All humans and most animal organisms possess special receptors with thresholds so high that they are excited only by stimuli that cause, or might be able to cause, tissue damage ("noxious" stimuli, from the Latin "noxa", damage). These receptors are called nociceptors. In humans, excitation of such receptors ordinarily causes pain, which in turn serves as a signal that the body is endangered by stimuli originating either externally (e.g., heat) or internally (e.g., inflammation).

The reception, conduction and central nervous processing of noxious signals together are called nociception, and the neural structures involved in these events are the nociceptive or nocifensive system. The subjective sensation pain, as was just pointed out, is often a consequence of activation of the nociceptive system. However, as will be shown, pains can also occur without any excitation of nociceptors, and the excitation of nociceptors need not always result in the sensation of pain.

In the past, the concepts of nociception and pain have not been distinguished as carefully as they should have been. Noxious stimuli have been called "pain stimuli", for instance, and the terms "pain receptors", "pain nerve fibers", "pain tracts" and "pain centers" have been used for the various components of the nocifensive system. To illustrate how wrong it is to equate neuronal structures, and the electrical and chemical processes by which they function, with the subjective world of the pain experience, consider that we do not speak of "pleasure receptors", "pleasure tracts" or "pleasure centers", although the excitation of various receptors in the human skin and mucosa can certainly give rise to pleasurable sensations.

In the following four sections of this chapter we shall first describe the different qualities and components of pain (4.1), then turn to neurophysiology, especially the bases of nociception and the psychophysics of pain (4.2), discuss some of the pathophysiological aspects of pain (4.3), and finally cast a glance at the most important procedures for inhibiting nociceptive processes and alleviating pain (4.4).

4.1 The Qualities and Components of Pain

Qualities of pain. The sense of pain can be subdivided into a number of qualities with respect to the site of origin of the pain. In Figure 4–1 these qualities are given
in the red boxes. The pain modality comprises the two qualities **somatic pain** and **visceral pain**.

If somatic pain derives from the skin, it is called **superficial pain**; if it comes from the muscles, bones, joints, and connective tissue, it is called **deep pain**. Superficial and deep pain are thus (sub-)qualities of somatic pain.

If superficial pain is produced by piercing the skin with a needle, the subject feels a sharp “flash” of pain, a readily localizable sensation that fades away rapidly when the stimulus stops. This sharp and localizable **initial pain** (first pain) is often followed, particularly at high stimulus intensities, by **delayed pain** (second pain) having a dull (or burning) character, with a latency of 0.5—1.0 s. The latter is more diffuse spatially and dies out only slowly; a good illustration is the pain felt in response to the squeezing of an interdigital fold.

Pains from muscles, bones, joints, and connective tissue are called **deep pain**. Like superficial pain, deep pain is an element in somatic pain. We are familiar, for example, with such pains as **headaches** — probably the most common of all forms of pain in humans. Deep pain is dull in nature, is poorly localizable as a rule, and has a tendency to radiate into surrounding regions of the body.

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**Fig. 4-1.** Qualities of pain (**red background**). The localization of each quality is also indicated (**gray background**), and examples of specific forms of pain are given.