48-747 Shape Grammars

KINDERGARTEN GRAMMARS

… mother found ‘Gifts’. And ‘gifts’ they were. Along with the gifts were the system, as a basis for design and the elementary geometry behind all natural birth of Form”

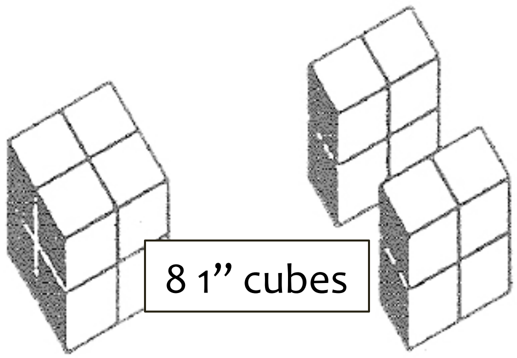
Developed by Friedrich Fröbel

Well known to designers because its formative influence on FLW

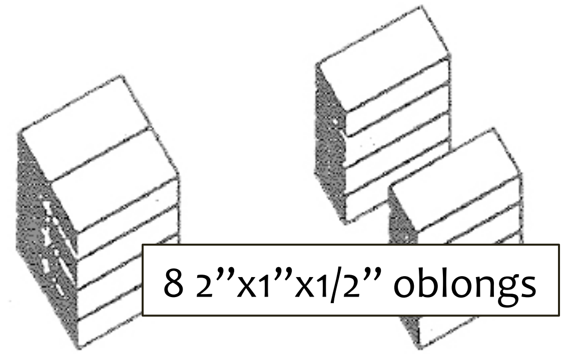
Based on a series of ***geometrical gifts***

+ a system of ***categories of form***

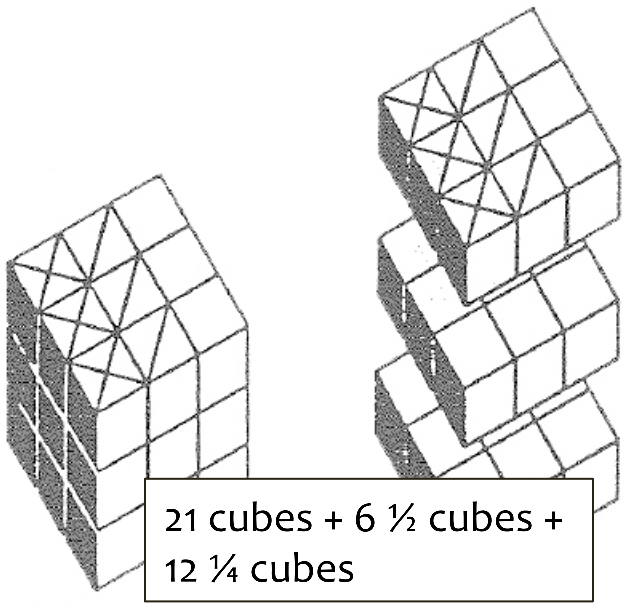
the **kindergarten method**



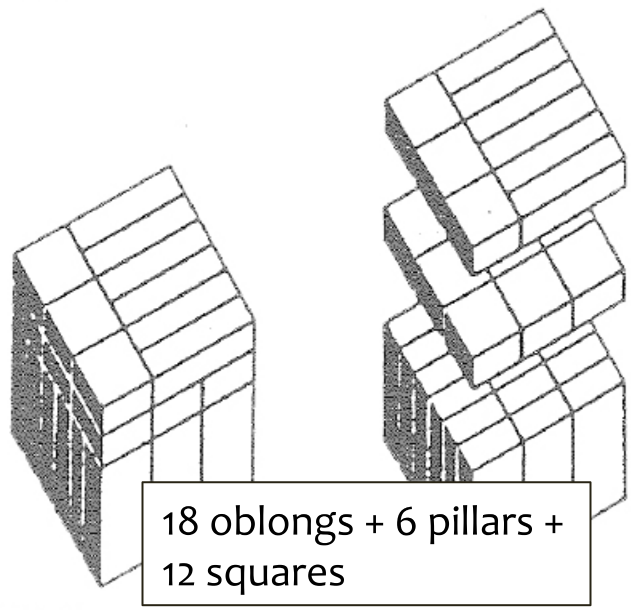
Gift 3



Gift 4



Gift 5

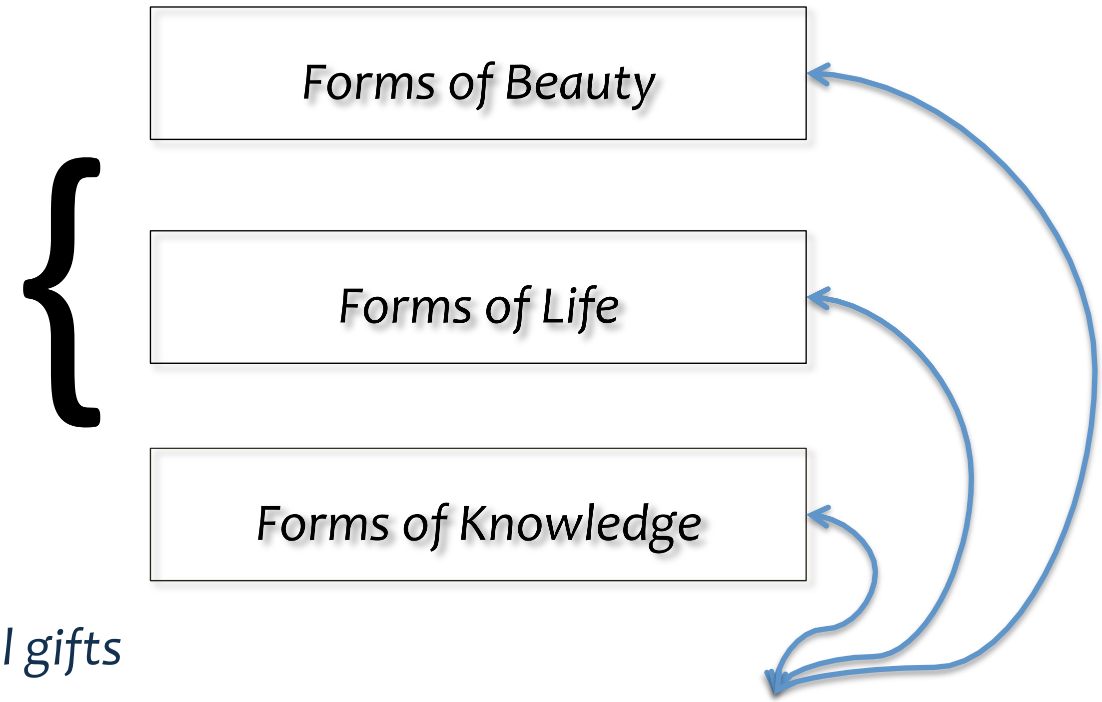


Gift 6

the gifts

form a vocabulary – the building blocks
e.g., cubes, ½ cubes, ¼ cubes, oblongs and so on

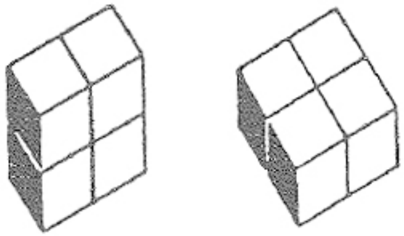
Verbal exposition and Visual exploration



