Sensory substitution from an ecological perspective

Lorena Lobo Navas[1], Carlos de Paz[2], David Travieso[2]
[1]Departamento de Psicología y Salud, Universidad a Distancia de Madrid, Spain
[2]Departamento de Psicología Básica, Universidad Autónoma de Madrid, Spain

Abstract. Sensory substitution enables individuals to compensate for the absence of a sensory modality by engaging alternative perceptual systems. From an ecological psychology perspective, sensory substitution devices facilitate perception and action by providing access to environmental information, particularly for individuals with sensory impairments. In this chapter, we present a conceptualization of sensory substitution from this ecological perspective, offering a framework for the development of special-purpose devices. Grounded in the principles of environmental scaling, perception-action coupling, and affordance perception (Richardson et al., 2008), we argue that various lines of research in ecological sensory substitution have demonstrated empirical improvements, revealing new possibilities in clinical, experimental, and theoretical domains.

1. Introduction

In a broad sense, sensory substitution (SS) refers to the phenomenon where one perceptual system compensates for the absence of another, enabling a form of "equivalent perception". This concept applies both to everyday tasks where certain sensory inputs are compromised, such as a person using touch to locate objects in a dark room, and to more specialized scenarios, like a firefighter relying on sound instead of vision in smoke-filled environments. For individuals with sensory impairments or professionals operating in low-vision conditions, spontaneous compensations occur naturally.

This ability to rely on other perceptual systems when the preferred one for a given task is unavailable highlights the practical relevance of SS; however, the terms *substitution* and *sensory* carry a certain level of controversy in the scientific literature (Auvray & Harris, 2014). First, how we define *substitution* is crucial. If we adhere to a strong phenomenological perspective and focus on the subjective experience of substitution, it becomes difficult or even impossible to establish equivalence. Certain aspects, such as color, have no direct substitute in private experiences with non-visual sensory modalities. However, other aspects, such as *distal attribution*—the ability to perceive objects as being located in external space rather than on the sensory surface—have been argued to be part of the experience with some sensory substitution devices (SSDs) (e.g., Auvray

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