

Reexamination of “Early Types” Hypothesis in the Baum Test

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バウムテストにおける「早期型」仮説の再検討

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Abstract

This study aimed to reexamine Koch’s “early types” hypothesis in the Baum test from the viewpoint of a cross-sectional study on child development. The 3,444 drawings (1,728 and 1,716 from boys and girls, respectively) in the Baum tests collected from Japanese children (from kindergarteners to high schoolers) in 2015–2018 were rated using Koch’s 25 early type indices and a new index called “scribble.” Data were then analyzed based on relationships between 26 indices and participants’ chronological ages (range = 3–18). As a result, early types were divided into four groups: four indices that appear at the earliest stages and disappear at an early stage; five indices that increase in the early stage and disappear or become rare afterward; four indices that have difficulties in capturing the developmental degree because they appear at a certain rate in any age; and twelve indices that were interpreted as rare types at any age. Detailed materials for interpretations of early types were shared, and limitations and problems of interpretation were discussed.

Key words: Baum test, early types, child development, Karl Koch

要 旨

本研究の目的は、バウムテストにおけるコッホの「早期型」仮説を、子どもの発達に関する横断研究のデータから再検討することである。2015～2018年の間に、日本人の子どもを対象としてバウムテストの絵3,444枚（男子1,728名・女子1,716名）を収集した。データは、コッホの早期型の25指標、および新しく考案した指標「スクリブル」を使って評価した後、計26指標と対象者の生活年齢（3～18歳）との関係を分析した。結果、早期型は次の4群に分けられた。1) 発達の極めて早期に出現して、幼い段階で消失する4つの指標、2) 発達早期では増加し、やがて消失するか稀な表現となる5つの指標、3) どの年齢でも一定の割合で出現するため発達の適度を捉えることが難しい4つの指標、4) どの年齢でも稀な型と解釈される12の指標。本稿によって早期型解釈のために詳細な資料が共有されると同時に、解釈の限界と問題も考察した。

キーワード：バウムテスト、早期型、子どもの発達、カール・コッホ

I. Introduction

1. The Baum Test and Developmental Research

The Baum test (tree-drawing test) is a psychological assessment method devised by Swiss psychologist Karl Koch (1906-1958). Today, this method is used worldwide. In particular, this has been the most frequently used technique in Japan for over 20 years (Ogawa, 2011).

For Koch, examining the possible relationship between the Baum (the drawn tree in this test) characteristics and child development was essential for establishing the basic theory of this test. The results of his developmental research using the 58 indices he developed built his theory and summarized evidence showing the change in appearance rate of Swiss children's representation of the tree with development (Koch, 1957/2010, pp. 300–305). Japan implemented the Baum test around the 1960s. In Japan, the findings of many articles reported in the initial period (e.g., Ichitani et al., 1968) have provided psychologists valuable insights into the development of the Baum test and understanding children's drawings in clinical situations. However, in recent years, developmental studies on the Baum test have seldom been conducted (e.g., Kishimoto & Kishimoto, 2012). Thus, the reference area on this topic that supports our research and practice has not been sufficiently revised, which is of great concern.

2. Early Types

Koch classified 25 of the 58 indices as the *early types*. Although each of these indices has its own meaning, the early types can generally be described as a group of partial Baum representations that appear in the early stages of development and are less likely to appear as development progresses. According to Kishimoto (2015, pp. 70–71), Koch originally identified these types from his hypnosis experiments and not from his developmental research. He hypnotized some participants, provided them suggestions to trace back to their age successively, and administered the Baum test to them under the trance state at each age. He then extracted the representation forms that began to appear during this specific regression process. He confirmed how such extracted forms could be recognized at each age in a cross-sectional study on child development. This historical background, in which Koch progressed from understanding individual representations to mass representations, is important

in comprehending Koch's idea of early types.

The hypothesis of early types has also not been fully verified until today (e.g., Sado et al., 2019). Reexamining this hypothesis is a necessary task for the current users of the Baum test. Using data from a medium-sized cross-sectional study on child development, I will examine how the frequency of early types changes with current child development. As noted above, reexamining the early types hypothesis from population results differs from the order of Koch's approach; however, the results of this work will be significant for the development of the Baum test in Japan and abroad.

3. Purpose

This study aims to 1) provide present-day results on Koch's 58 indices, including early types, to researchers and practitioners for publishing the findings on the relationship between Baum test representation and child development; and 2) clarify how the early types have the potential and/or the limit to capture the children's developmental degree and rediscuss the hypothesis of early types.

II. Methods

1. Participants

Participants consisted of 3,386 children (1,701 boys and 1,685 girls) enrolled in kindergartens (3 grades), elementary schools (6 grades), junior high schools (3 grades), or high schools (3 grades) in the Tōkai region, Japan. These schools were institutions that actively cooperated in this research and not randomly selected. I contacted the principals of these schools with the help of other psychologists I am acquainted with. Moreover, I obtained participation and consent from those principals. Kindergarteners were recruited from ten facilities in one area. Students from all other grades – from primary school to high school (both private and public) – were recruited from three or more schools in two or more areas.

The chronological ages (CA) of all participants ranged from 3 to 18. CA were calculated from the participant's respective dates of birth to the date of the Baum test administration, based on the rule of Tanaka-Binet Intelligence Scale (Tanaka Education Institute, 2003). If the number of days of CA was 30 or more, the month of CA moved forward and was reduced for less than 30 days. In this study, the participants' CA were abbreviated sequentially from

CA 3 to 18.

2. Procedures

From 2015 to 2018, I used the group method to administer Baum test interventions in either one or a few classes at the respective institutions. When administered to a few classes simultaneously, assistants who were certified clinical psychologists or graduate students specializing in clinical psychology, helped with the Baum test intervention according to the researcher’s instructions. Staff from the institutions were present during almost all the interventions.

