compression in Hearing-impaired People: A question of much interest in psychoacoustics is how BM compression changes with increasing hearing loss. Using temporal masking curves, we measured BM compression at 4 kHz in normal-hearing people and in hearing-impaired people with mild-to-moderate sensorineural hearing loss. Against the accepted wisdom, we found little correlation between maximum compression and hearing loss. Surprisingly, compression was still evident in people with up to 60 dB of hearing loss. Results were published in the Journal of the Acoustical Society of America.

Software Development: The computers that ran the experiments were upgraded from Silicon Graphics workstations running Unix to PCs running Linux and using high-spec soundcards. I ported the existing C software across systems, developed new experimental modules, and maintained the software for multiple users. I also ran simulations in Matlab, learned bash-script programming, and wrote a Monte Carlo simulation program on psychophysical adaptive-tracking.

Psychophysics Research at Victoria University of Wellington

I was involved in many different research projects in Wellington. The main ones were:

The Theory of GOC analysis: The main theoretical contribution of my Ph.D. is a mathematical theory explaining how and why group operating characteristic analysis (distributed detection or decision fusion) works. GOC analysis is a computational procedure that decreases decision error in a signal detection task. It enables a group of observers to perform better at such tasks than an individual observer. The theory is based on stochastic ordering. It shows how error-free performance is recoverable from noisy data by running experimental replications.

GOC/FORA development: This project involved writing computer programs for ROC and GOC analysis of multiple-replication experiments. GOC analysis leads to a function of replications added (FORA), which allows estimation of asymptotic, error-free performance. The results of this project formed a large portion of my own Ph.D. research, and assisted a colleague of mine, Judi Lapsley Miller, in her Ph.D. research.

The $As_{IFC}=P(C)_{2IFC}$ project: This multi-author project investigated non-parametric relationships between the single-interval and two-interval forced-choice tasks, both theoretically and experimentally. My contributions included theoretical developments, stimulus generation, and data collection and analysis. A paper was published in the Journal of Mathematical Psychology.

2IFC Aural Amplitude Discrimination: This was an attempt to extend envelope-based and energy-based signal detection models from single-interval to two-interval forced choice paradigms. The SIFC models had been put forward in the 1960s in papers by L. Jeffress, D.M Green and W.J. McGill, based on analog electronic detectors, but the models had not been extended completely to the 2IFC paradigm. It turned out that my 2IFC derivations were expressible in closed form only for particular values of the bandwidth-duration product of the signal and masker.

Signal-generation: This involved the development of computer programs for generating digital signals with high quality temporal and spectral characteristics. The process required understanding of time-series analysis and fast Fourier transforms. The programs were used for the $As_{IFC}=P(C)_{2IFC}$ project, and for both my own and Judi Lapsley Miller's Ph.D. experimentation.

Type 2 ROC analysis: This multi-author project investigated decision making in Type 2 psychophysical tasks, both theoretically and experimentally. A Type 1 task involves an observer deciding about the occurrence of events in their environment, whereas a Type 2 task involves an observer deciding whether their Type 1 decision was correct or incorrect. My contributions included, data collection and analysis and ongoing theoretical development. A paper on this topic in the Psychonomic Bulletin & Review.

Earlier Research Work

RESEARCH ASSISTANT (1987–1990, VICTORIA UNIVERSITY OF WELLINGTON). I was a research assistant for Dr. John Whitmore in the School of Psychology on six different projects. These involved experiments and models of diotic and dichotic amplitude discrimination, frequency discrimination, and Type 2 decision making. I helped develop programs for signal generation, modelling, experimental control and data analysis, and acted as a listener.

MARKET RESEARCH ASSISTANT (1986-90, HEYLAND RESEARCH, WELLINGTON).

TRAFFIC RESEARCH ASSISTANT (1987-1990, TRAFFIC DESIGN GROUP, WELLINGTON).

Academic Degrees from Victoria University of Wellington, New Zealand

- Ph.D. in Psychology—conferred 2000
- B.Sc. (Hons) in Psychology—First Class—conferred 1989
- B.Sc.—conferred 1988

Scholarships and Awards

- University Grants Committee Postgraduate Scholarship
- J.L. Stewart Scholarship
- University Blue for flying disc sports (twice)

Interests

Reading, science, history, technology.

