Piaget's Studies in Generalization

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The triptych

Recherches sur l'abstraction réfléchissante
(1971-1972; published 1977)

- *Studies in Reflecting Abstraction* (2001)

Recherches sur la généralisation
(1972-1973; published 1978)

Recherches sur les correspondances
(1973-1974; published 1980)

Two questions

Abstracting and generalizing are supposed to be tightly linked: any property that has been abstracted supports generalizing.

1. Can reflecting abstraction and constructive generalization lead to *errors*?
2. Are there *levels* of abstracting and generalizing (or are levels to be defined in structural terms only)?

Chapter 2: Combining lengths

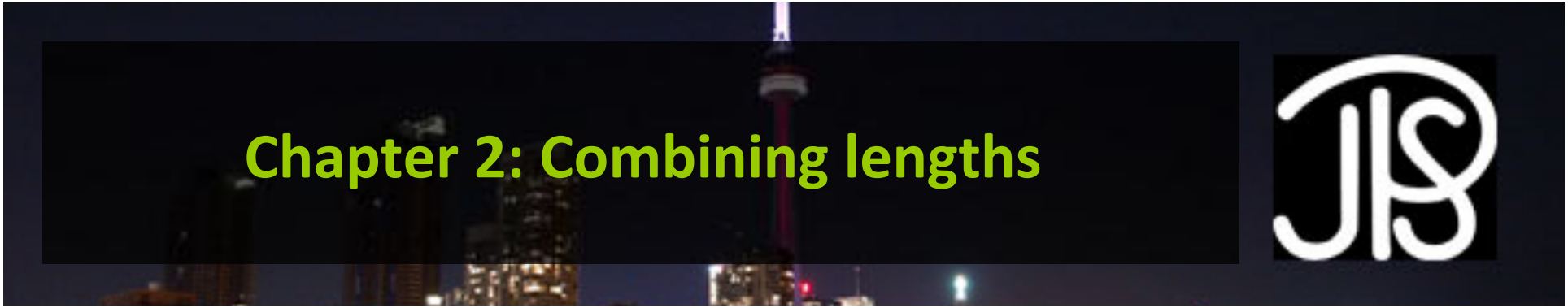
Jean Piaget and Alex Blanchet

Children line up rectangles on the table to meet length targets

- 24 rectangles, length and width numbered along the sides
- Single length and double length targets

Trick question (using only rectangles whose length and width differ by 3, go from target length *n* to target length *n+2*)

How many combinations of lengths for 1, 2, 3, 4… rectangles?



Chapter 2: Combining lengths

1) “Inductive [generalization] is limited to applying to new objects a scheme already known by empirical abstraction (or by reflecting abstraction, but only when the scheme was constructed prior to the generalization, without this construction intervening in the mechanism of the same generalization)” (p. 44)

Chapter 2: Combining lengths

2) “Constructive generalization […] gives rise to new forms by completing or differentiating. This second form of generalizing thus marks progress in intension, but naturally also in extension (insofar as it is subordinated to intension); hence it creates new contents, or enriches empirical contents by providing them with new forms.” (p. 44)

Chapter 2: Combining lengths

"In general terms, inductive generalization is based on observations [*constatations*] or on just the results of actions, whereas the constructive kind generalizes the actions or operations themselves, broadening and completing the forms that they already had." (p. 44)

Chapter 2: Combining lengths

"In sum, at every level we find both inductive generalizations and constructive generalizations (whether pre-existing generalizations that serve as frameworks or current generalizations that serve, so to speak, as drivers). But it is apparent that the constructive generalizations come to predominate more and more over the inductive, and subordinate them via a continuous process." (p. 46)

Chapter 2: Combining lengths

IA (5-year-olds)

- –Meet single length targets without much trouble
- –Not adept at meeting double length targets with the same rectangles (which then have to be rotated)
- –Center on the length or the width of the rectangles
- –Fail to differentiate among possible combinations