The participants were given sufficient drawing tools (a 4B pencil and a white sheet of A4 paper). Instructions for the test were given in Japanese (Nihongo): “Minonaru-ki o ippon kaite-kudasai” (実のなる木を一本描いてください / Draw a fruit tree). However, since young children often cannot understand this normal instruction, more concrete instructions were used for participants aged 3 years (kindergarteners; CA 3-4) to 7 years (first graders in elementary school; CA 6-7): “Ringo-no-ki o ippon kaite-kudasai” (リンゴの木を一本描いてください / Draw an apple tree).

3. Rating and Analysis

A total of 82 participants (2.4%) represented two or more trees on a drawing paper in the collected data (Koch, 1957/2010, pp. 88–89). Thirty participants’ drawings (0.9%) representing four or more trees on a drawing paper were excluded from the analysis. Of the participants’ drawings, 52 (1.5%) that represented two or three trees on a drawing paper were included in the analysis, and each tree was counted as one sample. As a result, the number of participants changed to 3,444 (1,728 boys and 1,716 girls). Table 1 shows the revised number of participants in each CA.

Koch’s 58 indices were used for rating. The index number followed Koch’s list, but the index names in English were renewed (Koch, 1957/2010; Nakajima, 2016, for examples and definitions of each index). However, Koch’s 58 indices alone cannot fully evaluate the Baum characteristics of young children since they drew an undifferentiated form in the test. Therefore, a new index was created and added to Koch’s index and a group of early types. Its name and definition are as follows: scribble (No. 0), “squiggles or circles, or the process of drawing was ultimately rejected/failed by the participant – when determined as this, the

drawing never matches all other indices.”

Based on the index criteria, all collected Baums were individually rated by three certified clinical psychologists, including myself. Then, if two or more psychologists agreed on a rating, that judgment was adopted as the final evaluation in the rating procedure.

In the analysis, the results of 59 indices were statistically described from the perspective of the participants’ CA. When necessary, the results of two previous studies (Ichitani et al., 1968; Koch, 1957) were referenced for analysis of this study. Although gender differences are not considered in the discussion due to space constraints, the results are present in the appendices for both, boys (Appendix A) and girls (Appendix B).

4. Ethical Considerations

This study protocol was approved by the Ethical Review Committee of Tokoha University (approval No.: 2017-028H). All participants and their parents provided informed consent.

III. Results

The results of this study are summarized as follows. Four groups – or layers – are found in the early type indices.

Table 1 presents the relationship between 59 indices and 15 CA stages, and the result of the developmental changes of present-day children using Koch’s classical approach. For this study, we focus only on the results of 25 early types and scribble (No. 0). The results of indices other than the early types can serve as reference material for future research. In an analysis describing the percentiles of appearance rates for each type of drawing, “3% or less” and “10% or less” were used as each criterion of “disappearance” and “rare.”

Early types with frequencies of more than 10% among all CA were recognized in 13 of 26 indices. These 13 early types can be divided into three groups based on changes in appearance rates with child development. The first includes four indices that decreased in frequency from the earliest stage and disappeared at the early stage (Nos. 0, 5, 14, and 15). The second involves five indices that increased in frequency in early development and decreased afterwards, and then shortly disappeared or became rare representations with development (Nos. 2, 17, 34,

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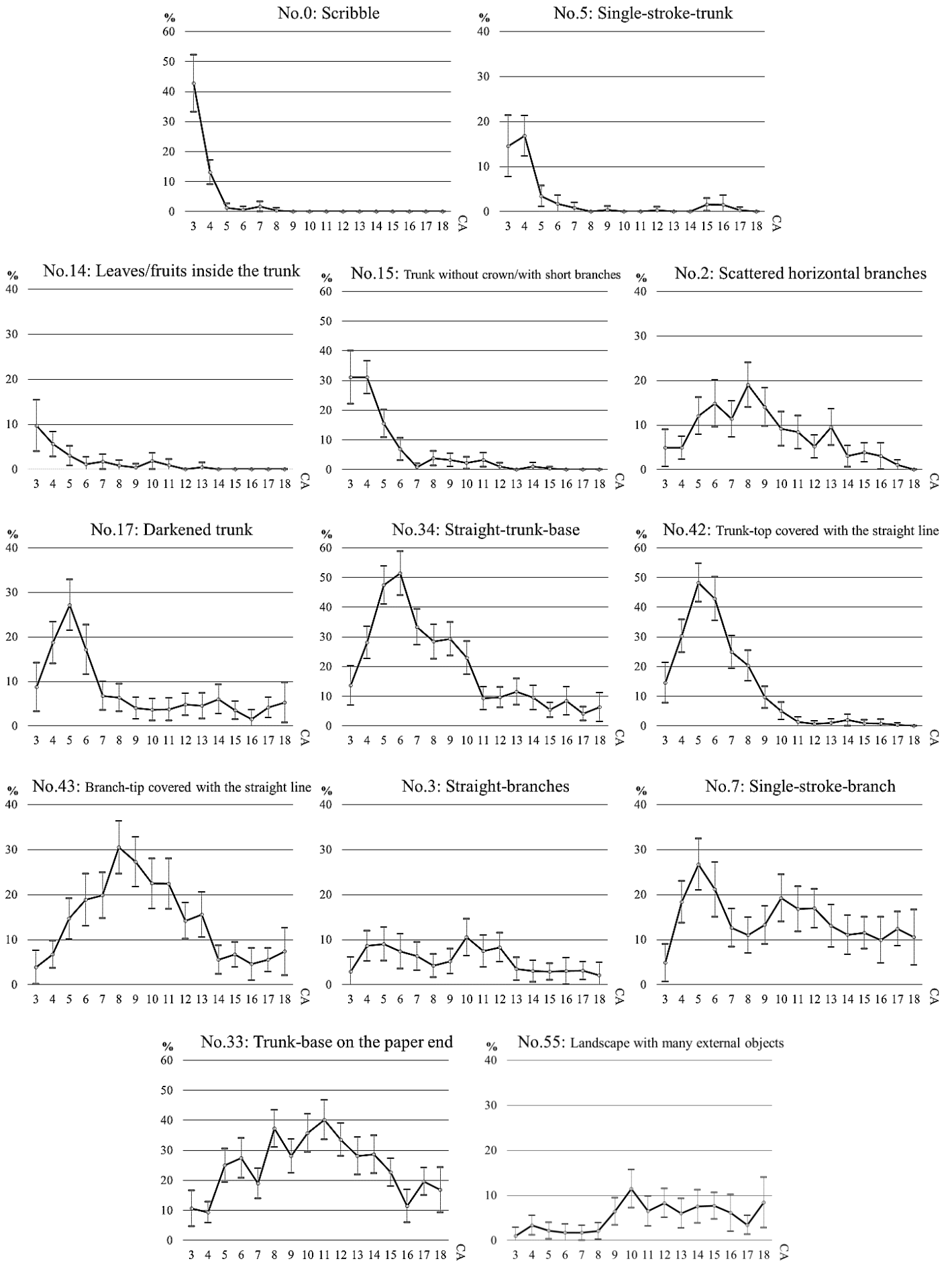


