This paper introduces several experiments that attempt to quantify the relations between tones and key distances from a psychological point of view, and to examine the results to explain music-theoretical construction. This paper is organized through four major sections. First, the author explains the definition of tonal hierarchy and describes some previous psychological experiments. She then compares the results with the formal tonal definition, to show the possibility of psychological approach to tonal hierarchy. A following experiment is then introduced, which improves the first study with a more rigorous design and a better potential for generalization. Furthermore, the author investigates whether the experimentally measured tonal hierarchies can be used to produce a measure of interkey distance. In the last part of the paper, she constructs a four-dimensional spatial representation of interkey distance and discusses the advantages and disadvantages of other two-dimensional spatial representations.

The concept of tonal hierarchy is very common in western music. A tonal context designates one particular tone as most central. All the other tones have functions specified with respect to this tone. Usually, stability of tones is taken as a parameter to express the tonal hierarchy. In 1979, Krumhansl and Shepard proposed a probe tone method for an experiment, in which they obtained statistical results from listeners to represent the tonal hierarchy in terms of music perception. However, the results are overtly dependent on the listener’s music background. For example, the results from well-trained listeners matched almost perfectly with music theory while the data from the least-trained listeners hardly could provide any relative information. Later, Krumhansl and Kessler implemented a subsequent probe tone experiment in 1982, which eliminated the impact of listener’s background and expended the scope to include a variety of different contexts. Both major and minor keys are considered.

To acquire key distances from the experimental results of tonal hierarchy, the author introduces the concepts of circle of fifths, and the relative and parallel relation between major and minor keys. If two keys have similar hierarchies, then it is likely that the modulations between them would be able to effected relatively easily. At last, the author introduces a four-dimensional spatial representation, which can express the key distances visually. This paper describes many fundamental theories about music key structure, which is very helpful for understanding the tone and key concepts. Furthermore, I am impressed by the psychological analysis which can reflect similar patterns with music theory.