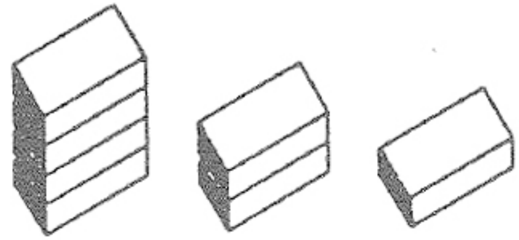
based on the *geometrical gifts*

+ a system of ***categories of form***

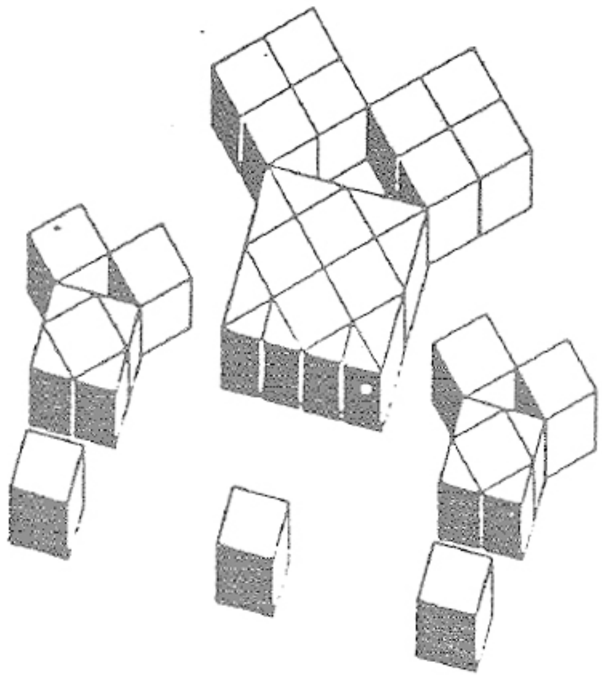
the **kindergarten** method



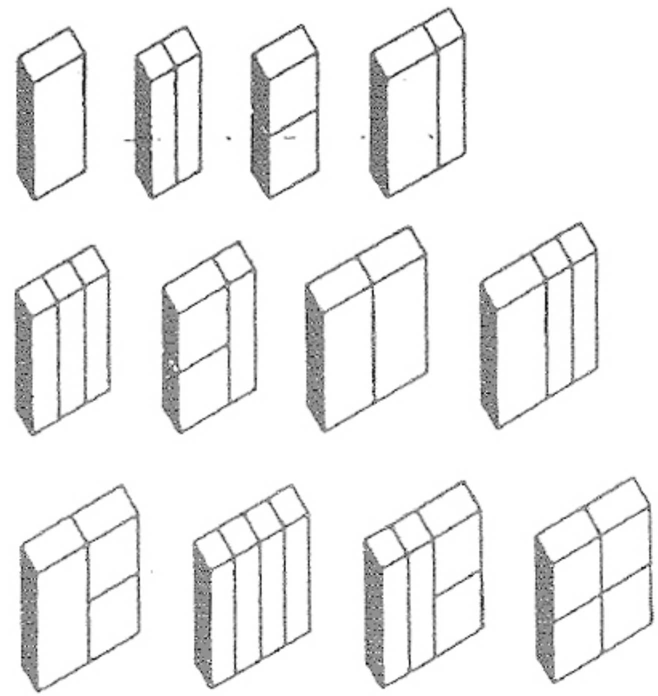
Gift 3: equivalence



Gift 4: division by 2

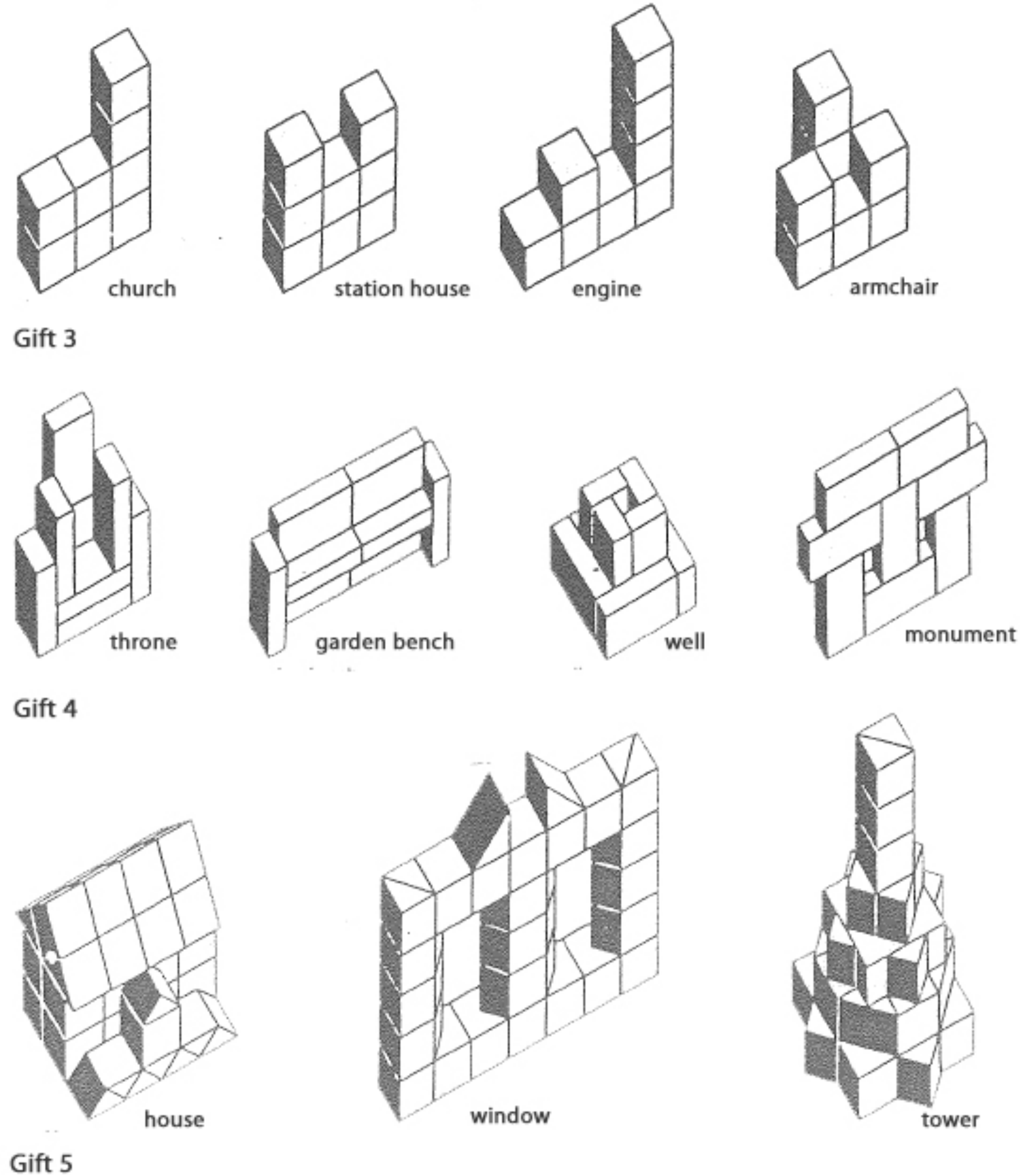


Gift 5: pythagorus' theorem

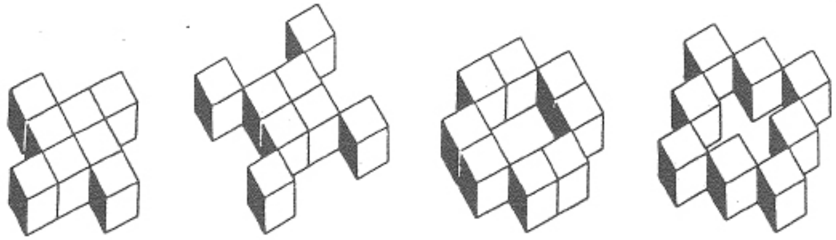


Gift 6: expanding series

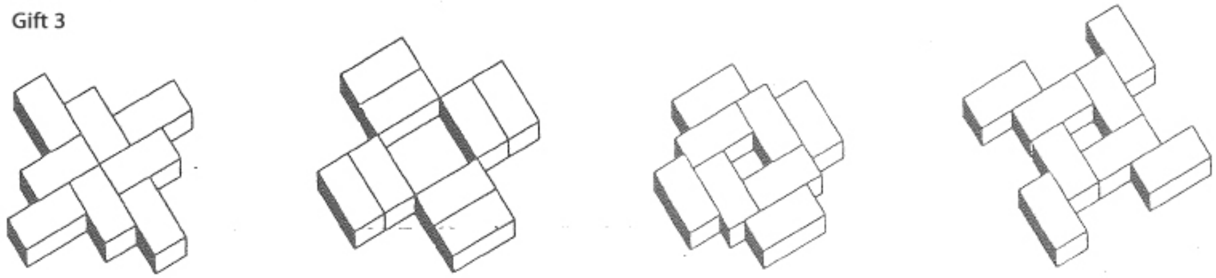
forms of knowledge



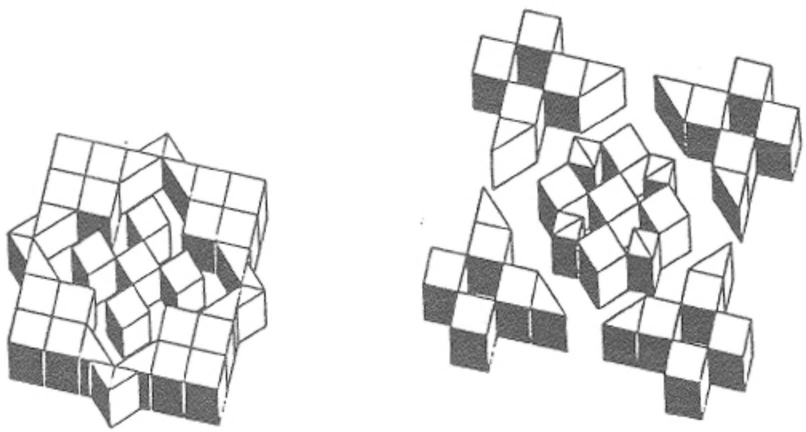
forms of life



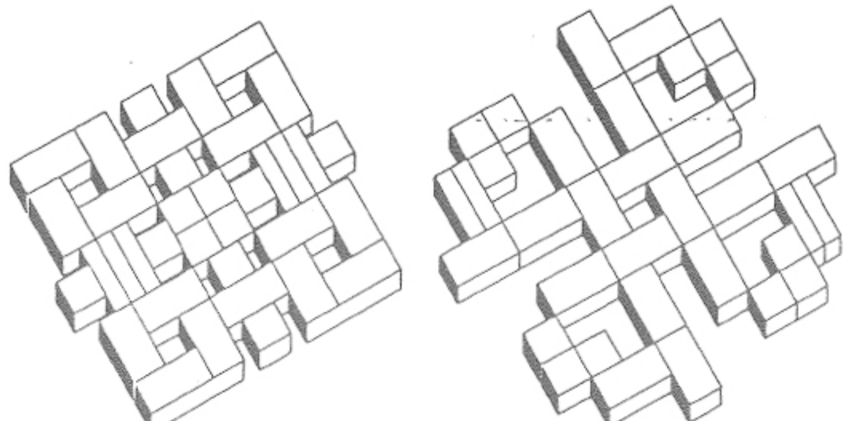
Gift 3



Gift 4



Gift 5



Gift 6

forms of beauty

Categories of forms suggest possibilities of design, in principle, the combination suggests a language (of designs)

Gifts constitute a vocabulary that gives rise to an pedagogical analogue in …

the **studio** method

Vocabulary

Architectural and structural elements

Categories

Architectural programmes

Building types

Historical styles

Symbolic references

Aesthetic doctrines (manifestos)

the studio encourages ***FREE PLAY*** *within these constraints*

abstractly, ***TRANSITIONS*** *from shapes (forms) to shapes (forms)*

the **studio** method

suggest a course of actions –

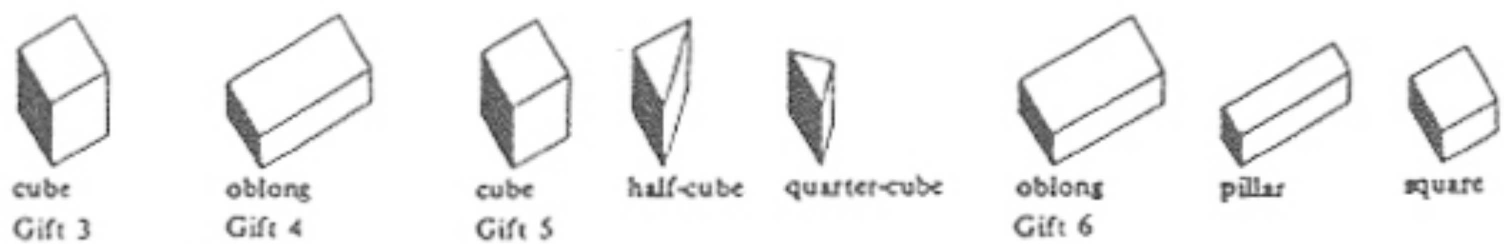
starting with a ***vocabulary*** (shapes)

- essentially, compositions– from shape to shape
(free play with forms)

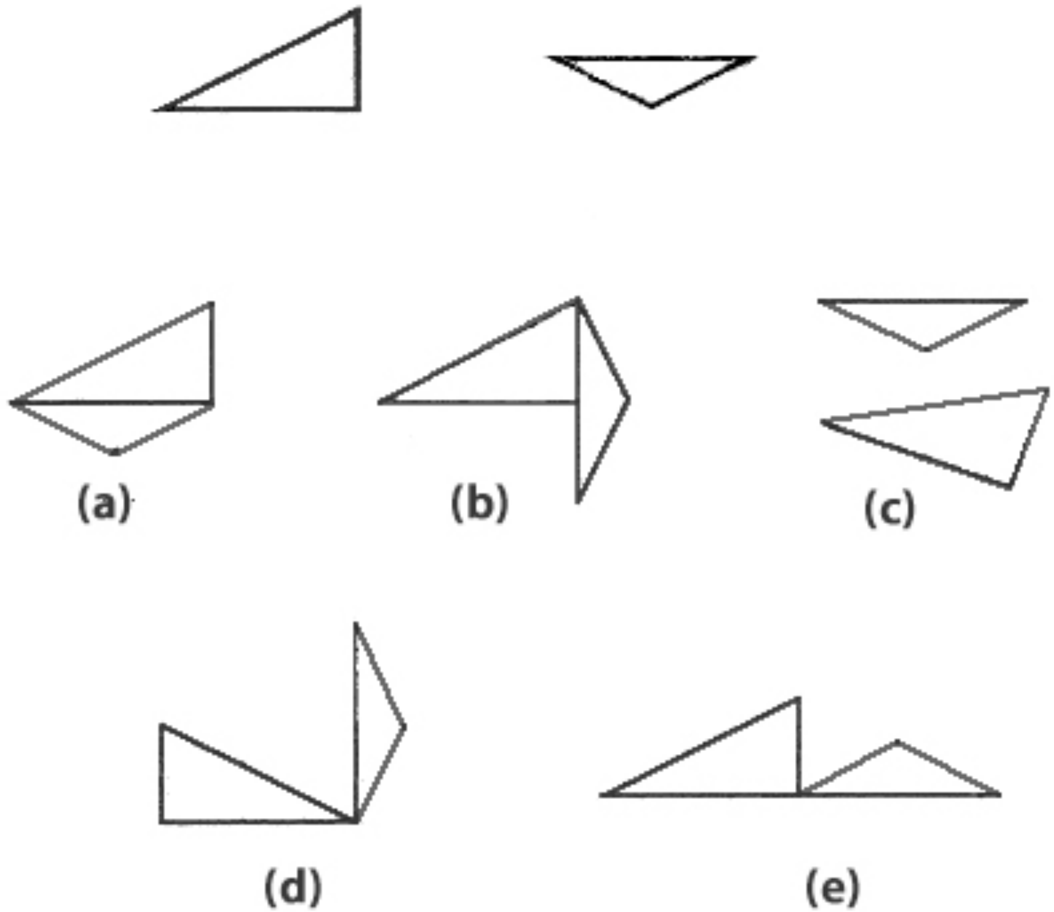
↓

relationships between shapes (forms)

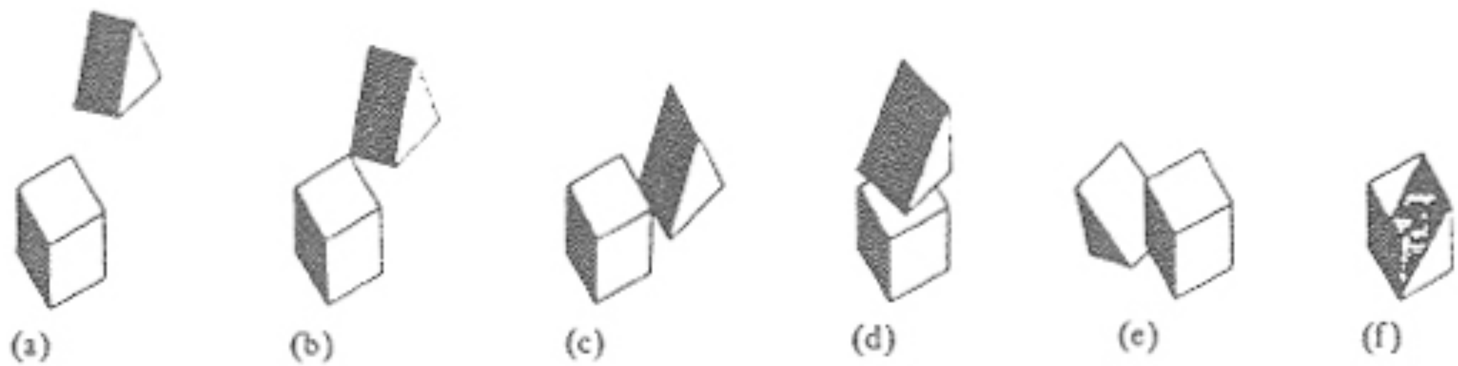
transitions



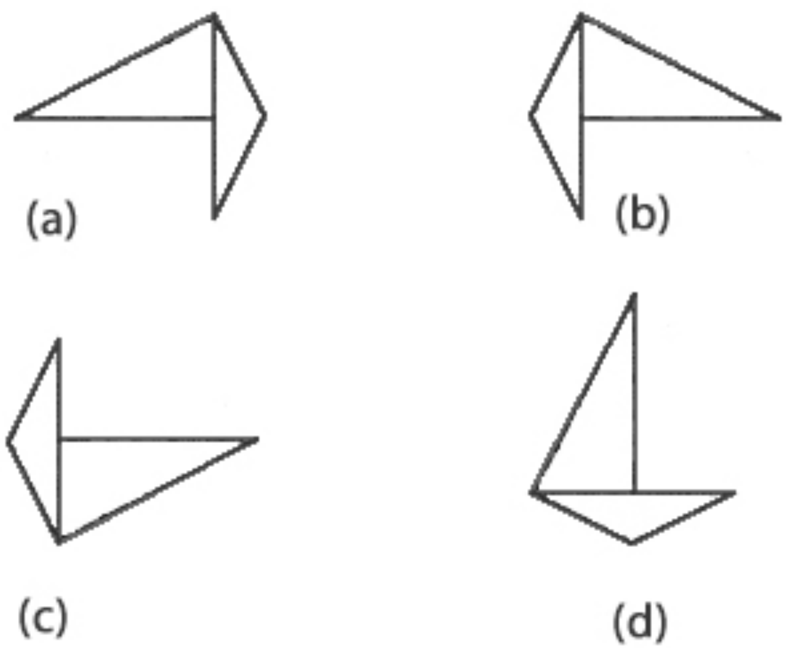
vocabularies

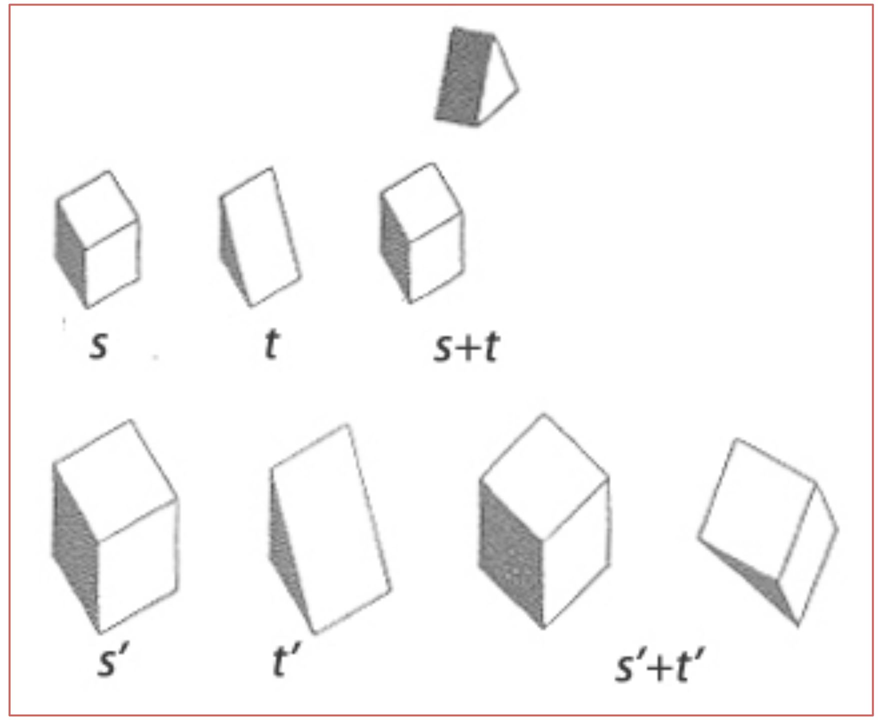


spatial relations arise whenever there are two or more shapes



spatial relation between a cube and a quarter-cube the number of shapes in the relations are identical and there is ***a geometrical transformation*** that maps every shape in one relation to a corresponding shape in the other relation





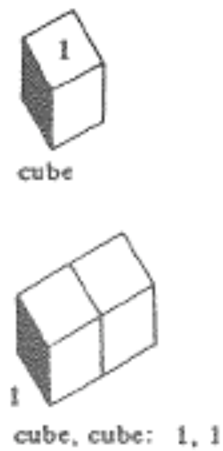
equivalent spatial relations arise *whenever*

Face to face. That is right.
Edge now are meeting quite.
Edge to face now we will lay,
Face to edge will end the play.

