arities to the same comparisons made by a machine.

3. The third objective is to clarify aspects of forensic transcription of speech. Different techniques may be used properly depending on the question from a client. First, a well-known technique using automatic speech recognition applied to forensic transcription and automatic alignment is presented. In case there is a part of a recording under scrutiny, this should be treated as a disputed utterance. This means a different way to approach the problem, which will be presented here.

4. A final fourth objective was to adapt and develop tools and databases to be used in a forensic phonetic analyst's environment.

1.3   Major Research Questions

1.3.1   The concept *robustness*

The main concept of this thesis is *robustness*. Ploughing one's way through references there are several gaps to be filled especially when it comes to *robustness* of forensic speaker comparison parameters. In the thesis several aspects of the *robustness* of analysis parameters used in forensic phonetics will

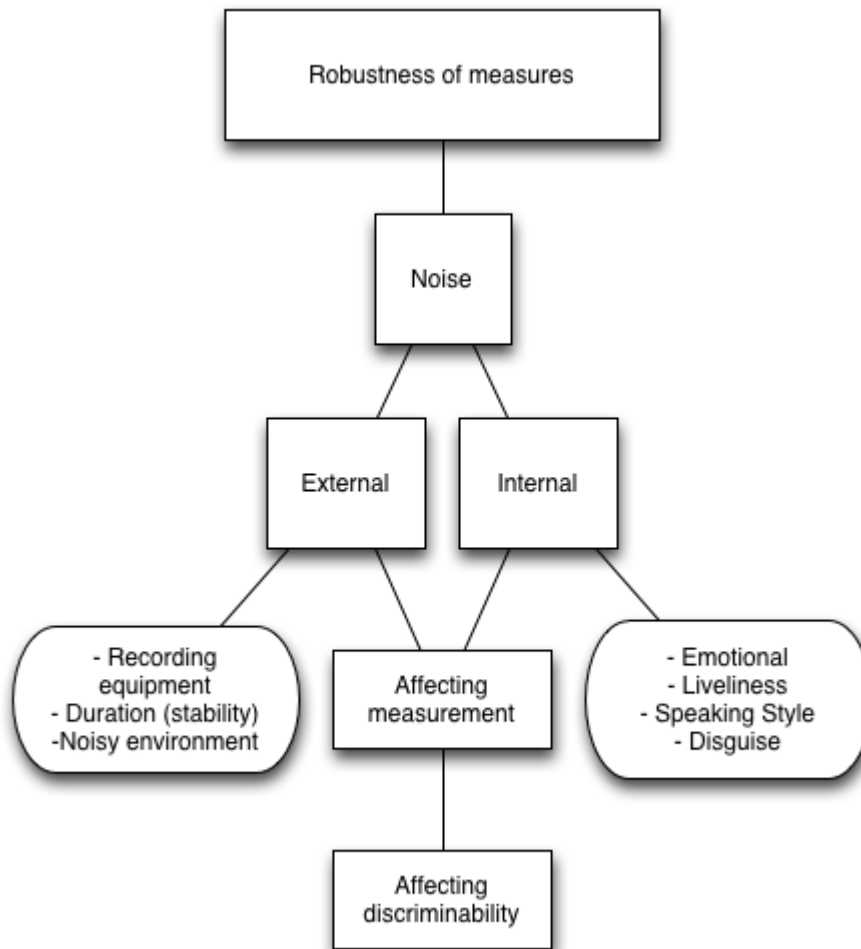be investigated. The concept of *robustness* will here be used to mean mainly *resistance to noise.*

Figure 1.3.1: Large Robustness as treated in this thesis.

The concept *noise*

From an engineer's perspective, noise often refers only to environmental noise, such as in noisy recordings (Reynolds *et al.*, 2000; Kimura *et al.*, 2004; Nakasone and Beck, 2001;

Reynolds, 2003) or mismatched recordings, i.e. recordings made on different recording media Alexander *et al.* (2005). All this is what is referred to as noise here. However, noise affecting parameter values conveying variation in phonetic and linguistic studies can also be given a wider definition. Between-speaker variation in perceptual studies, for example, may also be seen as noise affecting robustness (Clopper and Pisoni, 2004). So can within-speaker variation due to changes in the speaker's emotional state (Doherty and Hollien, 1978), speech liveliness(Traunmüller and Eriksson, 1995b) or level of vocal effort(Jessen *et al.*, 2005). This wider definition is also used here.

The concept robustness and noise

There are patents covering robust speaker recognition or "robust pattern recognition", where robustness is not explicitly defined (Pilz, 2006). In forensic speaker comparison the concept of robustness is used in conjunction with methodology (Drygajlo *et al.*, 2003; Gomez *et al.*, 2007). Robust statistics have several different definitions depending on whether one applies a frequentist or Bayesian approach, i.e. depending on the choice between probabilistic or non-probabilistic methods (Huber and Ronchetti, 2009). The concept of robustness is often used in speaker comparison contexts when referring to the discriminative power of a parameter (Gomez *et al.*, 2007;