Publications

- Harris J.M. & Drga, V. (submitted) *Manual and verbal estimates of egocentric distance in depth under binocular viewing conditions*.
- Plack, C.J., Oxenham, A.J., Simonson, A., O'Hanlon, C.G., Drga, V., & Arifianto, D. (2008). *Estimates of compression at low and high frequencies using masking additivity in normal and impaired ears*, Journal of the Acoustical Society of America, **123**, 4321-4330.
- Plack, C.J., Oxenham, A.J. & Drga, V. (2006). *Masking by inaudible sounds and the linearity of temporal summation*, Journal of Neuroscience, **26**(34), 8767–8773.
- Harris, J. & Drga, V. (2005) *Using visual direction in three-dimensional motion perception*, Nature Neuroscience, **8**, 229-233.
- Plack, C.J., O'Hanlon, C.G., Drga, V. (2005). *Additivity of masking and auditory compression*, In: Pressnitzer, D., de Cheveigne, A., McAdams, S. & Collet, L., eds. *Auditory Signal Processing : Physiology, Psychophysics, and Models*. New York: Springer, 2005, pp. 60-66.
- Plack, C.J., Drga, V. & Lopez-Poveda, E. (2004). *Inferred basilar-membrane response functions for listeners with mild to moderate sensorineural hearing loss*, Journal of the Acoustical Society of America, **115**, 1684-1695.
- Galvin, S.J., Podd, J., Drga, V., & Whitmore, J.K. (2003). *Type 2 tasks in the theory of signal detectability: Discrimination between correct and incorrect decisions*, Psychonomic Bulletin & Review, **10**, 843-876.
- Plack, C.J., & Drga, V. (2002). *Psychophysical evidence for auditory compression at low characteristic frequencies*, Journal of the Acoustical Society of America, **113**, 1574-1586.
- Lapsley Miller, J.A., Scurfield, B.K., Drga, V., Galvin, S.J., & Whitmore, J.K. (2002). *Non-parametric relationships between single-interval and two-interval forced-choice tasks in the theory of signal detectability*, Journal of Mathematical Psychology, **46**, 383-417.
- Plack, C.J., Oxenham, A.J., & Drga, V. (2002). *Linear and nonlinear processes in temporal masking*, Acustica united with Acta Acustica **88**, 348-358.

Conference Posters

- Drga V. & Harris, J.M. (2007) *The use of horizontal disparity in distance perception in sparse, dark environments*, Optical Society of America Fall Vision Meeting, September 2007. Berkeley, CA.
- Drga V. & Harris, J.M. (2006) *Near-distance estimates using binocular vision in the dark*, 8th Workshop on Active Vision, September 2006, Dundee, UK.
- Drga V. & Harris, J.M. (2005) *Distance perception during binocular viewing via stereogoggles at different display distances*, European Conference on Visual Perception, August 2005, La Coruna, Spain.
- Harris, J.M. & Drga V. (2005) *Scene layout and binocular distance perception: effects of angular separation and task*, Vision Sciences Society Meeting, May 2005, Sarasota, FL.
- Plack, C.J., Oxenham, A.J. & Drga, V. (2004). *The Linearity of Temporal Summation*, Association for Research in Otolaryngology Mid-Winter Meeting, Abstr. 128.
- Drga, V., & Plack, C.J. (2003). *Psychophysical Estimates of Basilar Membrane Compression at 4 kHz in Normal-Hearing and Hearing-Impaired Listeners*, Association for Research in Otolaryngology Mid-Winter Meeting, Abstr. 883.
- Plack, C.J., Drga, V., & O'Hanlon, C.G. (2003). *Psychophysical evidence for auditory compression at low characteristic frequencies*, Association for Research in Otolaryngology Mid-Winter Meeting, Abstr. 884.
- Lapsley Miller, J.A., Drga, V., & Miller, L.M. (2001). *Evidence that the energy detector is not an appropriate model for Gaussian noise detection in humans*. Association for Research in Otolaryngology Mid-Winter Meeting, Abstr. 250.

Conference Presentations

- Drga V. & Harris, J.M. (2006). *Interactions in near-distance perception during binocular viewing*, Scottish Vision Group Meeting, April 2006, Aberdeen, UK.
- Drga V. & Harris, J.M. (2005). *Distortions of distance perception during binocular viewing*, Scottish Vision Group Meeting, April 2005, Kirkmichael, UK.
- Drga V. (1993) *Theory of group operating characteristic (GOC) analysis*. Psychophysics Symposium, New Zealand Psychological Society Annual Conference, Wellington, NZ, August 1993.
- Drga V. (1993) *Transfer-function analysis of rating scales in the theory of signal detectability*. Psychophysics Symposium, New Zealand Psychological Society Annual Conference, Wellington, NZ, August 1993.
- Drga V. (1993) *Transform-average group operating characteristic analysis*. Psychophysics Symposium, New Zealand Psychological Society Annual Conference, Wellington, NZ, August 1993.

Other Presentations

- What To Do About Error: Lessons From Medical Diagnostics*, Fife-Tay Vision Meeting, November 2006.
- Distortions of distance perception during binocular viewing*, (with Harris, J.M.), Fife-Tay Vision Meeting, November 2005.
- Improving performance in discrimination tasks by group operating characteristic (GOC) analysis*. Department of Psychology Research Seminar, Otago University, New Zealand, Sept 2003.
- Basilar membrane nonlinearity in normal hearing and hearing-impaired listeners* (with Plack, C.J.), Research Seminar, Institut de Recherche et Coordination Acoustique/Musique (IRCAM), Paris, France, April 2001.
- Estimating errorless performance in discrimination tasks*. Department of Psychology Research Seminar, Victoria University of Wellington, New Zealand, Oct 1995.
- The transfer function for human beings in simple psychophysical tests*. Institute of Statistics and Operations Research Seminar, Victoria University of Wellington, New Zealand, Nov 1994.

Doctoral Thesis

- Drga, V. (1999). *The theory of group operating characteristic analysis in discrimination tasks*. Unpublished doctoral dissertation. Victoria University of Wellington, Wellington, New Zealand. Available at <http://www.psychophysics.org/vitthesis.htm>