Seeking for the grasp. Iterative subdivision model of conceptualization

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Introduction

Concepts are fundamental collective constructs of individual items, capable of abstracting meaningfully homogeneous groupings from multi-dimensional variation, and thereby enabling communication and action, and giving structure to learning and memory. In line with the embodied cognition paradigm, we will argue that this capability is due to the roots of concepts in perception and concrete actions.

Our elaboration adopts as its starting point the Conceptual Spaces theory (hereafter CS) of Gärdenfors (2000), which describes concepts as convex cluster formations of their elementary items in an abstract space that is determined by their quality properties qua dimensions. This theory has since its introduction provided the fertile soil for a vast range of theoretical and practical elaborations (see e.g. Zenker & Gärdenfors 2015).

In this chapter we apply CS as an instrument of describing perspective-dependent analytic inquiry in dynamic terms. The idea of *perspectives*, or near synonymously *points of view*, as subjective determinants of perception and cognition is both omnipresent in everyday cognition and language, and an evergreen topic of psychology and philosophy. The notion of perspectivism dates back to Leibniz, with reference to perception. The idea was later associated strongly with Nietzsche, who In *Beyond Good and Evil* claimed that “there are no facts, only interpretations”.

Further, according to him, "*one always knows or perceives or thinks about something from a particular perspective - not just a spatial viewpoint, but a particular context of surrounding impressions, influences, and ideas, conceived of through one's language and social upbringing and, ultimately, determined by virtually everything about oneself, one's psychophysical make-up, and one's history*" (Solomon 1996, 195). As Baghramian puts it, there can be more than one correct account of how things are in any given domain (2004, Chapter 10). This accepted, the issue is not which perspective is correct or true, but how to explore and mutually relate multiple perspectives. Consequently, there is no need to assume that the exploration of perspectives would at some point be satisfied, or to expect the convergence of perspectives to any final or 'true' form.

To elaborate the idea of perspectives formally and computationally has been our long-time mission. Hautamäki articulated already in 1986 the relation between points of view and conceptual spaces (see Hautamäki 1986; 2015; 2016). The contribution of our more recent work (Kaipainen & Hautamäki 2011; 2015; 2016,) with respect to the CS has been the distinction between between *ontological space* (for short *ontospace*) and *perspectival space*. The notion of *ontospace* corresponds technically to the conceptual space as articulated by Gärdenfors 2000, but it has been assigned a different role in our model. It is not where concepts manifest themselves, but the space of *uninstantiated but potential conceptual structures*. The intuition behind these definitions is that when talking about a certain domain, we have to identify a set E of entities in this domain. To describe these entities a set of qualities $Q_1,....Q_n$ are used. Formally, the ontospace was defined as a Cartesian product of quality dimensions. Quality dimension $<Q_i,D_i>$ consists of a quality (or variable) Q_i and a set D_i of values for the quality. If there are n qualities, then the ontospace is the product $\mathbf{A} = D_1 x...x D_n$, and its elements are n-tuples of the form $<d_1,\ldots,d_n>$ where each d_i belongs to the set D_i. Thus all entities in the set E are represented by elements of ontospace (for formal details see Hautamäki 2016).

In our formulation, it is the *perspectival space* **B** where items of the ontospace become manifest as clusters in a *perspective-dependent* manner (Kaipainen & Hautamäki 2011, 2015). By definition, the perspectival space has a dimensionality lower than that of the ontospace.

Formally, the manifestation is due to reduction function R_P from the ontospace A into the perspectival space B, P referring to a perspective. R_P respects perspective P, which we have defined as a prioritization among the quality dimensions[1] that influences the apparent clustering. It can be regarded as an element corresponding to the interest, attitude or disposition of the cognizer towards the domain under inquiry. Perspectival space can be metaphorically imagined as a projection surface behind the ontospace onto which the items inhabiting the ontospace appear clustered in different ways, depending from which angle the light is shone through it.

However, even our perspectival augmentation of the CS remained static in the sense that it did not describe the dynamical evolution of perspectives, concepts and spaces. In this chapter we elaborate the notion of perspective-dependent concepts further into an iteratively looping dynamical model. Our approach is to regard concepts as transiently emergent elements of continuous dynamical cognition, such that are subjectively formed in the fly, depending on the individual's situated and contextualized disposition with respect to changing conditions. We aim at a model that explains how concepts and perspectives, on one hand, come about, how they evolve, and how they may steer perception and analytic cognition. Before formalizing our *iterative subdivision model of conceptualization*, however, we seek to relate the dynamics of concepts and perspectives to the embodied concretia of actions of hand and eye.

Grasping and actionability of concepts

New explanatory potentials open when a *perspective*, as we have formally described it above, is associated with an intention to accomplish something. Metaphorically, a perspective can be seen as an angle and a distance to an object of inquiry allowing a view and therewith a 'grasp' of essential aspects of it that would otherwise be obscured.

Reflected against its Latin origin and correspondent expressions in many languages, the word 'concept' suggests an association between the cognitive means and the manipulative action of hand. In Latin, the word 'concept' breaks down to "con " (together) + "cept" (derivative of

[1]In a mathematical or statistical context this would be called 'variable'.

