

Upper Limits to The Stage of Development

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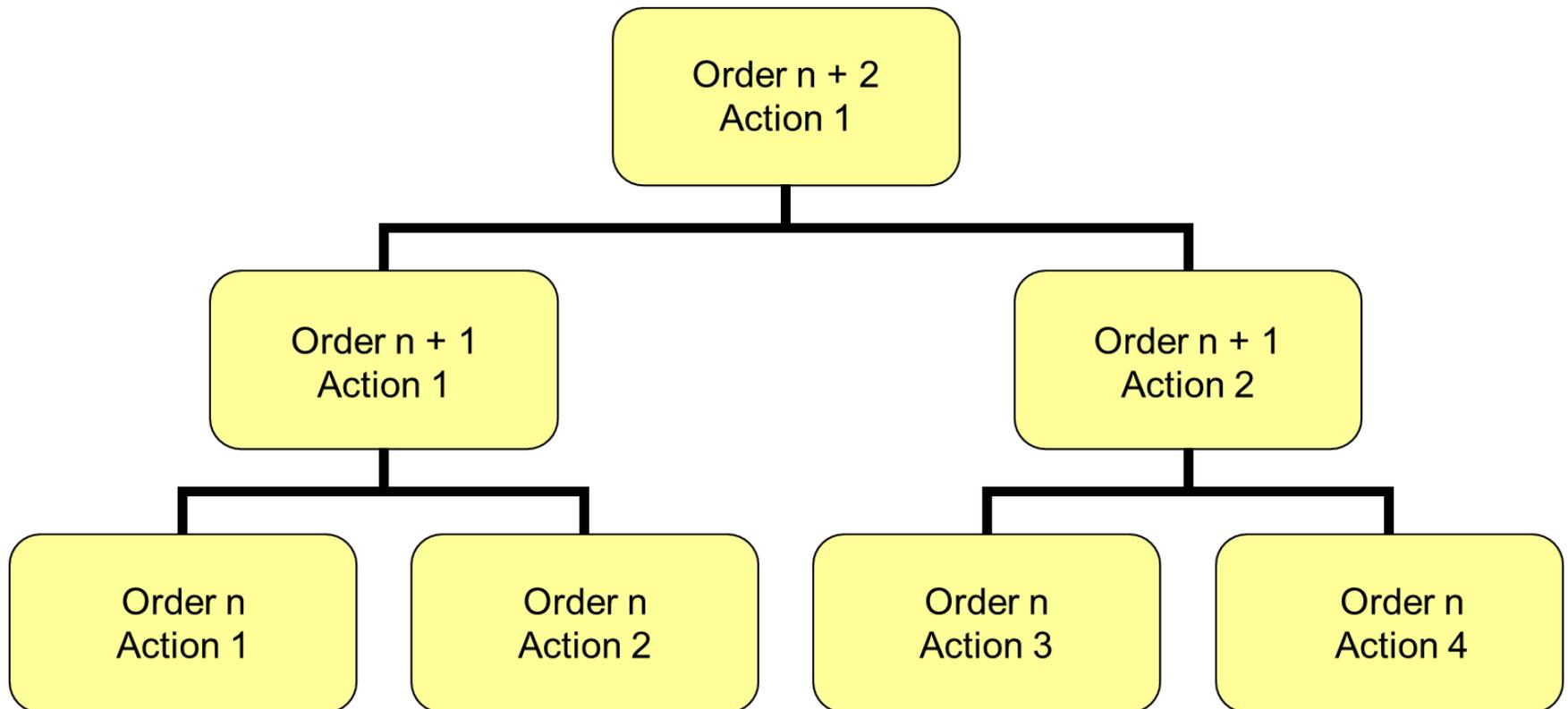
- A number of different previous methods for measuring “smarts” have led to the Model of Hierarchical Complexity (MHC), a context free neo-Piagetian mathematical model of behavioral complexity.
- It provides a way to classify tasks as to their hierarchical complexity
 - This is called the Order of Hierarchical Complexity (OHC)

- Using this model, this study presents an empirical test of a single parameter, K , in a mathematical model of the upper limits of the stage of development (“smarts”).
- MHC provides an explanation for how differences in rate of stage change results in a difference in terminal state (highest stage).
- K is equal to the derivative of moral maturity stage of a person’s performance with respect to time.
- We take the $\log_2 2^N$ to get stage and hence have to take \log_2 age