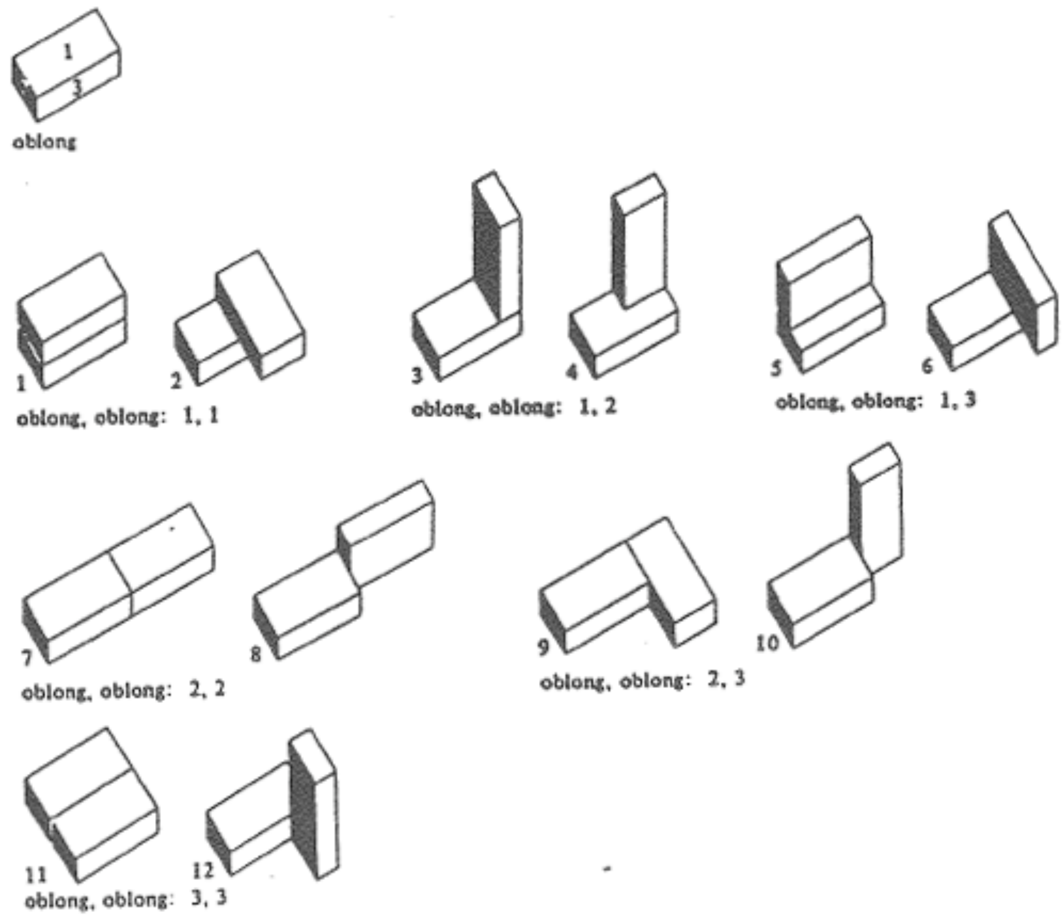
- Spatial relations specified by two blocks
- A face overlaps another face so that the faces share a vertex and edges intersecting at this point coincide
- The blocks do not interpenetrate

lets us play

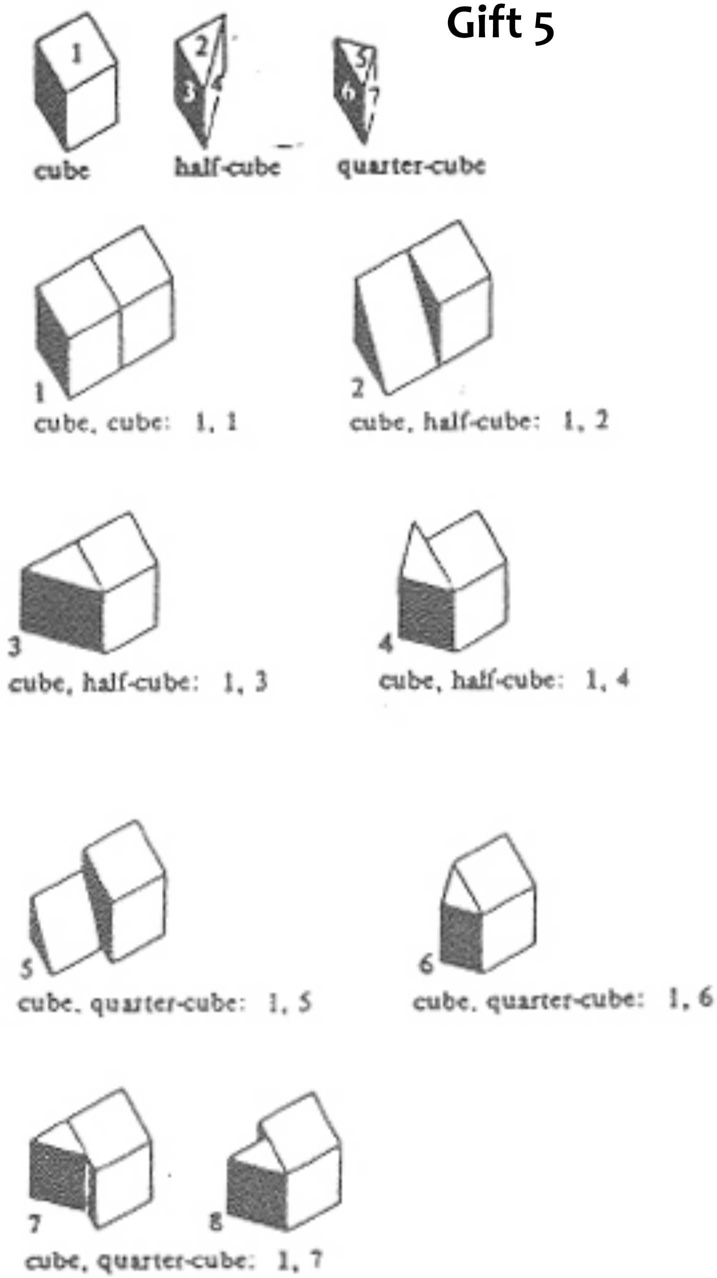
Gift 3

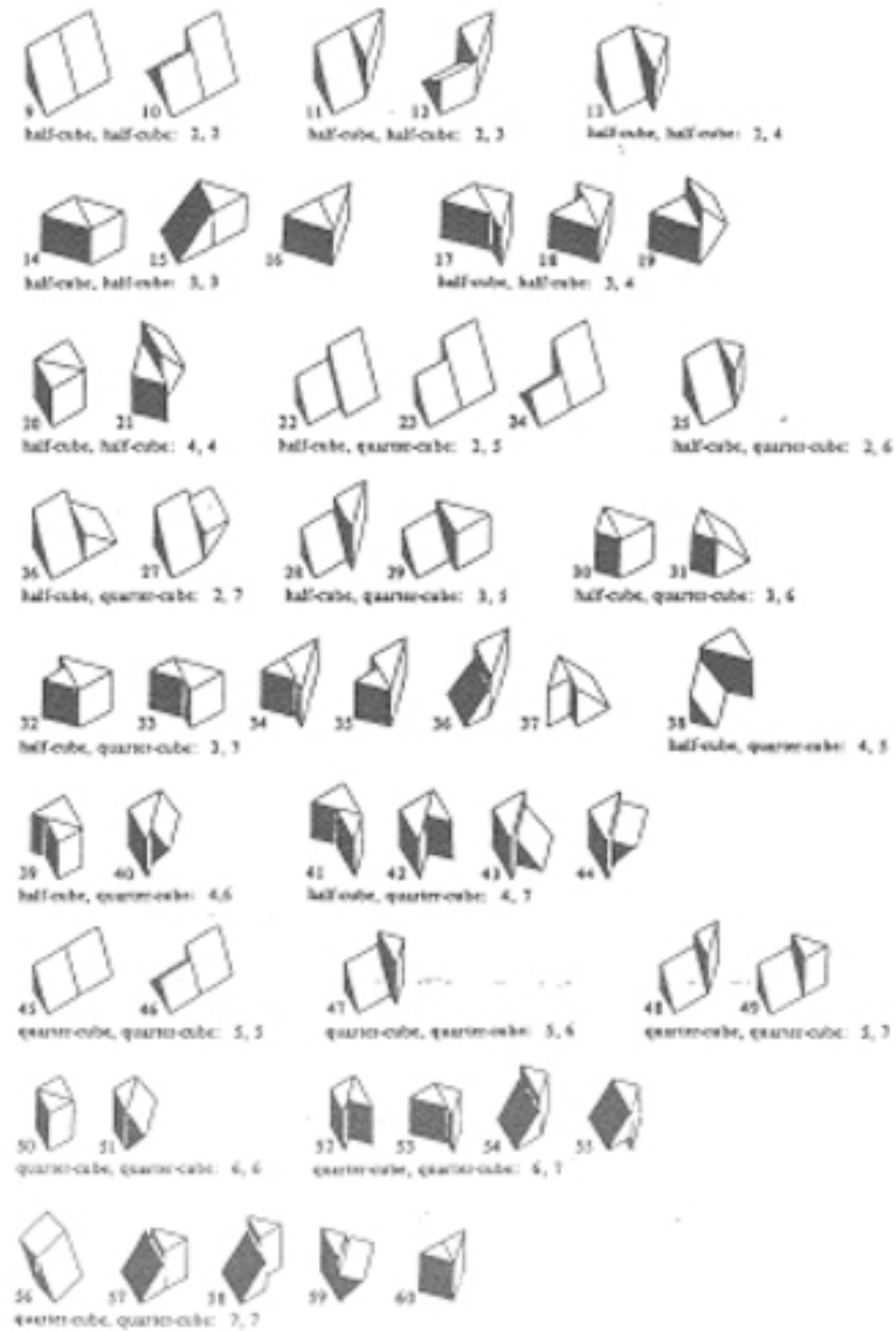

1
cube
1
cube, cube: 1, 1

Gift 4

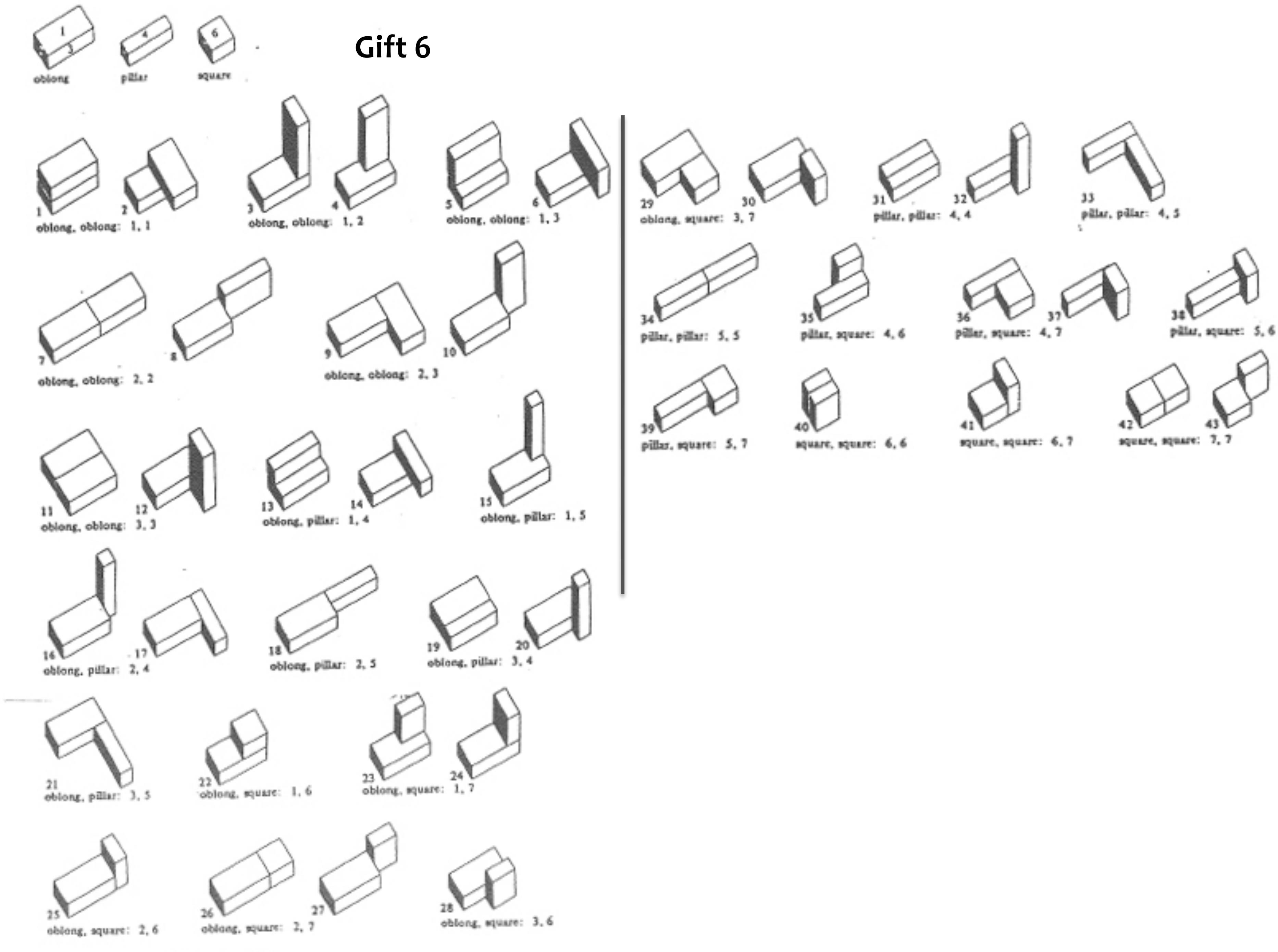

1
3
oblong
1
2
oblong, oblong: 1, 1
3
4
oblong, oblong: 1, 2
5
6
oblong, oblong: 1, 3
7
8
oblong, oblong: 2, 2
9
10
oblong, oblong: 2, 3
11
12
oblong, oblong: 3, 3

