Structural Information Theory

The Simplicity of Visual Form

Structural information theory is a coherent theory about the way the human visual system organizes a raw visual stimulus into objects and object parts. To humans, a visual stimulus usually has one clear interpretation even though, in theory, any stimulus can be interpreted in numerous ways. To explain this, the theory focuses on the nature of perceptual interpretations rather than on underlying process mechanisms, and adopts the simplicity principle, which promotes efficiency of internal resources, rather than the likelihood principle, which promotes veridicality in the external world. This theoretically underpinned starting point gives rise to quantitative models and verifiable predictions for many visual phenomena, including amodal completion, subjective contours, transparency, brightness contrast, brightness assimilation, and neon illusions. It also explains phenomena such as induced temporal order, temporal context effects, and hierarchical dominance effects, and extends to evaluative pattern qualities such as distinctiveness, interestingness, and beauty.

EMANUEL LEEUWENBERG is Emeritus Associate Professor at the Donders Institute for Brain, Cognition and Behaviour at Radboud University Nijmegen, The Netherlands.

PETER A. VAN DER HELM is Assistant Professor at the Donders Institute for Brain, Cognition and Behaviour at Radboud University Nijmegen, The Netherlands.

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Emanuel Leeuwenberg
Peter A. van der Helm

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Preface

This book does not provide a comprehensive survey of perception research. Rather, it deals with a specific, some might say idiosyncratic, approach to perception, and to visual form in particular. This approach is called structural information theory (SIT). Basically, SIT is a theory about structures irrespective of whether these structures are perceptual. Historically, however, SIT has been developed within the domain of visual perception research. A fundamental phenomenon in this domain is that, to humans, a visual stimulus usually has one clear interpretation even though any stimulus can, in principle, be interpreted in numerous ways. SIT addresses this phenomenon and aims at producing quantified and falsifiable predictions concerning the human interpretation of visual stimuli.

SIT was initiated, in the 1960s, by Emanuel Leeuwenberg and has been elaborated further by Hans Buffart, Peter van der Helm, and Rob van Lier. It began as a quantitative coding model of visual pattern classification that, in interaction with empirical research, developed into a general theory of perceptual organization. The home of SIT has always been the Radboud University Nijmegen, where it has been tested in collaboration with Harry van Tuijl, Frans Boselie, Rene Collard, Lucas Mens, Hans Mellink, Jantien van der Vegt, Cees van Leeuwen, Jackie Scharroo, Tessa de Wit, Arno Koning, Árpád Csathó, Gert van der Vloed, Matthias Treder, and Vinod Unni. Contributions and applications from elsewhere include those by Frank Restle, Hans-Georg Geissler, Ursula Schuster, Friedhart Klix, Ulrich Scheidereiter, Martina Puffe, Giovanni Adorni, Luigi Burigana, Albina Lucca, Remco Scha, Mehdi Dastani, Rens Bod, and Kasper Souren.

Our goal with this book is to provide an overview of SIT in a way that is accessible to a broad audience. We presuppose no special knowledge in the reader, neither of perception nor of SIT. In the Introduction, we discuss the unique status of perception and the roots of SIT. Then, we discuss SIT, in twelve chapters grouped in three parts. Part I shows how SIT's starting assumptions emerge from attempts to explain visual

form phenomena. At the end of this section, an overview is presented of SIT's assumptions and theoretical foundations. Part II begins with a coding manual presenting practical heuristics that can be used to describe various stimulus types. The subsequent chapters report applications of SIT to visual form perception. Part III attends to aspects of visual form beyond the scope of SIT and to applications of SIT beyond the field of visual form. We end the book with an overview and a conclusion. Complementary to this empirically oriented book is a book by Van der Helm (2013) which is focused on SIT assumptions and foundations.

Emanuel Leeuwenberg and Peter A. van der Helm