Figure 1. Results on 13 Indices of Early Types

42, and 43). Finally, the third comprises of four indices recognized at a certain rate in any CA (Nos. 3, 7, 33, and 55). Figure 1 shows the results of these 12 indices in the above order. In addition, these line graphs demonstrate the changes in the appearance rates of the indices with child development. The confidence intervals (95%) for these results were calculated and reflected in the graphs. The fourth group (12 of 26 indices) includes early types with frequencies of less than 10% among all CA (Nos. 1, 4, 10, 12, 16, 18, 23, 27, 39, 40, 46, and 49). These indices will not be considered thoroughly in the discussion since they were rare representations at any CA. Hence, the changes with child development cannot be considered significant. This does not mean that classifying these 12 indices as early types is inappropriate. Rather, “less than 10%” is defined here for convenience. Therefore, closer examination of these 12 indices may reveal similar characteristics in each of the three groups described below.

IV. Discussion

1. Analyses of the First Group

Scribble (No. 0), single-stroke-trunk (No. 5), and leaves/fruits inside the trunk (No. 14) were frequently recognized in the earliest stage and disappeared at CA 5. These results suggest that in CA 5 almost all children can draw a basic tree shape, emphasize the thickness of the trunk, and avoid drawing an extremely unnatural placement of leaves and fruits. In addition, a trunk without crown/with short branches (No. 15) was also recognized frequently in the earliest stage and disappeared in CA 7. This suggests that almost all children overcome the unnatural representation of the upper trunk at this age.

These four indices appear at the earliest stage and disappear relatively early developmentally. The results of the three indices, except for the new scribble index, showed developmental features similar to those of previous studies. They are useful indices to understand the developmental degree in young children, particularly at CA 3–7. In other words, although their presence or absence can provide useful suggestions regarding the degree of the psychological development of Baum test participants, they also have limitations, being effective in understanding developmental characteristics only in early childhood.

2. Analyses of the Second Group

Presence of scattered horizontal branches (No. 2), branch-tip covered with the straight line (No. 43), darkened trunk (No. 17), and straight-trunk-base (No. 34) increases in the early stage and decreases in older children (trunk-top covered with the straight line will be discussed later). Although a straight-trunk-base showed developmental features similar to the results of previous studies, indices of scattered horizontal branches, darkened trunk, and branch-tip covered with the straight line were different from previous research findings. Compared to previous studies, scattered horizontal branches have higher frequency (at around CA 6–10). Darkened trunk had lower frequency (around CA 6–15). For branch-tip covered with the straight line, Japanese children seem to show higher frequencies (around CA 7–13) compared to Swiss children. The meaning of these four indices varies, depending on the CA of individuals who draw them. Therefore, when they appear in an individual's Baum, we should not examine their appearance only from a human development perspective but also fully consider the age of the participants. For instance, the meaning of straight-trunk-base would be as follows: A participant drew this at CA 6, suggesting the state of his/her prosperous development. If this appeared at the Baum of CA 11, it suggests that the individual may have non-severe developmental delay. However, the results of this study show that one in ten children drew it at CA 11; hence, this may be a misinterpretation since it is not surprising that this outcome appears in a child's Baum of CA 11.

The trunk-top covered with the straight line (No. 42) has a special position in this group. Koch (1957/2010, p. 193) stated this index as “impressive developmental index.” In the analysis, I found an increase in appearance from 15% to 48% between CA 3 and 5 – matching decreases in the first group indices – and a decrease in appearance from 48% to 1% between CA 5 and 11, that disappeared at CA 11. This result suggests that children attempt to overcome the schematic way of the apical termination (Huzioka & Yoshikawa, 1971; Yoshikawa, 1985) from the early stages of development. This index may be the only one of the second group that presents the most orderly developmental trait. Therefore, interpreting the Baum relative to psychological development, the appearance of this index that can be used at CA older than the first group indices, is worth noting.

3. Analyses of the Third Group

Straight-branches (No. 3), single-stroke-branch (No. 7), trunk-base on the paper end (No. 33), and landscape with many external objects (No. 55) were recognized at a certain rate in any CA. Therefore, interpreting the appearance of these indices is complex. Thus, it may be certain that these appearances do not immediately indicate a developmental delay in participants at all CA. Although these four indices have been included in the early types group, they are less sensitive to the developmental characteristics of participants.

4. Significance of Present Study

As the results of this study show, when understanding the meaning of the appearance of early types, we must consider that each of the early types has different implications and that the psychological meaning of each early types depends on the participant’s age. In addition, when one of the early types is identified in a Baum and is determined to be an unsuitable appearance for the participant’s age, the therapist will often interpret that the participant may have developmental delay. It is one of the clinical judgments that psychologists make from the participant’s Baum. This thought process is not irregular, and the associated risk will be discussed later. The results presented in this paper will help such therapists’ internal work.