Gift 5

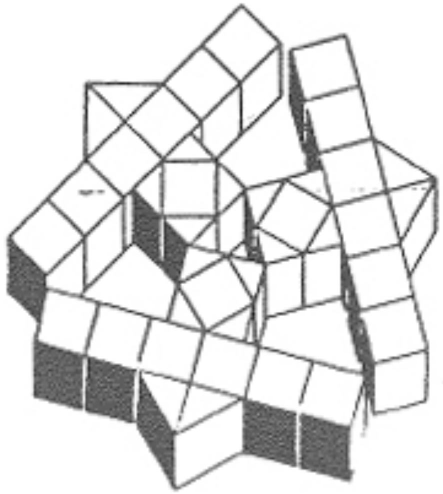

1
2
3
4
5
6
7
cube
half-cube
quarter-cube
1
cube, cube: 1, 1
2
cube, half-cube: 1, 2
3
cube, half-cube: 1, 3
4
cube, half-cube: 1, 4
5
cube, quarter-cube: 1, 5
6
cube, quarter-cube: 1, 6
7
8
cube, quarter-cube: 1, 7



Gift 6

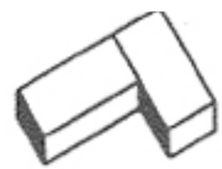


oblong
pillar
square
1 2 oblong, oblong: 1, 1
3 4 oblong, oblong: 1, 2
5 6 oblong, oblong: 1, 3
7 8 oblong, oblong: 2, 2
9 10 oblong, oblong: 2, 3
11 12 oblong, oblong: 3, 3
13 14 oblong, pillar: 1, 4
15 oblong, pillar: 1, 5
16 17 oblong, pillar: 2, 4
18 oblong, pillar: 2, 5
19 20 oblong, pillar: 3, 4
21 oblong, pillar: 3, 5
22 oblong, square: 1, 6
23 24 oblong, square: 1, 7
25 oblong, square: 2, 6
26 27 oblong, square: 2, 7
28 oblong, square: 3, 6
29 30 oblong, square: 3, 7
31 32 pillar, pillar: 4, 4
33 pillar, pillar: 4, 5
34 pillar, pillar: 5, 5
35 pillar, square: 4, 6
36 37 pillar, square: 4, 7
38 pillar, square: 5, 6
39 pillar, square: 5, 7
40 square, square: 6, 6
41 square, square: 6, 7
42 43 square, square: 7, 7



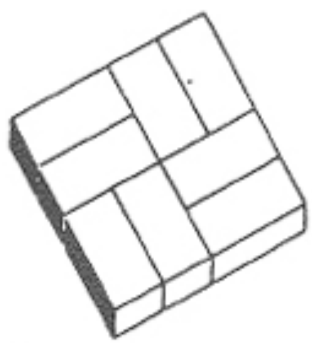
5-1 5-3 5-6 5-8 5-16

4-11

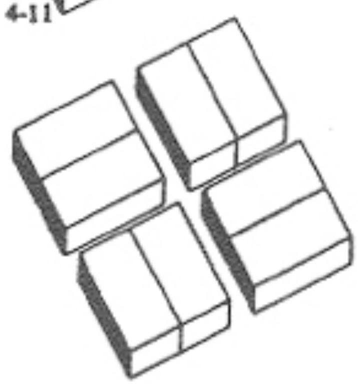


4-9

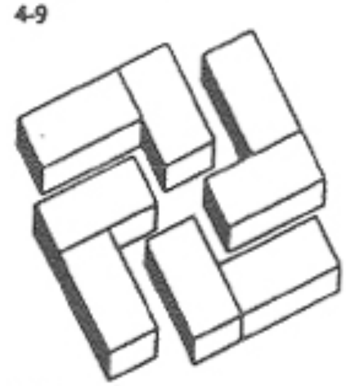
part of playing
is **seeing**



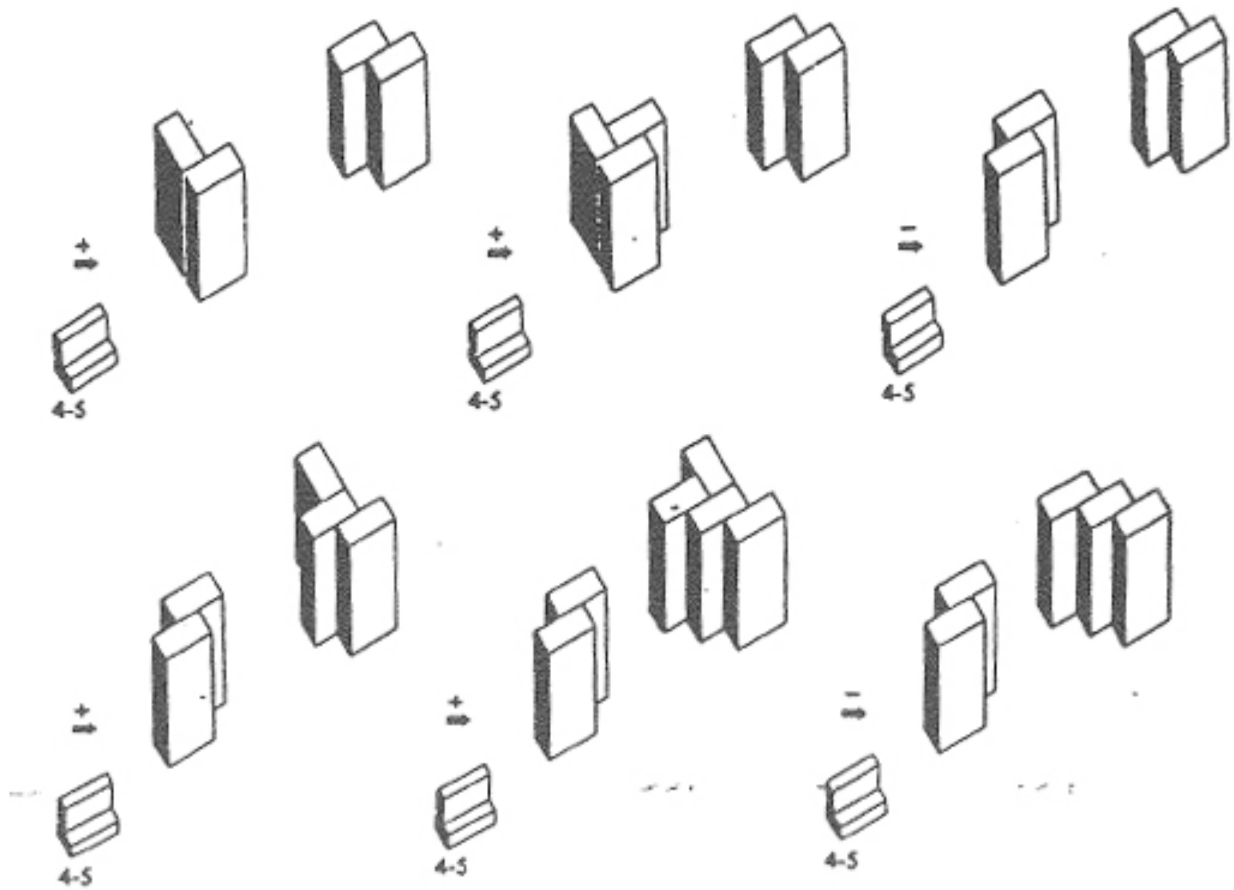
(a)



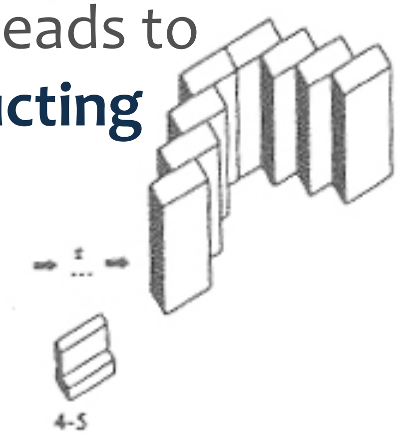
(b)

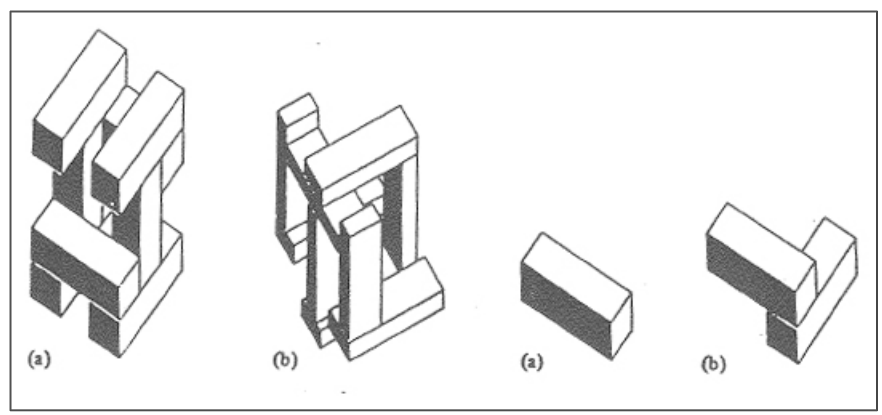


(c)

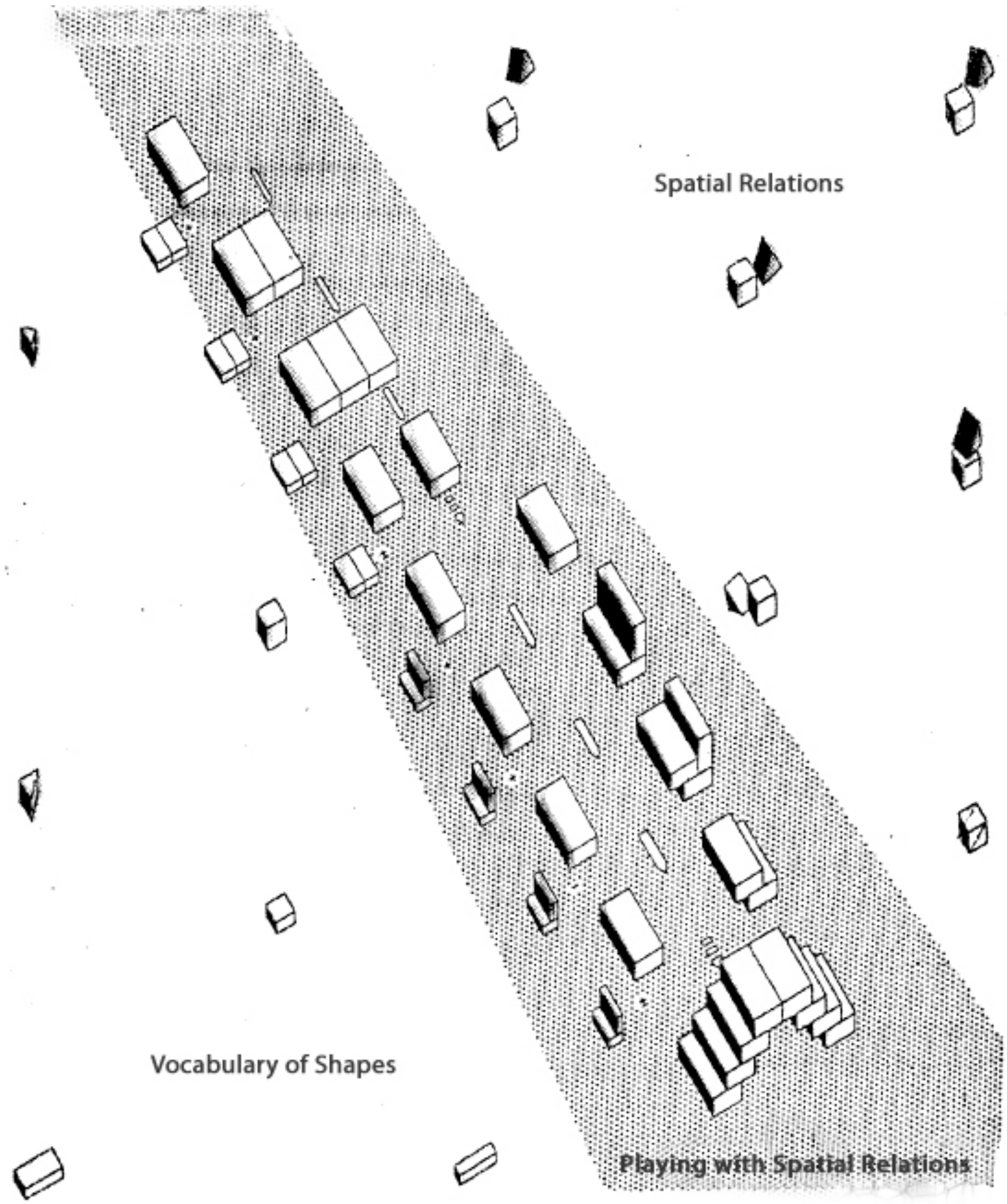


seeing leads to
constructing





playing with
spatial relations



recapping the studio method via the kindergarten suggest courses of actions – essentially, compositions –

from shape to shape (forms)