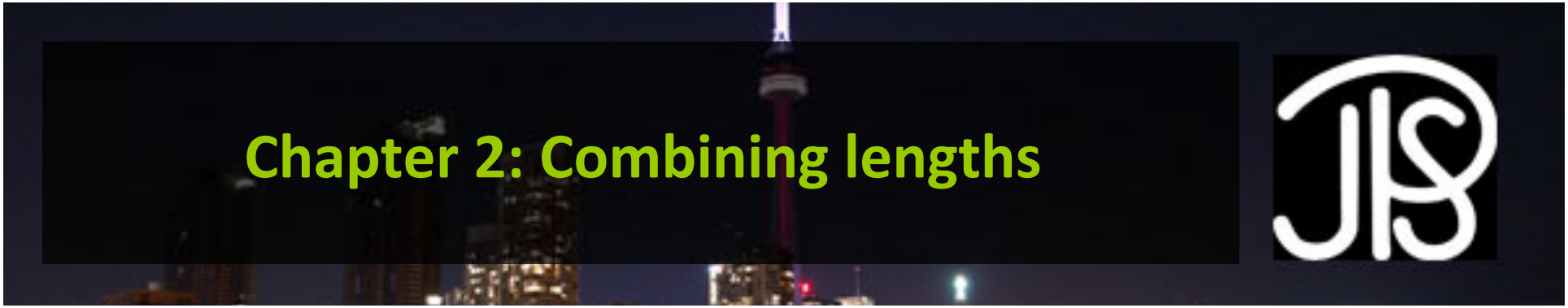
Chapter 2: Combining lengths

IB (6-year-olds)

- Begin to coordinate aligning and rotating
- Otherwise rely on "groping" (*tâtonnements*) to meet length targets

Chapter 2: Combining lengths

"A constructive generalization is involved, of course in part, to the extent that the subject begins to understand that a non-square rectangle has two distinct dimensions, and that in turning it one necessarily finds a new length *L* or *W*: hence the possible use of rotation. But all there is to this is a preliminary step whose purpose is to establish the meanings. Consequently it is a simple general framework, not a mechanism that takes into account the passage from one action to the next. […] the child is in no way yet able to infer the consequences of a particular rotation; it is thus only in regard to the results of his action that he refuses, accepts, or generalizes such attempts, and to the extent that it remains like this, the generalization is obviously still inductive." (p. 37)



Chapter 2: Combining lengths

IIA (7 and 8-year-olds)

- Children begin to make inferences relating the length and width of the same rectangle and of different rectangles
- They rely on explicitly on the numbers inscribed on the rectangles

Chapter 2: Combining lengths

"The reactions of the present substage IIA mark a notable advance: the child notes both dimensions of a given rectangle right away and, by groping, puts them into relation with the dimensions of the others. Hence constructive generalization begins to take off. From a simple framework, it becomes an instrument of quantification that subordinates the values *L* and *W* that are being added to the predicted length of the alignment needed to reach the target." (p. 39)

Chapter 2: Combining lengths

"The first indicator of this transformation in the function of generalizing is that the subject really understands the two-target problems. He grasps right away (or nearly so […]) this it isn't a matter of hitting one target after another, but two at once, with the same elements, some of which merely need turning to *L* or to *W*." (p. 39)

Chapter 2: Combining lengths

"[…] concrete operations are just beginning at Level IIA, which means that deduction is still attached to material actions and to what has been noted about objects; hence, it proceeds by abstractions that are pseudo-empirical and not yet reflected, as they will be in the formal stage around 11-12 years of age. The stage difference is particularly marked for the impossible solutions: none of these subjects understands the general reason why with differences of 3 between *L* and *W* the total length of the alignment cannot be increased by 2 units." (p. 40)

Chapter 2: Combining lengths

IIB (9 and 10-year-olds)

- "Long stretches of trial and error for the two-target problems because *'I'm trying to calculate it*'" (p. 41)
- Realize why the trick problems are insoluble
- Arrive at an incorrect additive rule for the number of possible combinations

Chapter 2: Combining lengths

"In many studies, notably on causality, Level IIB appears to mark a regression from IIA on certain points, yet on further analysis we note that the subject is actually discovering new problems that complicate the task for him, yielding the impression that he is on a wild goose chase (*qu'il cherche midi à quatorze heures*). In the present study, the phenomenon is particularly striking: while the subjects are doing more and more reasoning, there is no observable progress in the results at Level IIB; instead, there is some apparent backsliding whose cause remains to be found[…]" (p. 40)

Chapter 2: Combining lengths

"[…] the subjects do more deducing than at Level IIA and often carry out calculations before noting [the results of placing the rectangles], an indication of progress in constructive generalization. In particular, they react better to the impossible solutions […] But precisely because they seek to reason before acting, the risk of error increases and they engage more often in groping, which is one reason for the apparent steps backward" (p. 41).