The present study applied the early types hypothesis in a present-day context by dividing the early types into four groups. However, in this paper, discussing the results of all early type indices is not possible, considering CA and other factors. This work requires a large amount of space. For this reason, the study aimed “to provide the present-day results on Koch’s 58 indices, including early types, to researchers and practitioners for publishing the findings on the relationship between Baum test representation and child development.” Thus, presenting Table 1 and Figure 1 was itself one of the main aims of this study. Both present some norms on the relationship between the early types and child development. In many respects, this study remains open to professionals’ judgment on interpreting and applying these results. The method adopted in the presentation for sharing the Baum test evidence on child development not only enhances the significance of this paper, but also contributes to Baum test users who are interested in child development and in

utilizing the objective elements in the interpretation process.

In addition, this study did not analyze the combinations of early types. Certainly, when two or more unexpected indices of early types from the perspective of child development appear in a Baum test drawing, the therapist’s interpretation on the participant’s psychological development will be more critical. Therefore, some psychologists may seek and utilize some equations that can assess the child’s stage of development from a combination of early type indices in a Baum. Although this topic is interesting in Baum test research, using an existing developmental test like Wechsler’s or other instrument could be better when the psychologist wishes to capture the participant’s developmental features clearly.

V. Conclusions

We examined the characteristics of 25 early types indices and a new index “scribble”, by analyzing the changes in the frequency of appearance of the Baum representation with child development using data from cross-sectional studies with about 3,500 drawings. Early types were classified into four groups. First, four indices were useful for capturing the degree of psychological development in young children as these appear at the earliest stage and disappear with development. Second, five indices were needed to clearly understand the meaning of the appearance relative to the actual age of the participant. They increase in early development and decrease or become rare representations afterward. Third, four indices, which had difficulties in capturing the degree of psychological development, were used because of the indices’ appearance at a constant rate at any age. Finally, twelve indices were located as rare early types because they seldom appear in any age.

I would like to highlight the utilization of the findings obtained from this study as the perspective of *development* often regulates our thinking. As in the proverb, “When all you have is a hammer, everything looks like a nail,” we cannot overemphasize this risk in the Baum test interpretation. The developmental perspective is, so to speak, a psychological myth. This can be beneficial or harmful for our professional understanding. A pitfall of the Baum test is that what may be perceived as an unexpected appearance of early types, may not always be evidence of

developmental delay in an individual. From another perspective, perhaps the method of capturing meaning in the early types reveals personal bias on the development of the psychologist. For instance, specific changes in child development shown in Figure 1, differ from the growth or developmental curves discussed in developmental psychology. Moreover, we should not identify this study's results as milestones standardized by intelligence tests. We risk misunderstanding that a direct parallel relationship between this result for early types and developmental changes in children, exists. Thus, Koch was thorough in understanding the early types (Kishimoto, 2015, pp. 70–78) and also examined the *regression* factor in their appearance. Koch's experience in conducting hypnosis experiments supported this perspective.

This approach does not diminish the usefulness of the early types. Rather, if psychologists are open to not only the perspective of developmental delay but also regression and other features, the early types become a significant perspective for psychologists. In this regard, Table 1 and Figure 1 are materials used for considering the psychological weights or meaning accents when the early types appear in a Baum. In these cases, the four groups of early types derived from this study become guidelines in actual interpretation. Therefore, the detailed material presented in this study provides psychotherapists with norms for understanding a participant's developmental characteristics and provides researchers with future research material. Most of the early types of these hypotheses remain valid today. The hypothesis of the Baum test will begin enriching our clinical practice only by examining the material presented in this paper carefully, without falling into excessive simplification.

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Appendix A. Results for Boys (unit = number (%))