🡇

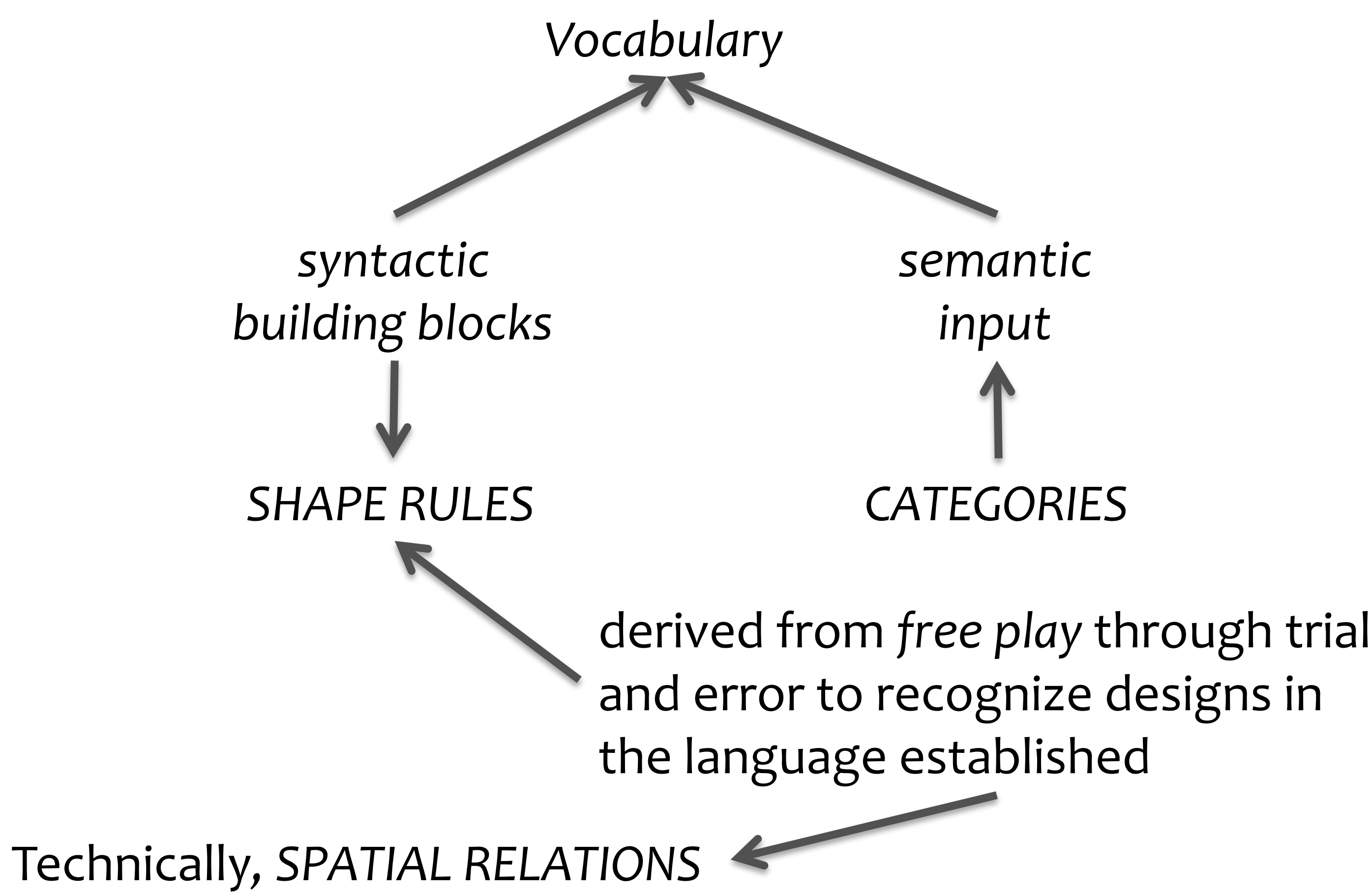
relationships between shapes (forms) 🡆 PLAY

🡇

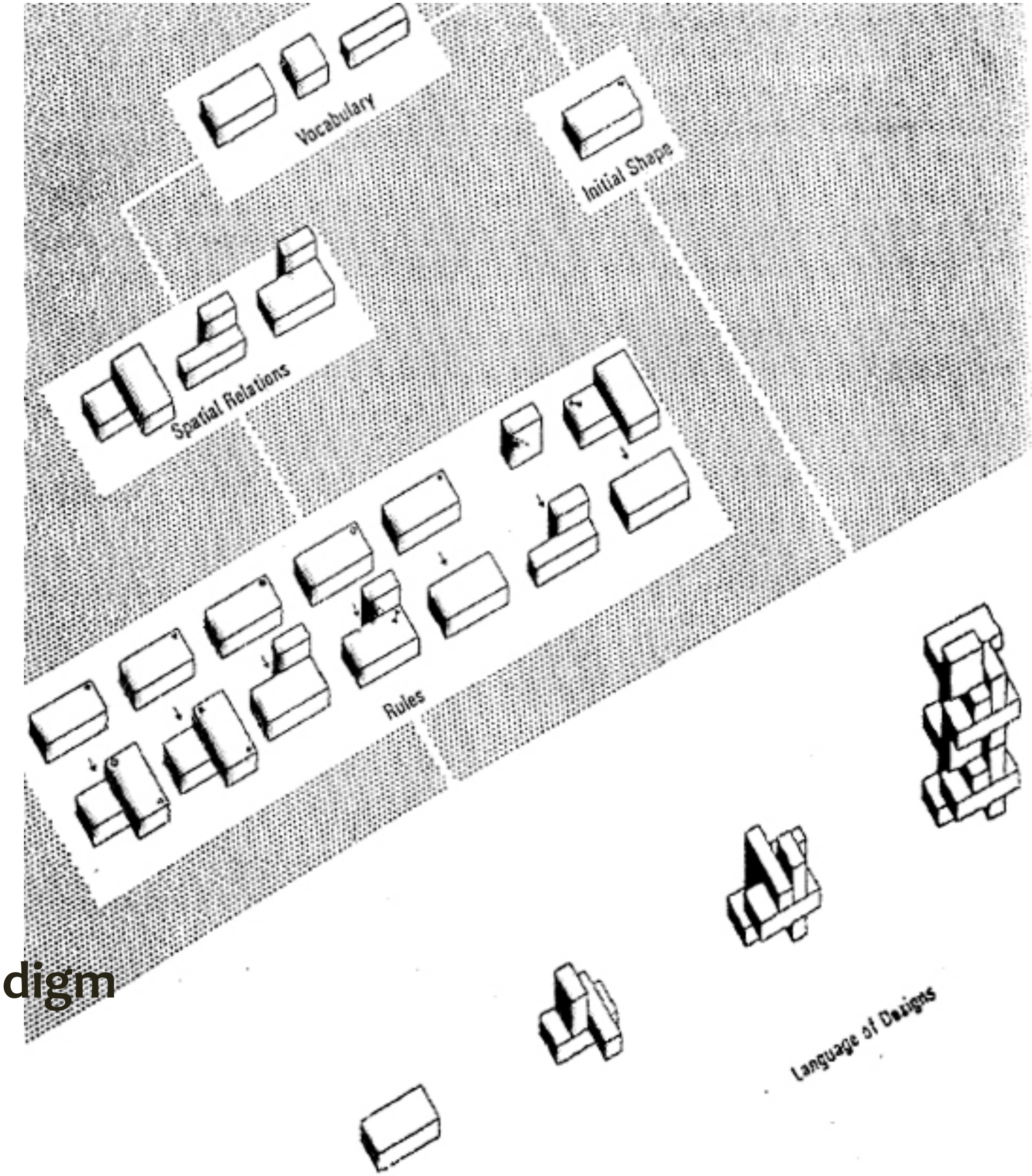
SHAPE RULES

transitions

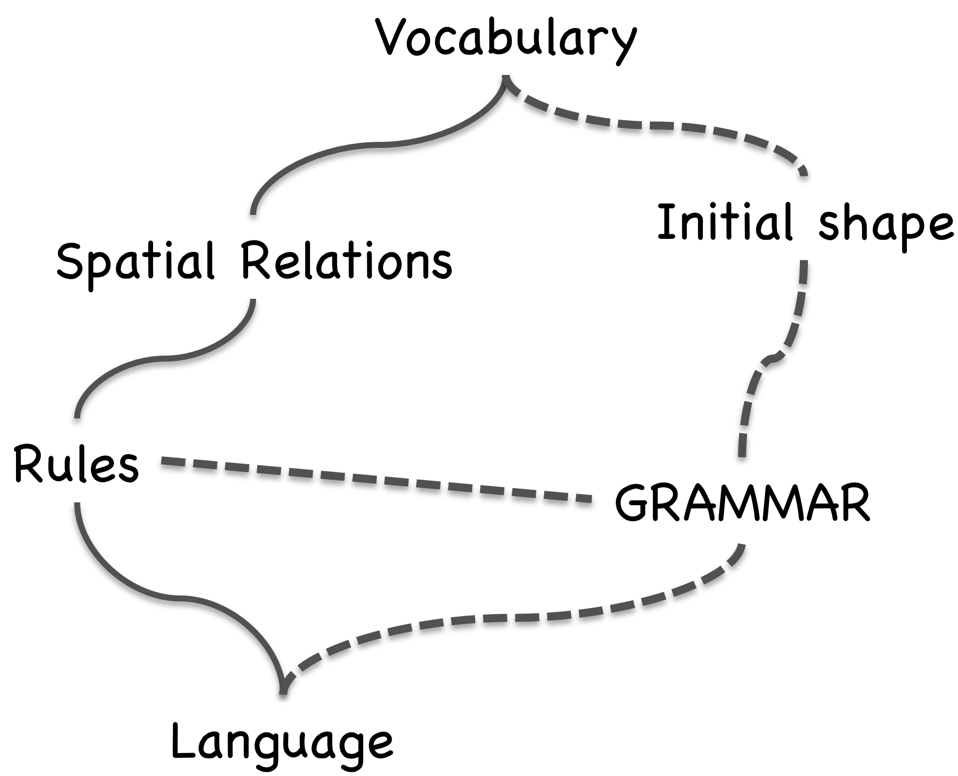
CONSTRUCTIVE PARADIGM



rules when coupled with **categories**, which offer meaning & purpose, give rise to a …



a constructive paradigm



the **grammar paradigm**

why rules ? ...
Rules offer greater precision and control than spatial relations
Rules are simpler than designs because they are localized
Rules increase the power of observation
Rules offer explicit and detailed descriptions of knowledge
Rules shift from simple possibilities to a realm of knowledge (i.e., languages of designs)
Rulers allow for the exploration of alternatives
Rules can be modified systematically to incorporate new ideas and changing circumstances

so ... lets look at **rules**

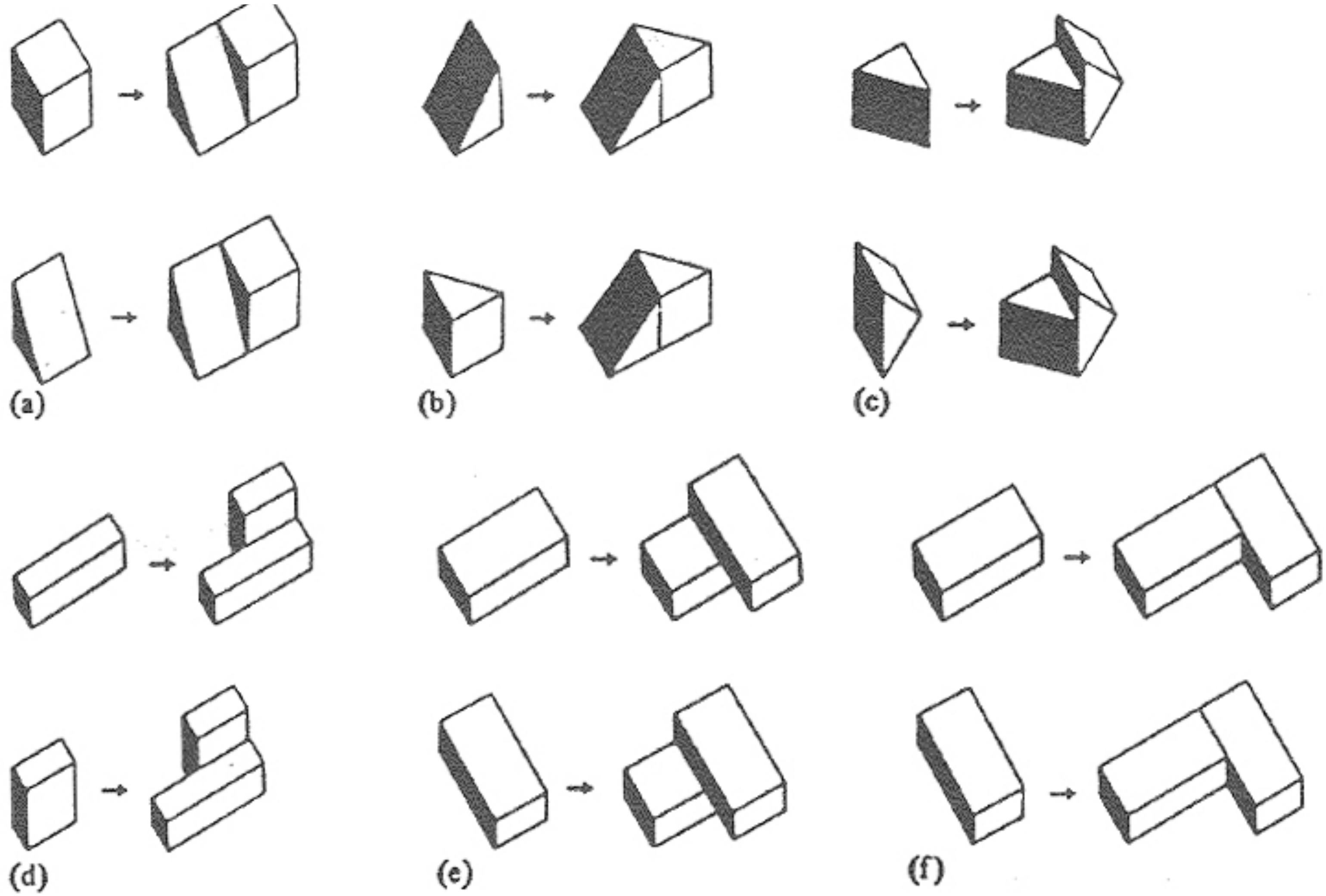
fall into two categories:

Additive rules	$x \rightarrow s + t$	$x \in \{s, t\}$
Subtractive rules	$s + t \rightarrow x$	$x \in \{s, t\}$

