

# Abstract of Doctoral Thesis

## The Development of Seriation in Childhood: Focusing on Analysis of the Drawing Serial Circles Task

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In the domain of cognitive development, seriation refers to the ordering of things. According to Piaget, who clarified the development of children's logical thinking, children can think logically about concrete things when they reach the stage of concrete operations, and this is due to the formation of a cognitive system known as grouping. Furthermore, seriation is positioned as "a group of rules of operation regarding relationships" (Sonoda, 2009, p. 117) among grouping. In other words, seriation is an important cognitive function that should be paid attention to in children's development, especially in the development of logical thinking.

In the drawing serial circles task, a B4 sheet of paper and a pencil are presented on a desk, and a child is asked to draw as many circles as possible on the paper, from the smallest circle to the largest one, in a gradually increasing manner. This task is one of the methods to grasp the development of seriation, which is considered to be a developmental feature at the age of five or six years old in Masato Tanaka's "the theory of hierarchies and stages on the reversible operations in human development" (or "the theory of hierarchies and stages", for short) (Tanaka & Tanaka, 1988; Hattori, 2020). It is often used in developmental diagnostic situations where "the theory of hierarchies and stages" is used as the theoretical basis.

The drawing serial circles task captures the beginning of the development of seriation and can positively capture the process of the formation of what Piaget refers to as grouping. In addition, it is an attractive method for diagnosing children's development due to its simplicity. However, the empirical investigation of the development of seriation in the drawing serial circles task has not been sufficiently conducted. Therefore, the main purpose of the present study was to clarify the developmental process of seriation in early childhood based on an empirical investigation of the serial circle drawn.

Based on a review of previous studies, it was hypothesized that there are approximately three periods in the development of seriation in the drawing serial circles task. In the first period (around 4 years of age), seriation is not fully established, but the start of seriation is seen, and responses of three items are observed. In the second period (around the mid-5 years of age), the beginning of the formation of seriation is observed, and responses of up to eight or nine items can be seen, starting from four or five items. The third period is the period when seriation stabilizes (around 6 years old), and responses of nine or ten items or more can be seen. The following three points were considered important to investigate for the present study, based on the above mentioned guidelines and the results of

previous studies.

- (1) Identify aspects of the transition from the start of seriation to the formation of seriation.
- (2) Clarify aspects of the process by which seriation becomes stable and secure.
- (3) Clarify the development of seriation in relation to developmental stages.

The conclusion based on the results and discussion herein is that the development of seriation in the drawing serial circles task undergoes the following process.

The period when a child is unable to conduct seriation (~4 years old): The stage of formative “Two dimensional operation”

Understands the concept of pairs and can draw small to large circles based on this concept. Still has difficulty understanding the middle concept and cannot yet draw small-medium-large, serialized circles.

The start of seriation (from mid-4 to 5 years old): The stage of reversible “Two dimensional operation” to the stage of formative “Three dimensional operation”

Recognition of the middle concept begins. The child is able to draw a small-medium-large series of circles, that is, a minimum number of three items can be drawn in the seriation.

The formation of seriation (around mid-5 years old): The stage of formative “Three dimensional operation”

Recognition of the middle concept is stabilized and the child is able to draw four or more series of circles. At this time, seriation tasks involving circle cards and bars can also be done.

The development of seriation (around 6 or 7 years of age): (The stage of reversible “Three dimensional operation”)

Children will draw at least six or seven series of circles. Most can draw a series of circles and bars. On the other hand, the number of circles in the drawing serial circles task does not increase with age, but the amount of variation between each child increases.

Furthermore, the applicability of the drawing serial circles task was examined based on a study that attempted to develop a new developmental diagnostic method. The new developmental diagnostic method aims to capture developmental stages, and the drawing serial circles task was adopted as a method to capture developmental characteristics around the age of five or six years old. The results of multiple response and hierarchical cluster analyses indicated that the circular series task was positioned in Category IV (the stage of formative “Three dimensional operation” in "the theory of hierarchies and stages"), which includes many developmental test items at the ages of five and six years old. In other words, the drawing serial circles task was considered to be an effective method of capturing the developmental stages of 5- and 6-year-olds.

The present study provides an overall picture of the development of seriation using the drawing serial circles task, and has also allowed for an examination of the relationship between seriation and developmental stages. This was a great achievement not only in terms of the development of seriation, but also in terms of the empirical basis for the developmental stages. Furthermore, we examined diagnostic methods aimed at understanding developmental stages, including drawing serial circles tasks, and confirmed that these methods were generally appropriate. The fact that we were able to demonstrate a method for assessing the developmental stage of early childhood is expected to contribute to the developmental support of children with disabilities in particular.