No	Boys: CA	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
θ	Number of Participants	56 (%)	126 (%)	123 (%)	91 (%)	125 (%)	118 (%)	138 (%)	102 (%)	114 (%)	150 (%)	97 (%)	107 (%)	155 (%)	49 (%)	136 (%)	41 (%)
1	Scribble	26 (46)	22 (17)	3 (2)	1 (1)	2 (2)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
2	Pure horizontal branches	2 (4)	12 (10)	8 (7)	3 (3)	3 (2)	5 (4)	2 (1)	1 (1)	3 (3)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)
3	Scattered horizontal branches	2 (4)	7 (6)	20 (16)	19 (21)	17 (14)	31 (26)	27 (20)	12 (12)	12 (11)	11 (7)	14 (14)	6 (6)	7 (5)	1 (2)	2 (1)	0 (—)
4	Scattered straight branches	0 (—)	16 (13)	13 (11)	8 (9)	7 (6)	7 (6)	12 (9)	17 (17)	3 (3)	16 (11)	3 (3)	5 (5)	4 (3)	4 (3)	4 (3)	2 (5)
5	Cross-forms	1 (2)	4 (3)	5 (4)	3 (3)	2 (2)	7 (6)	8 (6)	2 (2)	1 (1)	3 (2)	2 (2)	2 (2)	1 (1)	0 (—)	1 (1)	0 (—)
6	Single-stroke-trunk	9 (16)	23 (18)	5 (4)	3 (3)	1 (1)	0 (—)	1 (1)	1 (1)	0 (—)	1 (1)	0 (—)	0 (—)	1 (1)	1 (2)	0 (—)	5
7	Double-stroke-trunk	21 (38)	81 (64)	115 (93)	87 (96)	122 (98)	117 (99)	137 (99)	102 (100)	114 (100)	149 (99)	97 (100)	107 (100)	154 (99)	48 (98)	136 (100)	41 (100)
8	Single-stroke-branch	0 (—)	29 (23)	38 (31)	22 (24)	16 (13)	14 (12)	14 (12)	16 (15)	20 (18)	32 (21)	15 (15)	17 (16)	22 (14)	10 (20)	21 (21)	8 (20)
9	Scattered single-stroke-branch	0 (—)	2 (2)	7 (6)	6 (7)	5 (4)	8 (7)	15 (11)	12 (12)	12 (11)	14 (9)	7 (7)	7 (7)	13 (8)	4 (8)	12 (9)	4 (10)
10	Double-stroke-branch	5 (9)	13 (10)	34 (28)	31 (34)	54 (43)	85 (72)	100 (72)	69 (68)	86 (75)	91 (61)	58 (60)	55 (51)	89 (57)	23 (47)	64 (47)	17 (41)
11	Pure orthogonal branches	0 (—)	0 (—)	2 (2)	0 (—)	0 (—)	2 (2)	2 (1)	0 (—)	0 (—)	0 (—)	0 (—)	2 (2)	0 (—)	0 (—)	0 (—)	10
12	Scattered orthogonal branches	0 (—)	3 (2)	8 (7)	12 (13)	15 (12)	28 (24)	26 (19)	20 (20)	31 (27)	17 (11)	17 (18)	10 (9)	11 (7)	2 (4)	8 (6)	2 (5)
13	Branches to the ground	3 (5)	8 (6)	11 (9)	9 (10)	8 (6)	13 (11)	19 (14)	11 (11)	4 (4)	9 (6)	5 (5)	1 (1)	1 (1)	0 (—)	0 (—)	12
14	Scattered low-lying branches	3 (5)	14 (11)	35 (28)	27 (30)	36 (29)	65 (55)	75 (54)	46 (45)	44 (39)	57 (38)	38 (39)	25 (23)	37 (24)	9 (18)	18 (13)	4 (10)
15	Leaves/fruits inside the trunk	4 (7)	10 (8)	4 (3)	0 (—)	3 (2)	2 (2)	0 (—)	2 (2)	2 (2)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	14
16	Trunk without crown/with short branches	19 (34)	43 (34)	25 (20)	11 (12)	2 (2)	7 (6)	7 (5)	3 (3)	5 (4)	3 (2)	0 (—)	2 (2)	0 (—)	0 (—)	0 (—)	15
17	Sun/flower-form	3 (5)	24 (19)	40 (33)	12 (13)	10 (8)	8 (7)	7 (5)	3 (3)	4 (4)	7 (5)	4 (4)	6 (6)	6 (4)	0 (—)	1 (2)	0 (—)
18	Darkened trunk	1 (2)	4 (3)	15 (12)	7 (8)	5 (4)	4 (3)	11 (8)	3 (3)	6 (5)	10 (7)	4 (4)	3 (3)	1 (1)	1 (2)	3 (2)	1 (2)
19	Darkened branches	0 (—)	4 (3)	8 (7)	2 (2)	2 (2)	1 (1)	0 (—)	0 (—)	0 (—)	2 (2)	0 (—)	4 (4)	6 (6)	2 (4)	1 (1)	2 (5)
20	Crown in shading style (no branches)	15 (27)	59 (47)	84 (68)	55 (60)	90 (72)	92 (78)	123 (89)	94 (92)	96 (84)	123 (82)	83 (86)	89 (83)	115 (74)	38 (78)	102 (75)	38 (93)
21	Fruits	0 (—)	0 (—)	4 (3)	8 (9)	23 (18)	43 (36)	67 (49)	32 (31)	45 (39)	41 (27)	28 (29)	19 (18)	11 (7)	3 (6)	8 (6)	3 (7)
22	Leaves	0 (—)	0 (—)	0 (—)	0 (—)	3 (2)	0 (—)	3 (2)	0 (—)	0 (—)	2 (1)	2 (2)	2 (2)	1 (1)	0 (—)	1 (1)	0 (—)
23	Flowers	5 (9)	9 (7)	9 (7)	1 (1)	0 (—)	2 (2)	2 (2)	0 (—)	1 (1)	3 (2)	3 (3)	1 (1)	6 (4)	1 (2)	1 (1)	0 (—)
24	Oversized fruits/leaves	2 (4)	14 (11)	29 (24)	9 (10)	4 (3)	8 (7)	11 (8)	3 (3)	6 (5)	15 (10)	7 (7)	7 (7)	11 (7)	1 (2)	4 (3)	3 (7)
25	Blackened fruits/leaves	0 (—)	1 (1)	25 (20)	26 (29)	56 (45)	47 (40)	68 (49)	50 (49)	39 (34)	62 (41)	50 (52)	51 (48)	83 (54)	23 (47)	73 (54)	30 (73)
26	Floating fruits (in ball-form crown)	0 (—)	0 (—)	1 (1)	1 (1)	8 (6)	8 (7)	8 (7)	6 (4)	6 (5)	11 (7)	9 (9)	7 (7)	8 (5)	1 (2)	6 (4)	5 (12)
27	Falling or fallen fruits/leaves/branches	0 (—)	2 (2)	5 (4)	7 (8)	5 (4)	5 (4)	3 (2)	1 (1)	0 (—)	4 (3)	0 (—)	0 (—)	2 (1)	0 (—)	0 (—)	27
28	Spatial displacements	2 (4)	8 (6)	16 (13)	7 (8)	12 (10)	7 (6)	13 (9)	12 (12)	13 (11)	16 (11)	12 (12)	10 (9)	4 (3)	2 (4)	8 (6)	4 (10)