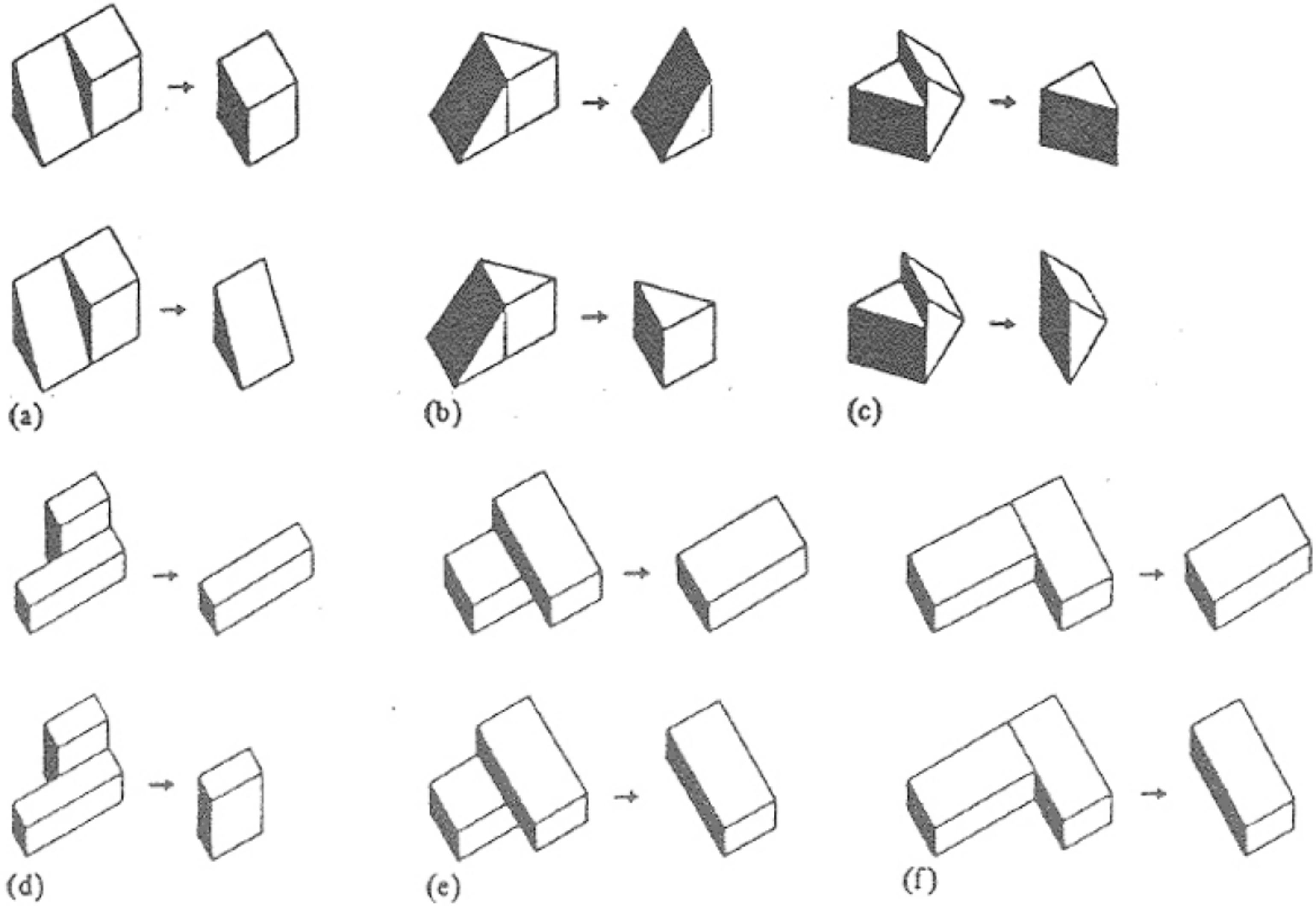
"forming" spatial relations

"breaking" spatial relations

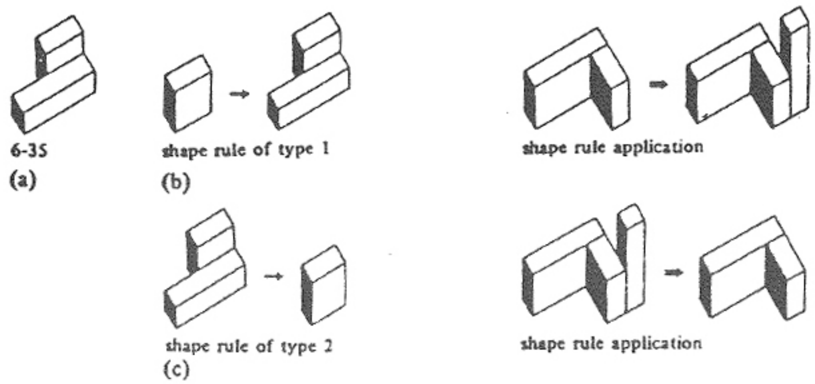
rules



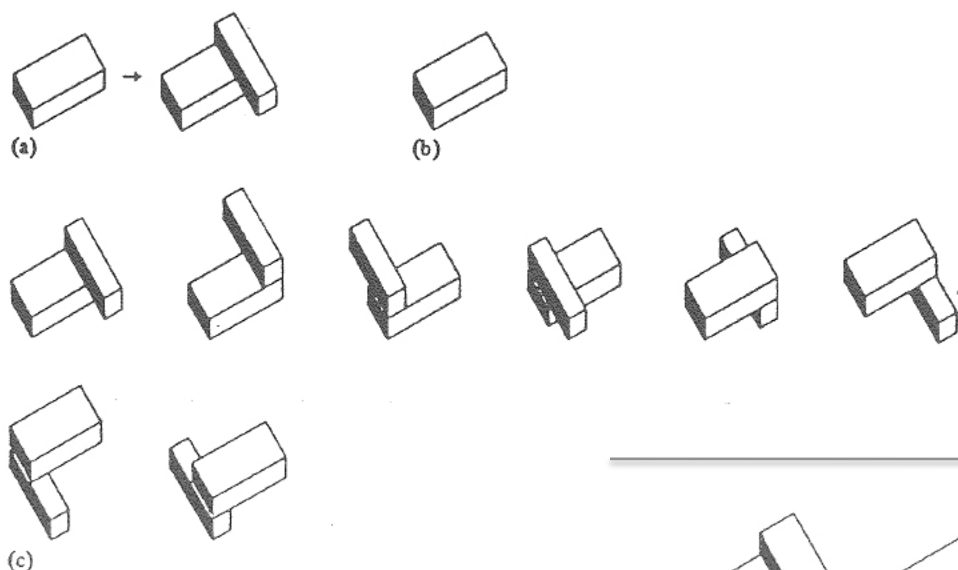
additive rules



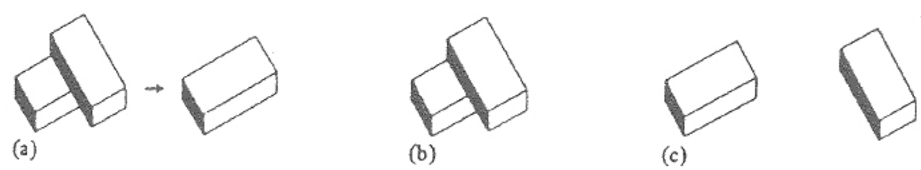
subtractive rules



from the same relation



under different transformations



rule application

Technically, equivalent to labeled elements

Rules can be aided by annotations

Labeled points

Rules can be aided by annotations

Additive rules	$\langle x, P\rangle \rightarrow \langle s + t, Q\rangle$	$x \in \{s, t\}$
Subtractive rules	$\langle s + t, P\rangle \rightarrow \langle x, Q\rangle$	$x \in \{s, t\}$

annotated rules

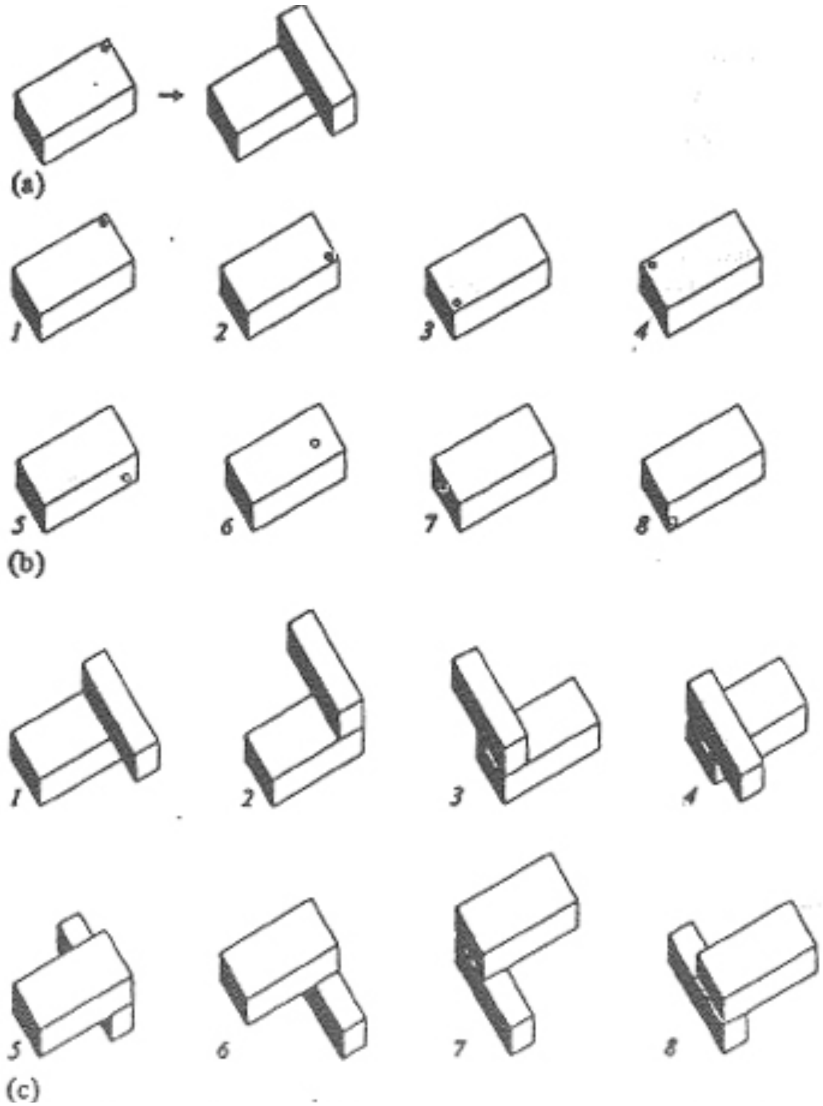
Annotations serve three purposes:

- add or destroy symmetry
- increase or decrease ambiguity
- help deal with interpenetration

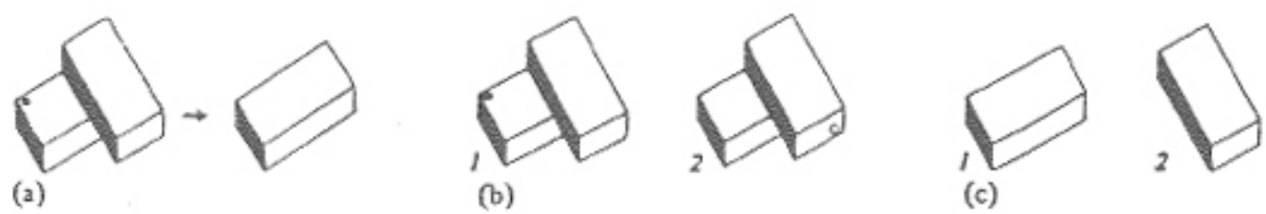
Labels are generally used to avoid such problems

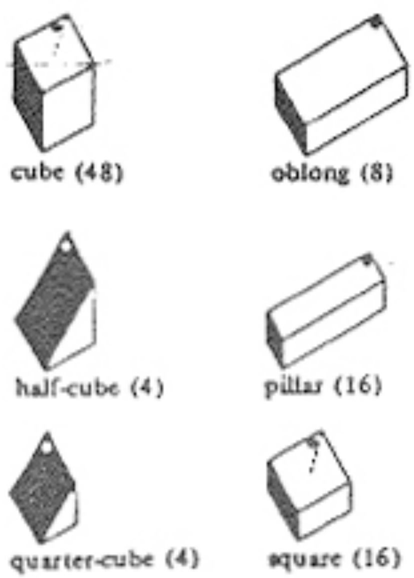
Labels are also used to demarcate stages in this play

