Contents

- List of figures ix
- List of tables xii
- Preface xiii

Introduction: Purpose and scope of this book 1

1 Relational perception and epistemology 5

- Introduction 5
- Epistemological implications of perception and cognition 5
- Relational perception and cognitive psychophysics 8
- The evolutionary perspective on comparative perception 12
- Summary and conclusions 14

2 Frame-of-reference models in psychophysics 17

- Introduction 17
- Adaptation-level model: a sensory-perceptual concept 22
- Range-frequency model: a perceptual-judgement model 23
- Similarity-classification model: a perceptual-cognitive theory 24
- Summary and conclusions 30

3 Behavioural psychophysics: Contrasting ideas and findings 31

- Introduction 31
- A general context model of behavioural psychophysics 33
- The two-alternative two-forced choice task (2A2FC method) 36
- Human psychophysics 36
- Animal psychophysics 43
- Summary and conclusions 53
## Contents

4 Developmental psychophysics

Introduction 55
Age-related studies: humans (Homo sapiens) 56
Age-related studies: infant chickens (Gallus gallus domesticus) 64
Comparative methodological issues 72
Summary and conclusions 75

5 New perspectives in perceptual-cognitive psychophysics

Introduction 77
Multiple-stage processing in perception and psychophysics 79
Relational psychophysics and cognitive neuroscience 82
Further research issues: nonlinear psychophysics 85
Summary and conclusions 90

6 General discussion and conclusions

Introduction 91
Perceptual constancy and memory in psychophysics 92
Toward a comparative-developmental theory in psychophysics 97
Future research directions – an evolutionary perspective 99
Summary and conclusions 102

Appendix 1: Apparatus for animal psychophysics 105
Appendix 2: Mathematics of transposition and psychophysics 109
Appendix 3: An engine model of relational psychophysics 111

STUART ANSTIS AND VIKTOR SARRIS

References 121
Author index 145
Subject index 151
Figures

1.1 Three epistemological gaps: phenomenological, brain-based and computational issues in comparative perception and psychophysics 7
1.2 Subjective contours: two examples of the so-called Kanizsa patterns (illusional triangles) 9
1.3 Transposition figure: size or contour (dotted vs. straight line) does not change the perceived shape of the “triangle” 10
1.4 Some well-known geometric-optical illusional figures 11
1.5 Predictions from a mathematical contour-distance model of relative size contrast 12
2.1 Focal (S, s) and context (C, c) stimuli, according to a general psychophysics model of perceptual information-integration 19
2.2 Range effects in psychophysics, with three different pitch-stimulus series 21
2.3 Cubic ("tritonic") trends for a systematic study of pitch context effects ("anchor" effectiveness versus context-effect limits) 28
2.4 Intraseries anchor effects on pitch judgements 29
2.5 Illustration of the hypothesized spatio-temporal area of contextual effects on the psychophysical response in humans and animals 29
3.1 Behavioural psychophysics paradigm: graphic illustration of the PSI process model 34
3.2 Asymmetry, range, and frequency “shift” effects: the predicted main trends for the three major types in context psychophysics 35
3.3 General experimental design for the behavioural-psychophysical study of “contextual” test effects 36
3.4 Human psychophysics: apparatus used for preschoolers, school children, and adults for behavioural size estimation 37
3.5 Psychophysical size-estimation data for human adults 38
3.6 Context-induced shift data, obtained in a visual search task with human participants on the basis of the delayed matching-to-sample method 39
3.7 Psychophysical time-estimation PSI data, obtained under different context conditions
3.8 Multidimensional psychophysics (two-dimensional case): the three predicted types of behavioural choice responses
3.9 Apparatus used in comparative psychophysics
3.10 Gradual occurrence of context-dependent size-response trends for chickens during the post-discrimination test stages 1, 2, and 3
3.11 Mean PSI trends for six chickens, each trained under identical conditions, but tested systematically with different ascending and descending “context” stimulus series
3.12 Choice data trends for six chickens in the two-modality case (size and colour)
3.13 Animal and human training data compared
3.14 Range, asymmetry, and frequency context-effect trends for A birds as compared with B humans
4.1 Examples of the equipment used in the age-specific studies with human participants, conducted in a participant-friendly game-like mode
4.2 Psychophysical size-estimation data for A human adults, B elementary school children, C preschoolers (kindergarten children)
4.3 Psychophysical time-estimation data for A human adults compared with those from B schoolchildren
4.4 Two-dimensional training and test stimuli (fairy tale figures) with human participants of different ages
4.5 Age-specific Type I, Type II, and Type III size-estimation data with four different age groups
4.6 Two-choice apparatus used to train and test infant chickens with size and / or colour stimuli, with the two chambers 1 (front) and 2 (back)
4.7 Schematic overview of the training and test stimuli for the infant chick studies
4.8 Training performance curves for the “absolute” and “relative” simultaneous training conditions
4.9 Post-discrimination individual test data for two infant chicks
4.10 Test choices in per cent for the different training conditions
4.11 Preference-score data for the infant chickens reflecting the distinction between an absolute and a relative choice strategy
4.12 Data sets obtained with various infant chick subgroups
4.13 “Signal” versus “signal-and-noise” context-test performance for the size subgroups of infant chickens
4.14 Contrasting hypothesized developmental trends for human infants, children, and adults under “asymmetry” versus
"frequency" context conditions in stimulus-generalization testing