29	Single-stroke-root	2 (4)	2 (2)	20 (16)	22 (24)	60 (48)	42 (36)	57 (41)	34 (33)	30 (26)	46 (31)	23 (24)	22 (21)	39 (25)	12 (24)	49 (36)	12 (29)
30	Double-stroke-root	5 (9)	5 (4)	1 (1)	1 (1)	1 (1)	3 (3)	2 (1)	6 (6)	7 (6)	6 (6)	4 (4)	6 (6)	1 (1)	0 (—)	4 (3)	0 (—)
31	Fir-tree-trunk	1 (2)	0 (—)	2 (2)	6 (7)	3 (2)	3 (2)	2 (2)	2 (1)	0 (—)	0 (—)	0 (—)	0 (—)	2 (1)	0 (—)	1 (1)	0 (—)
32	Half-fir-tree-trunk	1 (2)	0 (—)	7 (6)	7 (8)	25 (20)	31 (26)	45 (33)	33 (32)	52 (46)	80 (53)	55 (57)	66 (62)	115 (74)	29 (59)	97 (71)	23 (56)
33	Conical trunk	6 (11)	14 (11)	24 (20)	20 (22)	13 (10)	42 (36)	41 (30)	38 (37)	46 (40)	48 (32)	26 (27)	32 (30)	38 (25)	4 (8)	27 (20)	7 (17)
34	Trunk-base on the paper end	7 (13)	33 (26)	58 (47)	48 (53)	55 (44)	47 (40)	49 (36)	28 (27)	13 (11)	21 (14)	17 (18)	12 (11)	12 (8)	8 (16)	8 (6)	5 (12)
35	Straight-trunk-base	3 (5)	37 (29)	77 (63)	68 (75)	106 (85)	92 (78)	106 (77)	81 (79)	77 (68)	109 (73)	77 (79)	84 (79)	138 (89)	47 (96)	125 (92)	37 (90)
36	Ball-form crown	0 (—)	0 (—)	2 (2)	2 (2)	4 (3)	3 (3)	3 (2)	0 (—)	1 (1)	4 (3)	7 (7)	2 (2)	5 (3)	0 (—)	5 (4)	0 (—)
37	Curly-half-form crown	2 (4)	15 (12)	10 (8)	3 (3)	5 (4)	3 (3)	0 (—)	2 (2)	3 (3)	3 (2)	3 (3)	1 (1)	10 (6)	1 (2)	1 (1)	2 (3)
38	Crown with tangled/scribble line	0 (—)	0 (—)	0 (—)	2 (2)	6 (5)	23 (19)	34 (25)	26 (25)	20 (18)	35 (23)	22 (23)	24 (22)	40 (26)	7 (14)	27 (20)	4 (10)
39	Tubular branches	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	0 (—)	1 (1)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	39
40	Curved and too-long branches	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	40
41	Curved and space-filling branches	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	40
42	Thema-change inside the crown	7 (13)	38 (30)	65 (51)	38 (42)	37 (30)	34 (29)	20 (14)	7 (7)	2 (2)	2 (2)	3 (3)	3 (3)	5 (3)	0 (—)	2 (1)	0 (—)
43	Trunk-top covered with the straight line	2 (4)	6 (5)	21 (17)	17 (19)	31 (25)	35 (30)	40 (29)	22 (22)	27 (24)	21 (14)	22 (23)	6 (6)	14 (9)	1 (2)	8 (6)	4 (10)
44	Branch-top covered with the straight line	0 (—)	0 (—)	0 (—)	1 (1)	2 (2)	1 (1)	1 (1)	1 (1)	0 (—)	2 (2)	1 (1)	5 (5)	0 (—)	2 (1)	0 (—)	4 (4)
45	Cut or fractured branches/trunk	1 (2)	5 (4)	5 (4)	1 (1)	2 (2)	1 (1)	7 (5)	2 (2)	5 (4)	0 (—)	1 (1)	1 (1)	0 (—)	0 (—)	1 (1)	0 (—)
46	Lump/dent on the trunk	0 (—)	2 (2)	7 (6)	2 (2)	0 (—)	1 (1)	2 (1)	0 (—)	1 (1)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	0 (—)	45
47	Additional forms	0 (—)	4 (3)	6 (5)	5 (5)	6 (5)	13 (11)	15 (11)	11 (11)	10 (9)	9 (6)	9 (9)	3 (3)	5 (3)	1 (2)	1 (1)	2 (4)
48	Stereoty pies	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	2 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	48
49	Stake and supports	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	49
50	Ladders	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	2 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	50
51	Guard and wire	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	2 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	50
52	Degenerative forms	1 (2)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	1 (1)	1 (1)	1 (1)	0 (—)	0 (—)	1 (1)	0 (—)
53	Third-dimension (excluding «ey»)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	8 (6)	9 (8)	8 (5)	7 (7)	6 (6)	11 (7)	3 (6)	6 (4)	2 (5)
54	Opposite-directed branching	0 (—)	0 (—)	0 (—)	0 (—)	5 (4)	6 (5)	9 (7)	13 (13)	16 (14)	8 (5)	12 (12)	7 (7)	12 (8)	1 (2)	9 (7)	1 (2)
55	Accessories	1 (2)	1 (1)	0 (—)	0 (—)	2 (2)	3 (3)	13 (9)	2 (2)	1 (1)	8 (5)	0 (—)	1 (1)	9 (6)	2 (4)	2 (1)	0 (—)
56	Landscape with many outer things	0 (—)	2 (2)	2 (2)	4 (3)	4 (3)	4 (3)	6 (4)	8 (8)	6 (5)	15 (10)	6 (6)	7 (7)	11 (7)	1 (2)	2 (1)	4 (10)
57	Only suggested landscape	7 (13)	15 (12)	11 (9)	16 (18)	25 (20)	19 (16)	37 (27)	29 (28)	34 (30)	63 (42)	34 (35)	36 (34)	48 (31)	14 (29)	40 (29)	21 (51)
58	Island and hill	0 (—)	0 (—)	1 (1)	0 (—)	5 (4)	5 (4)	7 (5)	4 (4)	7 (6)	10 (7)	5 (5)	3 (3)	5 (3)	1 (2)	2 (1)	4 (10)
59	Protruding from the upper-edge of paper	2 (4)	4 (3)	0 (—)	2 (2)	2 (2)	2 (2)	11 (8)	10 (10)	14 (12)	27 (18)	17 (18)	12 (11)	24 (15)	4 (8)	28 (21)	6 (15)