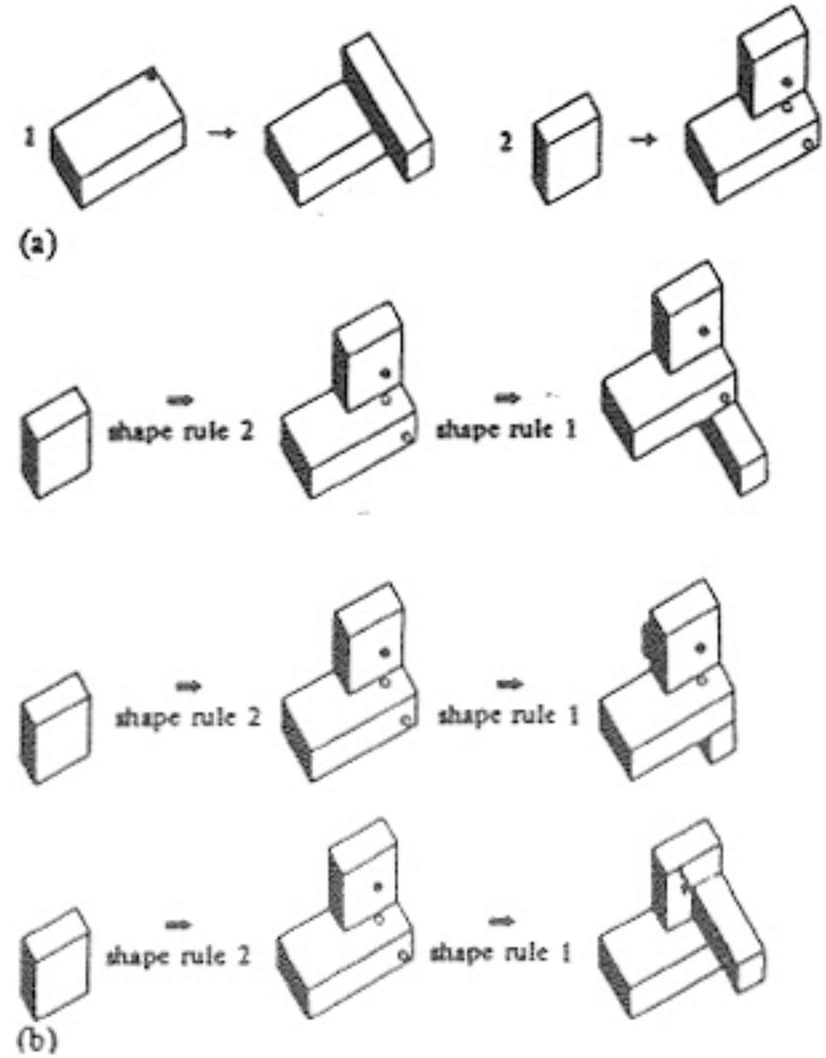
annotations and **labels**

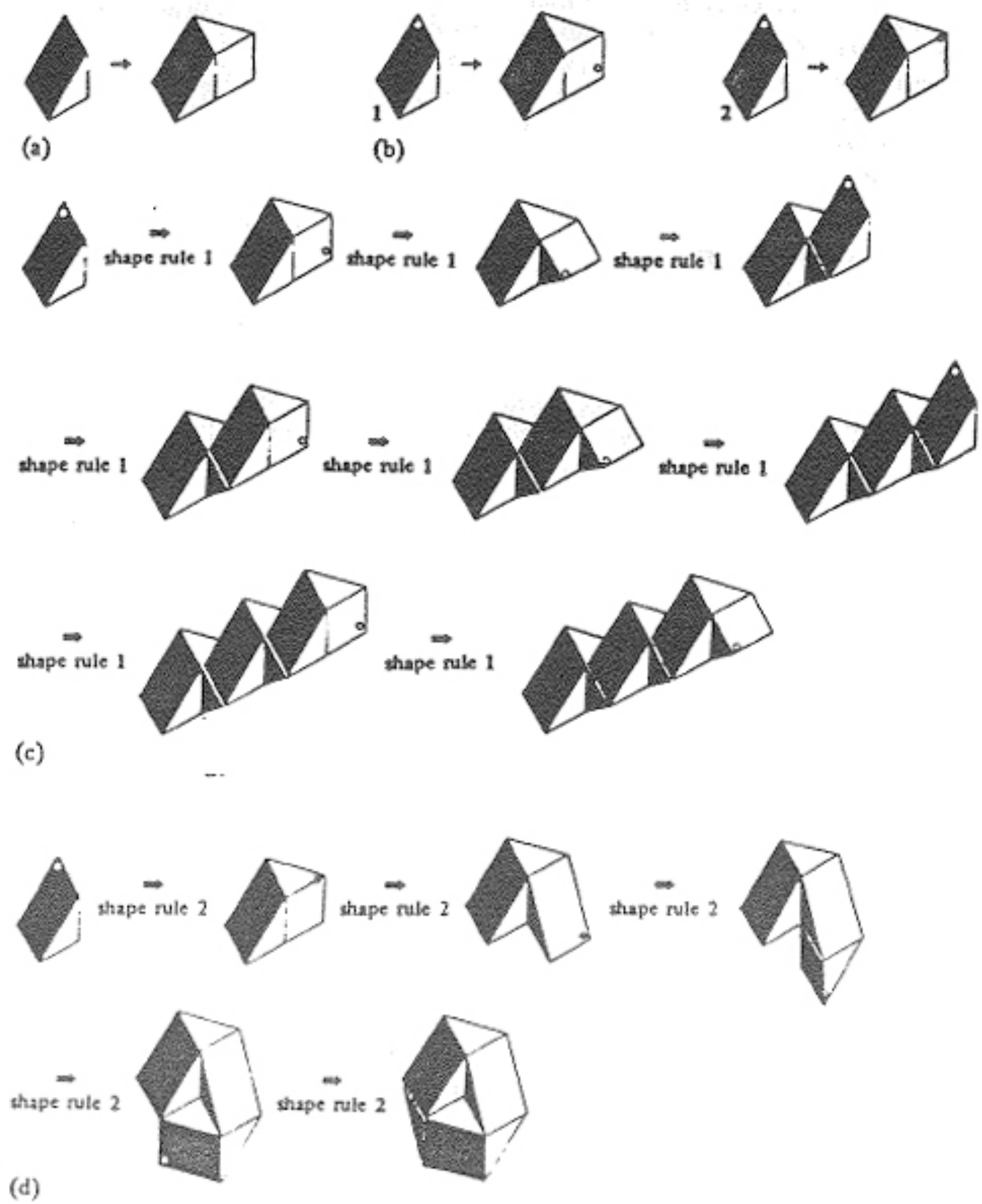


rule application according to the *symmetry of the lhs*

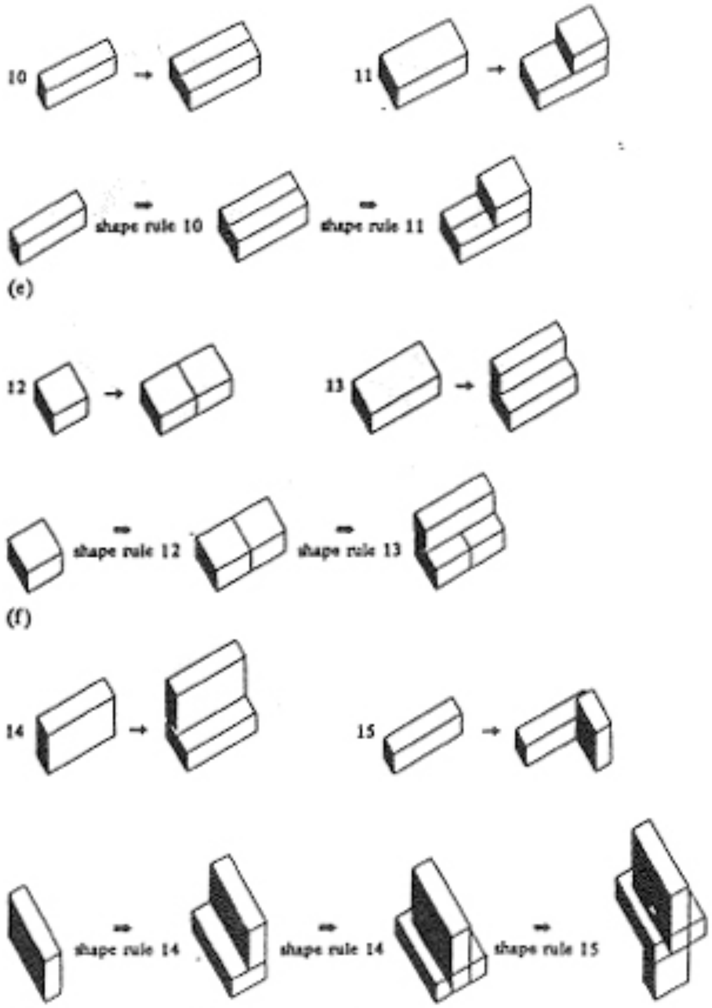


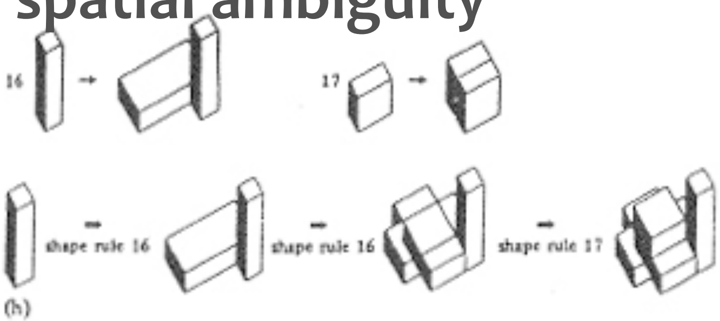

cube (48)
oblong (8)
half-cube (4)
pillar (16)
quarter-cube (4)
square (16)

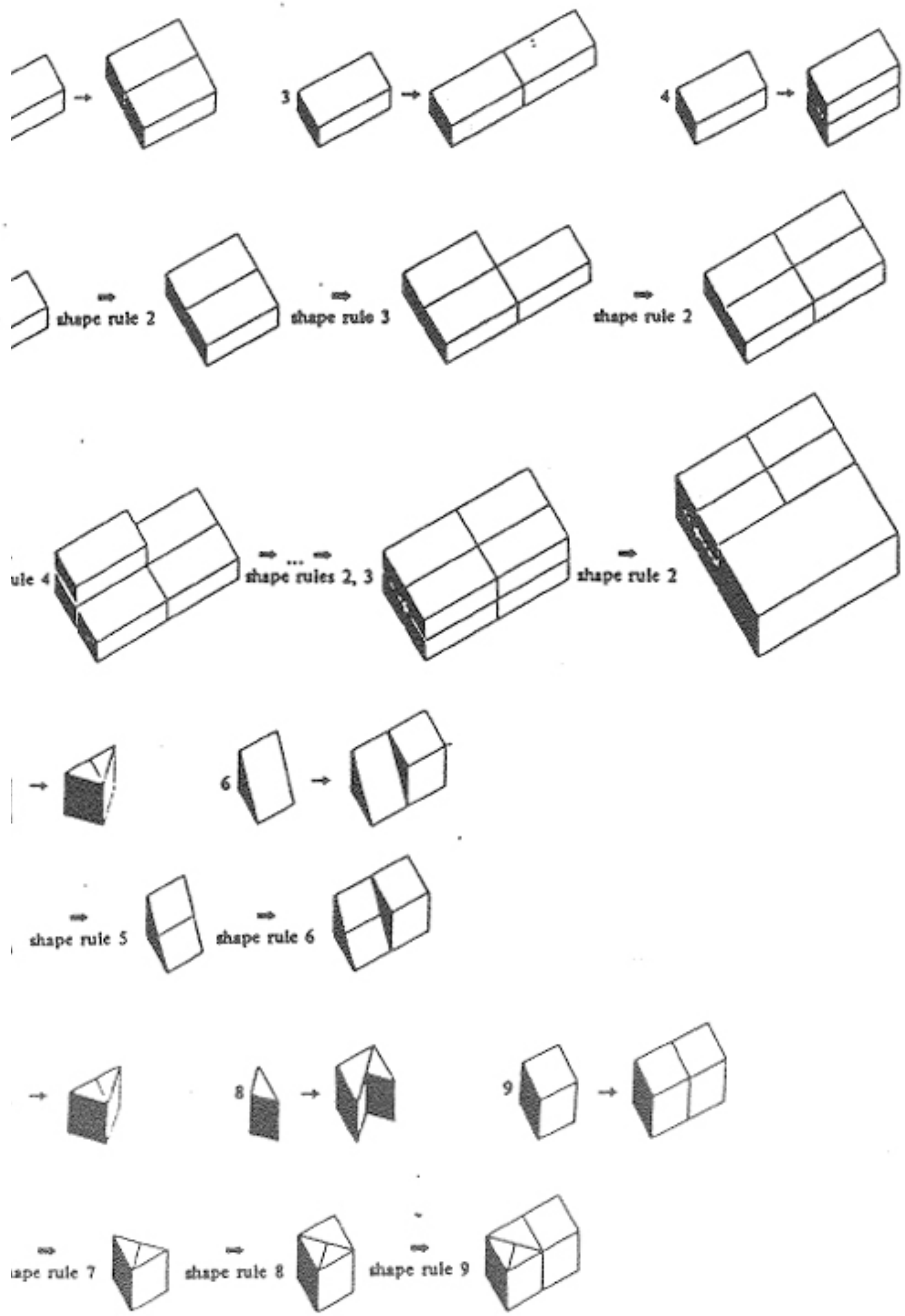

1
2
(a)
shape rule 2
shape rule 1
shape rule 2
shape rule 1
shape rule 2
shape rule 1
(b)

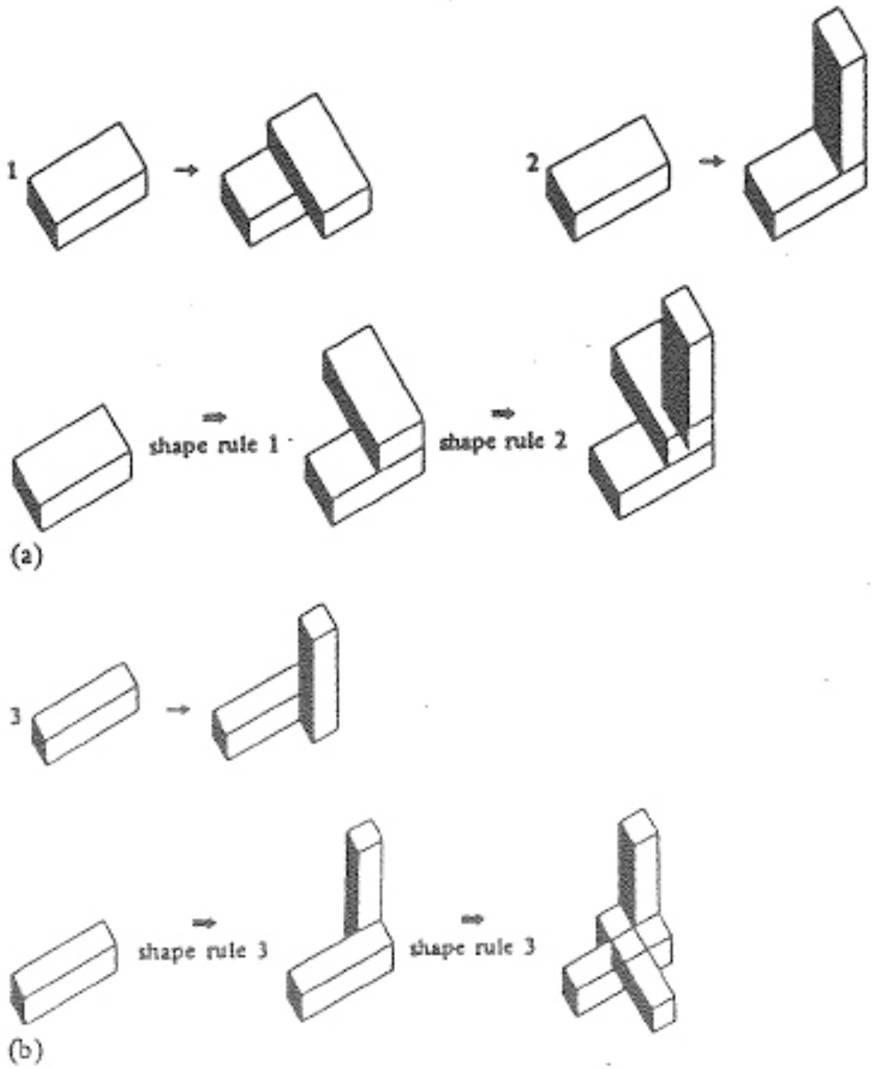

(a)
1
2
(b)
shape rule 1
shape rule 1
shape rule 1
shape rule 1
shape rule 1
shape rule 1
shape rule 1
shape rule 1
(c)
shape rule 2
shape rule 2
shape rule 2
shape rule 2
shape rule 2
(d)