The Model of Hierarchical Complexity

- Behavior can be analyzed by the difficulty of tasks that an individual successfully addresses
- We divide the task properties that influence item difficulty into two overall parts:
 - Order of hierarchical complexity of the items in a task
 - Aspects of task content that are non-structural
 - Language, culture or country, familiarity (to name a few)
- Probably the most important predictor of difficulty is the ***Order Of Hierarchical Complexity*** (OHC)
 - Commons' model identifies 16 orders of hierarchical complexity
 - It deconstructs tasks into the actions that must be done at each order to build the behavior needed to successfully complete the task
 - It classifies each task by its order of hierarchical complexity

- A task is at a higher order if:
 - It is defined in terms of two or more lower order task actions
 - It organizes lower order task actions
 - This organization is non-arbitrary



16 Orders of Hierarchical Complexity

Order	Name Complexity
0	Calculatory
1	Sensory & Motor
2	Circular Sensory-motor
3	Sensory-motor
4	Nominal
5	Sentential
6	Preoperational
7	Primary

8	Concrete
9	Abstract
10	Formal
11	Systematic
12	Metasystematic
13	Paradigmatic
14	Crossparadigmatic
15	Meta Crossparadigmatic

Changing Stage of Functioning in Development and Education: Process and Limits

- How stage change in school and life is accomplished is not well understood
 - Many models of change focus on only one kind of variable
 - For example, a model may emphasize the content and structure of the curriculum.
 - Another model may emphasize motivational or support factors.
- Bring about change of this kind is in effect a paradigmatic stage task
- Change in developmental stage and increase in knowledge, symbolized here as
- ΔB = distance between the required order of complexity of the higher order tasks and the order at which the person is successfully performing tasks
- The stimulus context*time on task*reinforcement for advancing

- The change in behavior is simply the product of the time actively engaged in getting the right answers to a task when placed in the developmental sequence correctly
- $\Delta B = t$ on task actively engaged in $\ast pl$ getting answer right when placed in sequence correctly
 - $t = f(S_{\text{Contingency for reinforcement for correct answers}})$
 - $pl = f(\text{being placed in the right place in the developmental sequence})$
 - Time engaging actively on a task is sensitive to contingent reinforcement of correct responses
- Rasch Analysis is used and Order of Hierarchical Complexity of items
 - These generate the correct task sequence
- Person stage scores are used to place people in the sequence correctly.
- Below the task required order, people have great difficulty responding correctly

Four Propositions Show What Determines The Upper Limits Of Stage

1. What are the Differences between required performance and actual performance
2. Total amount of hierarchical complexity of a task = 2^N_{OHC}
3. Is Age = t = Amount Of Hierarchical Information Processed Correctly
4. The limit of development is set by the rate of stage change, the parameter K

First, What Are The Differences Between Required Performance And Actual Performance

- First, is there a difference between the order of hierarchical complexity of tasks and the corresponding stage of performance on those tasks?
 - *Order* of hierarchical complexity (OHC) is an analytic measure applied to tasks
 - *Stage* is a performance measure of the most hierarchically complex task solved by the organism in question

Second, Total Amount of Hierarchical Complexity of a Task = $2^{N_{\text{OHC}}}$

- Pascual-Leone suggests that to solve a problem at Order n , there needs to be a working memory of 2^N .
- The stage N_{Stage} is the same as the N_{OHC} for the most hierarchically complex task solved.

Third, Is Age = t = Amount Of Hierarchical Information Processed Correctly

- Stage = the order of hierarchical complexity of a task (OHC) completed correctly
- N_{Stage} as log to the base 2 of age yields $N_{Stage} = \log_2 t$.
- The more time spent alive inevitably leads to more information being processed
- More information being processed leads to higher chances of coordinating the information to higher orders of complexity

Fourth, The Limit Of Development Is Set By The Rate Of Stage Change, The Parameter K

- The derivative of stage with respect to time is $d(\log_2 2^N) / dt = K$. N_{Stage} is substituted for $\log 2^N$ yielding $d(N_{\text{Stage}})/dt = K$
- By using N_{Stage} as a stage variable, K may be found for individuals
- Moral Maturity Score was regressed on Age of participants
- $\log_2 \text{Age}$ predicted moral maturity score $r(225) = .764, p = .000$
- It therefore is suggested that
 - K replace IQ (Commons, & Ross, 2008)
 - People consider the biological contribution to stage of development.