Appendix B. Results for Girls (unit = number (%))

No	Girls: CA	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
No	Number of Participants	47 (13.8)	141 (38)	109 (29)	84 (23)	112 (30)	118 (32)	111 (30)	116 (32)	100 (27)	139 (38)	102 (28)	92 (25)	158 (43)	82 (23)	154 (42)	54 (15)
1	Scrubble	0 (—)	3 (2)	4 (4)	0 (—)	0 (—)	0 (—)	2 (2)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
2	Pure horizontal branches	3 (6)	6 (4)	8 (7)	7 (8)	10 (9)	14 (12)	8 (7)	6 (5)	8 (7)	6 (6)	4 (3)	5 (5)	5 (3)	3 (4)	1 (1)	0 (—)
3	Scattered horizontal branches	3 (6)	7 (5)	8 (7)	5 (6)	8 (7)	3 (3)	3 (3)	1 (1)	7 (7)	8 (6)	4 (4)	1 (1)	5 (3)	0 (—)	5 (3)	0 (—)
4	Straight-branches	0 (—)	1 (1)	2 (2)	2 (2)	0 (—)	0 (—)	3 (3)	2 (2)	1 (1)	0 (—)	1 (1)	0 (—)	2 (1)	0 (—)	0 (—)	0 (—)
5	Cross-forms	6 (13)	22 (16)	3 (3)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	4 (3)	1 (1)	1 (1)	0 (—)
6	Single-stroke-trunk	23 (49)	106 (75)	106 (97)	84 (100)	109 (97)	118 (100)	111 (100)	116 (100)	99 (99)	139 (100)	101 (99)	92 (100)	154 (97)	81 (99)	153 (99)	54 (100)
7	Double-stroke-trunk	5 (11)	20 (14)	24 (22)	15 (18)	14 (13)	12 (10)	9 (8)	16 (14)	16 (16)	17 (12)	11 (11)	5 (5)	14 (9)	3 (4)	15 (10)	2 (4)
8	Single-stroke-branch	2 (4)	5 (4)	9 (8)	5 (6)	5 (4)	5 (4)	6 (5)	10 (9)	8 (8)	8 (6)	8 (8)	5 (3)	3 (4)	2 (1)	2 (1)	2 (4)
9	Double-stroke-branch	4 (9)	23 (16)	30 (28)	32 (38)	49 (44)	73 (62)	76 (68)	77 (66)	70 (70)	92 (66)	65 (64)	44 (48)	74 (47)	44 (54)	59 (38)	30 (56)
10	Pure orthogonal branches	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
11	Scattered orthogonal branches	0 (—)	1 (1)	2 (2)	3 (4)	11 (10)	15 (13)	14 (13)	11 (9)	11 (11)	17 (12)	5 (5)	3 (3)	3 (2)	1 (1)	4 (3)	1 (2)
12	Branches to the ground	0 (—)	0 (—)	3 (3)	3 (4)	3 (3)	7 (6)	4 (4)	2 (2)	2 (2)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)
13	Scattered low-lying branches	4 (9)	11 (8)	19 (17)	21 (25)	30 (27)	44 (37)	46 (41)	35 (30)	30 (30)	25 (18)	21 (21)	15 (16)	25 (16)	13 (16)	16 (10)	5 (9)
14	Leaves/fruits inside the trunk	6 (13)	5 (4)	3 (3)	2 (2)	1 (1)	0 (—)	1 (1)	2 (2)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
15	Trunk without crown/with short branches	13 (28)	40 (28)	11 (10)	6 (7)	2 (2)	4 (3)	1 (1)	2 (2)	2 (2)	2 (2)	0 (—)	0 (—)	5 (5)	3 (2)	1 (1)	1 (2)
16	Crown in shading style (no branches)	14 (30)	65 (46)	69 (63)	66 (79)	94 (84)	98 (83)	104 (94)	107 (92)	90 (90)	122 (88)	91 (89)	82 (89)	144 (91)	69 (84)	137 (89)	50 (93)
17	Fruits	0 (—)	8 (6)	8 (7)	11 (13)	30 (27)	46 (39)	47 (42)	40 (34)	45 (45)	46 (33)	24 (24)	15 (16)	27 (17)	18 (22)	29 (19)	7 (13)
18	Leaves	0 (—)	0 (—)	0 (—)	1 (1)	4 (4)	4 (3)	7 (6)	1 (1)	7 (7)	3 (2)	3 (3)	4 (4)	4 (3)	1 (1)	2 (1)	1 (2)
19	Flowers	0 (—)	0 (—)	0 (—)	0 (—)	2 (2)	2 (2)	2 (2)	2 (2)	0 (—)	2 (2)	2 (2)	3 (3)	7 (4)	2 (2)	3 (2)	1 (2)
20	Oversized fruits/leaves	0 (—)	9 (6)	2 (2)	0 (—)	0 (—)	1 (1)	2 (2)	0 (—)	0 (—)	2 (1)	2 (2)	0 (—)	3 (3)	2 (2)	3 (2)	2 (3)
21	Blackened fruits/leaves	6 (13)	18 (13)	17 (16)	15 (18)	5 (4)	7 (6)	5 (5)	6 (5)	9 (9)	15 (11)	11 (11)	13 (14)	18 (11)	7 (9)	11 (7)	5 (9)
22	Floating fruits (in ball-form crown)	0 (—)	20 (14)	24 (22)	40 (48)	66 (59)	63 (53)	71 (64)	70 (60)	54 (54)	76 (55)	62 (61)	63 (68)	115 (73)	55 (67)	112 (73)	43 (80)
23	Falling or fallen fruits/leaves/branches	0 (—)	1 (1)	2 (2)	2 (2)	5 (4)	9 (8)	11 (10)	9 (8)	17 (17)	11 (8)	5 (5)	14 (15)	17 (11)	5 (6)	12 (8)	3 (6)
24	Spatial displacements	1 (2)	3 (2)	4 (4)	3 (4)	6 (5)	3 (3)	2 (2)	2 (2)	0 (—)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
25	Single-stroke-root	0 (—)	5 (4)	10 (9)	5 (6)	4 (4)	1 (1)	8 (7)	4 (3)	5 (5)	3 (2)	1 (1)	1 (1)	4 (3)	1 (1)	5 (3)	1 (2)
26	Double-stroke-root	0 (—)	16 (11)	23 (21)	32 (38)	49 (44)	52 (44)	53 (48)	49 (42)	47 (47)	43 (31)	36 (35)	23 (25)	53 (34)	21 (26)	47 (31)	21 (39)