spatial ambiguity

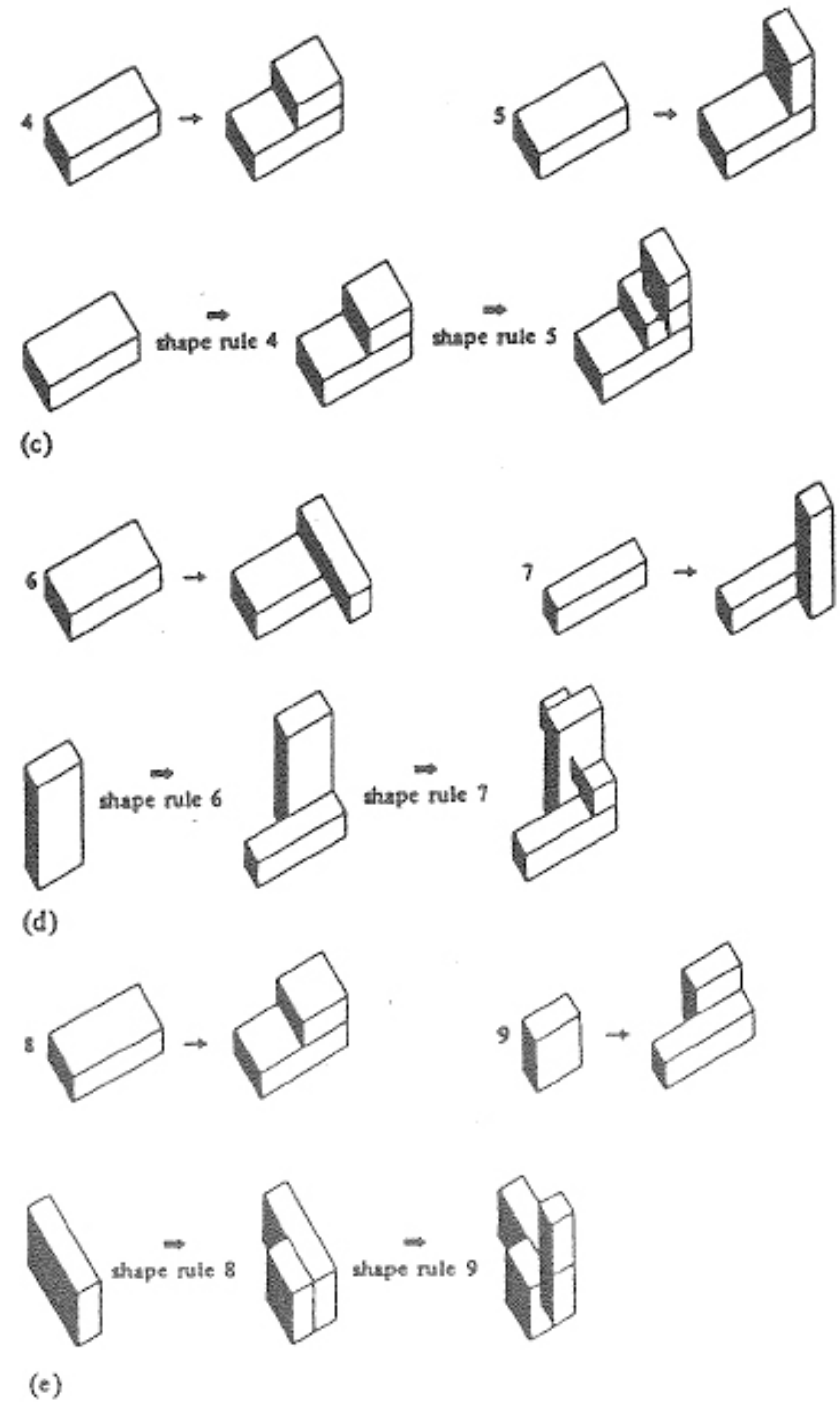


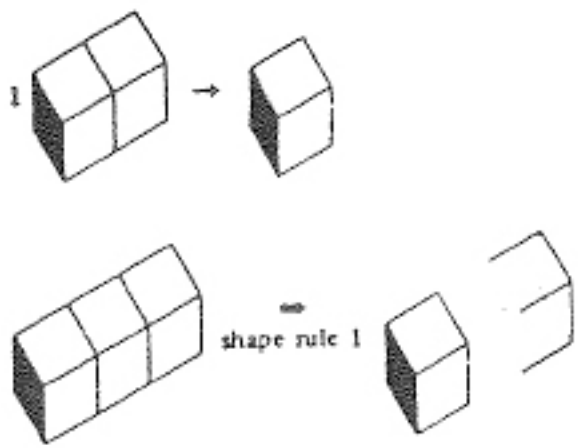


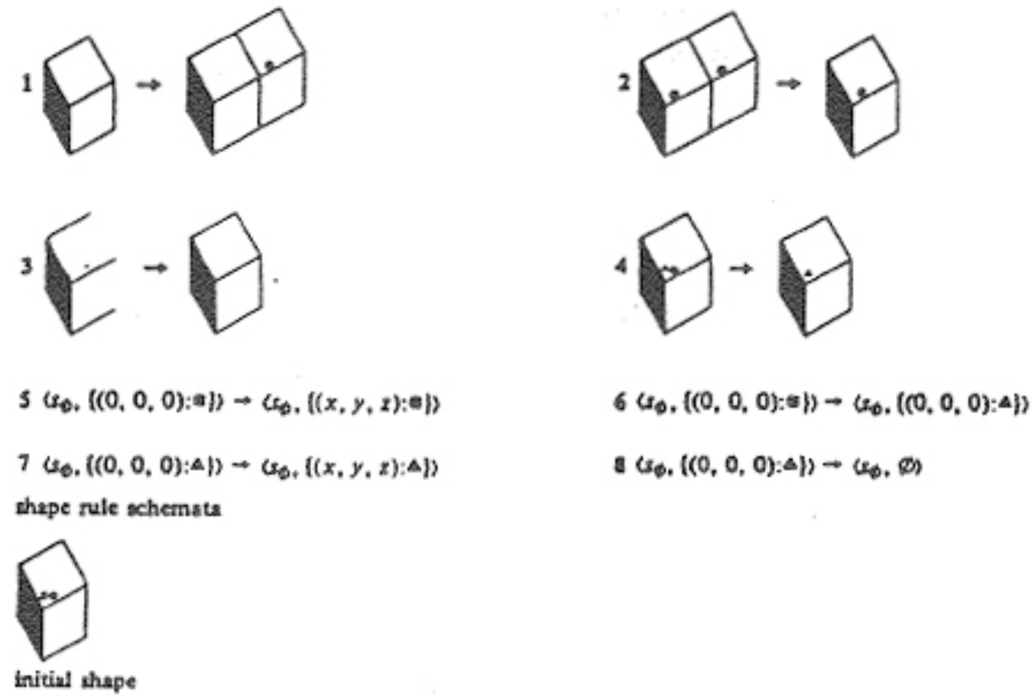




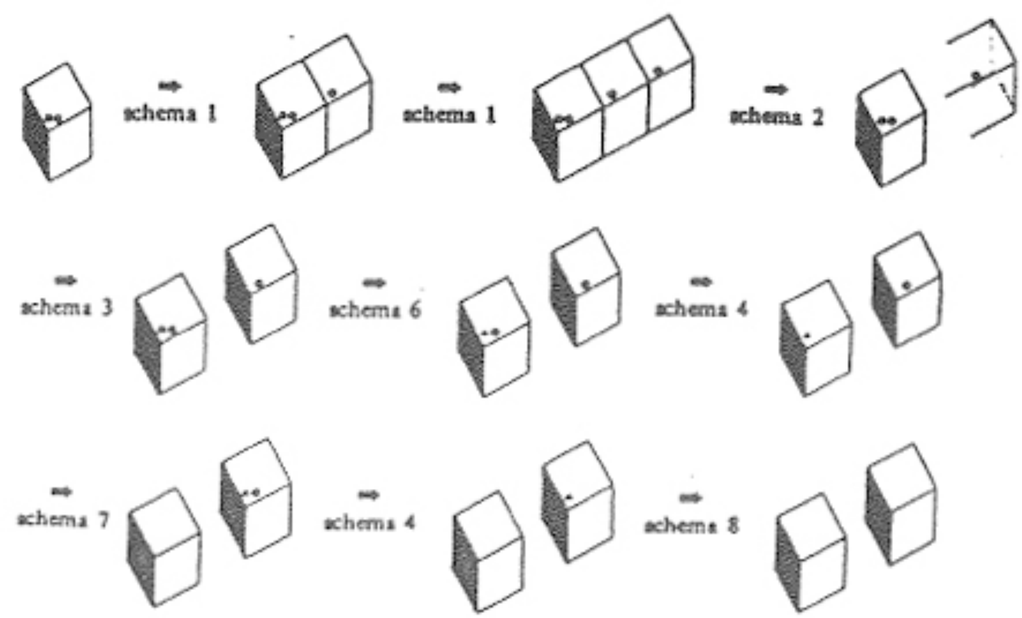
interpenetration







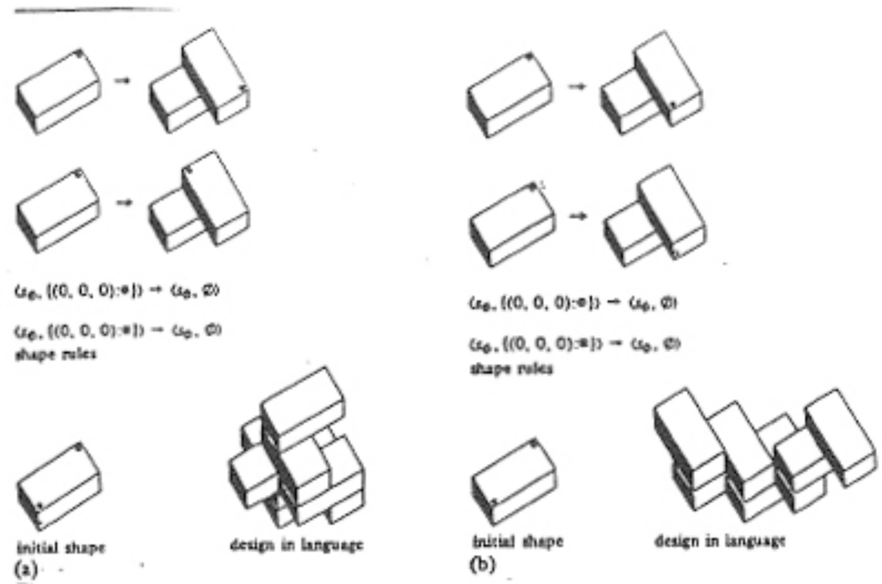
funny things happen under subtractive rules

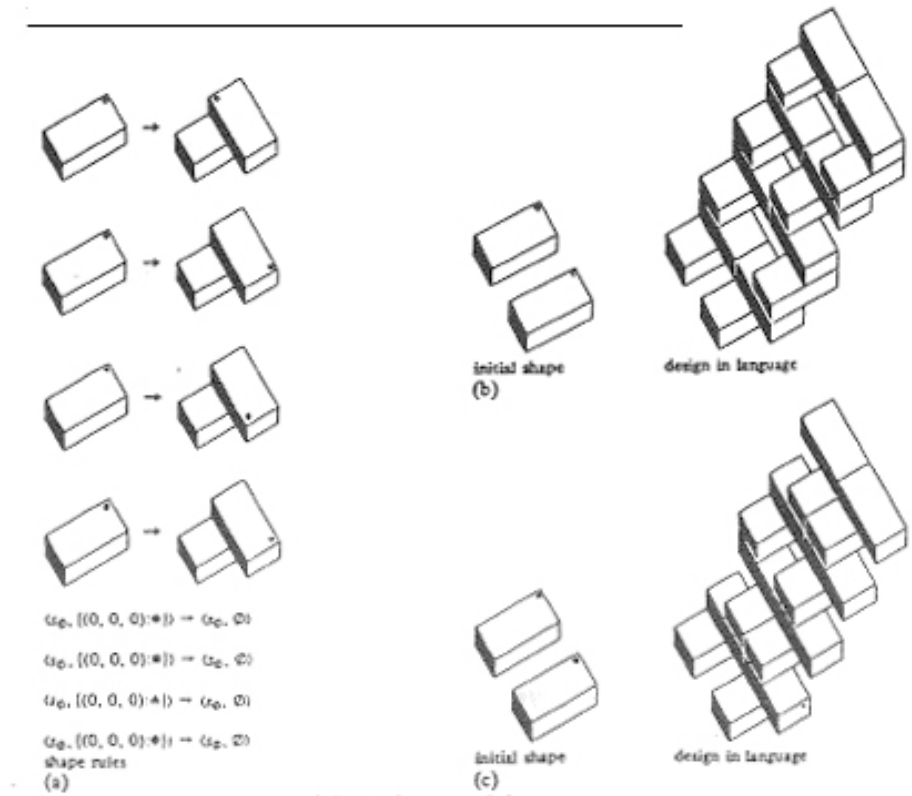


Given a corpus of designs find the ***simplest*** *grammar that specifies the designs*

Solution to the problem involves identifying hidden structures more often than not, vestiges of these hidden structures have been erased

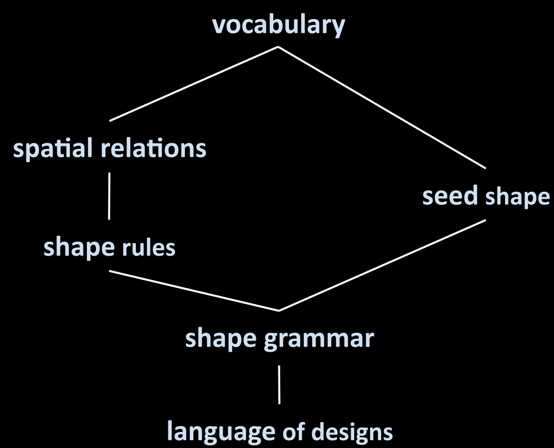
subtractive rules compound the inference problem





two grammars

more grammar examples in the kindergarten paper

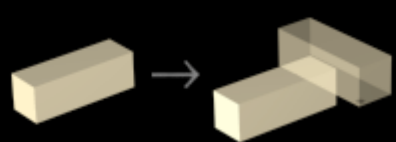


motivated by Frederick Froebel’s Kindergarten
model of free play and creativity through his gifts

vocabul
+ spatic

a design

free play



additive shape rule

subtractive shape rule

language

paradigm: child’s play

Play is the purest, the most spiritual, product of man at this stage,

and is at once the prefiguration and imitation of the total human life, –of the inner, secret, natural life in man and in all things.

It produces, therefore, joy, freedom, satisfaction, repose within and without, peace with the world.

The springs of all good rest within it and go out from it.

on ***Play*** in ***The Education of Man*** by **Friedrich Fröbel**