5.1 A general multiple-stage model of the intertwined mechanisms in perception and psychophysics for the low-level, i.e., sensory information gathering, mid-level, i.e., perceptual information synthesis, and high-level, i.e., memory-plus-decision and language functioning

5.2 Neuro-anatomy and neurobiological functioning of the infant chicken's perceptual behaviour during imprinting and learning

5.3 The detailed architecture of the IMHV designed around the anatomical connectivity of IMHV and its primary input area, the hyperstriatum accessorium (HA)

5.4 A flow chart of the nonlinear dynamic "system gamma general structure", as suggested for the dynamic modelling of psychophysical transposition "shifts" in comparative perception

6.1 Gradual increase and disappearance of psychophysical context effects with moderate versus extreme test-series stimuli (the Sarris effect)

6.2 A general cross-sectional and longitudinal research design in comparative perception and psychophysics with infant animals

6.3 A biopsychological ("cross-species") example for some future research: psychopharmacological and psychophysical paradigms combined

6.4 Schematic diagram: an evolutionary research perspective for the future study of comparative perception and psychophysics

A1.1 Computer-controlled apparatus, for the psychophysical study of chickens (schematic drawing)

A1.2 Animal psychophysics lab

A3.1 Hypothetical pecks made by an imaginary chicken to different sized cubes under two test-series conditions
Tables

1.1 Some major criticisms raised against limited perspectives of mainstream comparative psychology. 13
1.2 Typical differences between comparative-developmental evolutionary psychology and cognitive psychology. 14
2.1 Some basic issues in psychophysics ("invalidity", "noise", "bias"). 18
3.1 Shifting of test responding. 38
4.1 Some of the standard methods used to test human infants. 63
4.2 Experimental sets of training and test stimuli for the infant chicken’s "relative" versus "absolute" task conditions (simultaneous stimulus presentation). 66
5.1 A "top-down" (high-level, late process) versus "bottom-up" (low-level, early process) theory for conscious human vision. 81
A1.1 Set of training and test stimuli used (general design logic). 107
A3.1 Range 1, 2, 3, 4, 5. 114
A3.2 Asymmetrical shift 4, 5, 6, 7, 8. 114
A3.3 Compressed range 2, 2.5, 3, 3.5, 4. 115
A3.4 Two triangular distributions of cube sizes. 116
A3.5 Distribution favouring large numbers. 117
A3.6 Distribution favouring small numbers. 118