27	Fire-tree-trunk	0 (—)	6 (4)	2 (2)	0 (—)	1 (1)	5 (4)	3 (3)	2 (2)	0 (—)	5 (4)	1 (1)	2 (2)	1 (1)	1 (1)	1 (1)	1 (2)
28	Half-fire-tree-trunk	0 (—)	4 (3)	1 (1)	1 (1)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
29	Conical trunk	0 (—)	5 (4)	5 (5)	9 (11)	44 (39)	49 (42)	42 (38)	60 (52)	58 (58)	111 (80)	77 (75)	75 (82)	124 (78)	68 (83)	122 (79)	50 (93)
30	Trunk-base on the paper end	5 (11)	11 (8)	34 (31)	28 (33)	32 (29)	46 (39)	40 (34)	40 (34)	40 (40)	49 (35)	30 (29)	25 (27)	33 (21)	11 (13)	30 (19)	9 (17)
31	Straight-trunk-base	7 (15)	42 (30)	52 (48)	42 (50)	24 (21)	20 (17)	24 (22)	22 (19)	7 (7)	7 (5)	6 (6)	7 (8)	5 (3)	3 (4)	4 (3)	1 (2)
32	Ball-form crown	4 (9)	62 (44)	83 (76)	73 (87)	103 (92)	94 (80)	91 (82)	91 (78)	81 (81)	122 (88)	89 (87)	85 (92)	150 (95)	78 (95)	141 (92)	50 (93)
33	Curly-ball-form crown	0 (—)	4 (3)	6 (6)	4 (5)	2 (2)	2 (2)	0 (—)	1 (1)	0 (—)	0 (—)	2 (2)	1 (1)	3 (2)	1 (1)	2 (1)	1 (2)
34	Crown with tangled/scrabble line	2 (4)	13 (9)	8 (7)	12 (14)	6 (5)	5 (4)	0 (—)	1 (1)	0 (—)	0 (—)	2 (2)	1 (1)	3 (2)	2 (2)	3 (2)	0 (—)
35	Tubular branches	0 (—)	1 (1)	4 (4)	2 (2)	9 (8)	13 (11)	20 (18)	26 (22)	21 (21)	25 (18)	16 (16)	14 (15)	20 (13)	12 (15)	14 (9)	10 (19)
36	Curved and too-long branches	0 (—)	0 (—)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
37	Curved and space-filling branches	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
38	Thema-change inside the crown	0 (—)	0 (—)	0 (—)	2 (2)	11 (10)	4 (3)	8 (7)	7 (6)	4 (4)	2 (1)	5 (5)	3 (3)	7 (4)	10 (12)	5 (3)	3 (6)
39	Trunk-top covered with the straight line	8 (17)	43 (30)	49 (45)	37 (44)	22 (20)	14 (12)	4 (4)	4 (3)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)
40	Branch-tip covered with the straight line	2 (4)	12 (9)	13 (12)	16 (19)	16 (14)	37 (31)	28 (25)	27 (23)	21 (21)	20 (14)	9 (9)	5 (5)	7 (4)	5 (6)	8 (5)	3 (6)
41	Cut or fractured branches/trunk	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	2 (2)	0 (—)	2 (2)	1 (1)	3 (2)	0 (—)	2 (2)	2 (1)	0 (—)	2 (1)	0 (—)
42	Lump/dent on the trunk	2 (4)	4 (3)	5 (5)	1 (1)	0 (—)	0 (—)	2 (2)	0 (—)	0 (—)	1 (1)	2 (2)	2 (2)	1 (1)	0 (—)	0 (—)	0 (—)
43	Additional forms	0 (—)	1 (1)	1 (1)	0 (—)	1 (1)	0 (—)	2 (2)	2 (2)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
44	Stereotypes	0 (—)	0 (—)	3 (3)	2 (2)	6 (5)	4 (3)	5 (5)	4 (3)	5 (5)	6 (4)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
45	Stake and supports	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	0 (—)	0 (—)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
46	Ladders	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
47	Guard and wire	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	2 (2)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)
48	Degenerative forms	2 (4)	2 (1)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	1 (1)	0 (—)	0 (—)	0 (—)	1 (1)	1 (1)	1 (1)	0 (—)	0 (—)
49	Third-dimension (excluding 'key es')	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	1 (1)	5 (4)	11 (11)	8 (6)	3 (3)	2 (2)	4 (3)	6 (7)	1 (1)	1 (2)
50	Opposite-directed branching	0 (—)	0 (—)	2 (2)	2 (2)	4 (4)	2 (2)	6 (5)	3 (3)	7 (7)	9 (6)	3 (3)	3 (3)	2 (1)	0 (—)	6 (4)	1 (2)
51	Accessories	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	3 (3)	3 (3)	7 (7)	9 (6)	4 (4)	5 (5)	11 (7)	1 (1)	2 (1)	1 (2)
52	Landscapes with many other things	1 (2)	7 (5)	3 (3)	1 (1)	0 (—)	0 (—)	1 (1)	10 (9)	8 (8)	9 (6)	6 (6)	8 (9)	13 (8)	7 (9)	8 (5)	4 (7)
53	Only suggested landscape	3 (6)	6 (4)	8 (7)	10 (12)	19 (17)	15 (13)	28 (25)	31 (27)	16 (16)	40 (29)	31 (30)	28 (30)	36 (23)	17 (21)	25 (16)	9 (17)
54	Island and hill	0 (—)	0 (—)	0 (—)	0 (—)	0 (—)	1 (1)	8 (7)	7 (6)	2 (2)	1 (1)	4 (4)	3 (3)	7 (4)	2 (2)	1 (1)	1 (2)
55	Protruding from the upper-edge of paper	3 (6)	1 (1)	4 (4)	1 (1)	1 (1)	5 (4)	2 (2)	3 (3)	16 (16)	21 (15)	12 (12)	18 (20)	14 (9)	10 (12)	13 (8)	4 (7)