Chapter 2: Combining lengths

III (11-12 years of age)

- –Deliberate use of deduction
- –Immediate calculation of the dimensions of each rectangle needed to meet two targets (though this is not error-free)
- –Correct explanations of the impossibility
- –Computation of the number of possible alignments of *n* rectangles (the set of 2^n "base associations")

Chapter 2: Combining lengths

"By contrast, at Stage III constructive generalizing prevails decisively, on at least two points. On the one hand, the double target problems at last yield the elaboration of a deductive method allowing the appropriate coordinations for heterogeneous partitions to be controlled through calculation. Hence, as a corollary, the understanding that the trick problems (differences of 3 for an elongation of 2) are insoluble, which presupposes the ability to sum the differences." (pp. 45-46)

Chapter 2: Combining lengths

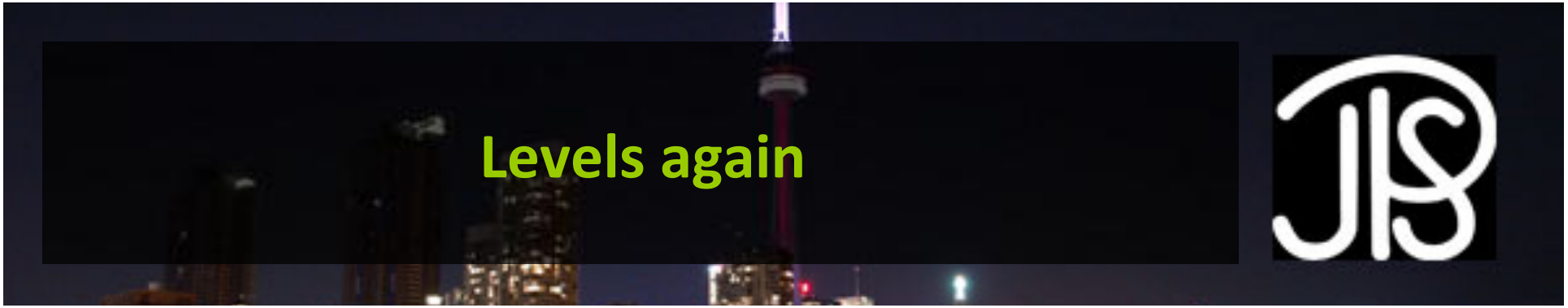
"On the other hand, the problem about the number of possible alignments for a given set of rectangles, which at Level IIB still elicited only incorrect additive solutions, is finally solved. This is a remarkable, nearly pure, instance of constructive generalizing (once the 4 possible combinations of 2 rectangles have been noted through pseudo-empirical abstraction)." (p. 46)

Chapter 2: Combining lengths

"Let us keep in mind first that while it is easy to construct a table of the stages in the development of a notion or of a structure (be it preoperational or operational) that are due to the functioning of abstraction and generalization, abstracting and generalizing are, by contrast, *merely functions* (in the biological sense, whereas notions and structures are organs). A function (such as nutrition in its innumerable forms) is permanent and uses diverse organs, so *it has no stages as a function."* (pp. 43-44, my italics).

Chapter 2: Combining lengths

"Conversely, it presents multiple forms of functioning tied to organs, and the biological problem is thus to know whether the function "creates" the organ or vice versa. From the cognitive standpoint, we think that the function of generalizing gives rise to structures that advance its functioning, leading to novel structures, and so on. The stages that we observe are *stages of structures*, but analyzing them permits further analysis of functioning, *which gets more advanced level by level* (albeit without allowing functioning to be their sole determinant)." (p. 44, my italics)



Levels again

- In Chapter 2, Piaget maintained that levels should be defined in structural terms only
- But *Studies in Reflecting Abstraction* presents levels of reflecting abstraction (and notes cases of reflected abstraction at Level IIB)
- By the time he drew up his “General conclusions” (Chapter 14), Piaget was having second thoughts about levels of constructive generalizing

Abstracting (Piaget, 1977/2001)

- …

Metareflection

Reflected abstraction

<u>Reflecting abstraction</u>

Empirical abstraction

Generalizing
(Piaget's "General conclusions", 1978)

Constructive generalization
(advanced)

Constructive generalization (basic)

Inductive generalization

Integrating
(Piaget's "General conclusions", 1978)

?

Synthesizing integrations

Completive integrations

Coordinative integrations

Generalizing (Henriques, 1978)

Formal generalization

Operatory generalization

Inductive generalization

The lineup

Metareflection	(Formal generalization)	
Reflected abstraction	Constructive generalization II	Synthesizing integrations
Reflecting abstraction	Constructive generalization I	Completive integrations
Empirical abstraction	Inductive generalization	Coordinative integrations