”capere ” = capture, catch). The *‘con’* prefix apparently hints at a plurality of primitive elements that can be grasped at once. As another example, in the Finnish language the word for concept *‘käsite’ is* a composite of “käsi” (hand) + “te” (object to manipulate), roughly ‘manipulable’. As yet another, the Swedish for concept is *‘Begrepp’*, in which “*Be*” is a prefix expressing focus on direct object + “grepp” (derivative of “*gripa*” = *grasp*). These etymological associations suggest an old link between the concrete action of hand and the abstract notion of ‘concept’. In the light of the embodied cognition paradigm of Varela et al. (1991) that addresses the bodily grounding of cognition, or the metaphor theory of language, that concept as a grasp goes beyond a mere etymological reference (Lakoff and Johnson 1980).

According to Cazeaux *“a concept brings together what would otherwise be inchoate or diffuse into a unit, lump or sequence that makes recognition possible”* (2017, 61) . He recognizes the contribution of Merleau-Ponty (1945) as the inspiration to a whole range of holistic philosophy and cognitive science, encompassing what Sheets-Johnstone has called the “corporeal turn” (2015). At the epicentre of this would be the articulation of cognitive science as the study of the embodied mind by Varela et al. (1991), the philosophy in the flesh, (Lakoff and Johnson 1999) as well as the relation of metaphors to the bodily situation in the environment by Lakoff and Johnson (1980). Gallese and Lakoff (2005) further argue for the neural grounds of such metaphors, on the ground of solid evidence for that the sensory-motor system is able to model both sensory-motor and more abstract concepts, and that these may not be separate but interwoven. Closely related to the embodied nature of cognition is the dynamic nature of cognition and the view to mind as motion, as discussed, among others by van Gelder and Port (1995). Equally relevant is the approach to the dynamic systems nature of cognition (Smith and Thelen, 1994) and, not to forget the recurrently dynamic perceptual cycle suggested by Neisser much earlier (1976). Approaching the topic of embodied mind from yet another angle, Rizzolatti and Arbib (1998) have found evidence of specific grasp neuron networks in the brain that are activated in response, not only to observation and performing grasping actions, but also associated with planning such. This suggests mental processing relating to grasping beyond mere motor control.

We cannot exhaust the vast literature on the relations of mind and body beyond recognition and homage. The reader may want to refer to, say, Dawson (2013), who provides a big picture of the interconnections of mind with the body and world. Nevertheless, we interpret that there is a safe ground to go further with the idea of *grasping* as a natural metaphor for what a concept is good for, as something that becomes accessible from an optimal working position, in a manner comparable to the work of a hand guided by vision. The hand approaches objects from a particular angle and from a point of view that best orientates the concrete operation. Consider an agent engaged in concrete work, who seeks a perspective - or an operative position - in which the object's most critical dimension for successful operation is *as perpendicular as possible* against the eye's view. Then it optimally reveals an angle as broad as possible and contributes to an optimal precision to access the object (Image 1). In contrast, it would not facilitate the operation to see the board from one if its ends and operate the saw between left and right, which would be both visually hard and ergonomically ineffective. Following the dynamic assumption of Neisser's perceptual cycle, we assume that the operative position and the optimal perspective is not given, but results from learning through explorative action (1976).

Figure. 1. A lumberjack's operative position, aligning hand and vision perpendicularly against the object to be cut. Photograph by Anne LaBastille

Quality prioritization in perception and cognition is a classic topic across philosophy, psychology and cognitive science. C.I. Lewis demonstrates this with an example of forms, a round penny looks round only when held in in the certain angle. (Lewis 1956, 122.) Indeed, in another perspective it appears as a line, in yet another as an oval. In the case of colors, when one says that a rose is red, one presupposes standard lightning in which the rose appears to have this color. He proposes also a temporal - causal relation between a quality and an action. According to him, associating a quality to a thing implies acting in certain way with the thing, and as a consequence, specifiable experience will eventuate (Ibid., 140). If I should bite an apple, it would taste sweet. *"The whole content of our knowledge of reality is the truth of such "If-then" propositions in which the hypothesis is something we conceive could be made by our mode of acting"* (Ibid, 142). The consequence of if-then propositions is a possible experience caused by our action. Dewey, in turn, formulates a straightforward procedural view to prioritization of qualities: "*inquiry is the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a unified whole* (1938, 108)." According to him, "[thought] is a mode of directed overt action" (Ibid., 166). Altogether, from Lewis and Dewey we adopt the idea of a concept as the result of a 'recipe'.

Iterative subdivision model of conceptualization

The main suggestion we put forward in this book chapter is that perspective-specific hierarchical conceptualization results from a sequence of iterative mental actions, which we compare to operative positioning against concrete objects of manipulation, as illustrated by Figure 1. Further elaborating our earlier formulation (Kaipainen & Hautamäki 2015), where reduction function R_p was described as an abstract operation without specified temporal duration or a sequence of steps, here we consider the transformation to be broken into a sequence of separate actions of cluster subdivision. This reasoning constitutes what we propose to constitute the *iterative subdivision model of conceptualization*. During such a sequence, clusters are determined in an increasingly sharply defined manner, so that the items they stand for are optimally homogeneous with respect to each dimension chosen[2], corresponding to what Dewey considered as "*a unified whole*", *"determinate in its constituent distinctions and relations"* (1938, 108). In our formalism it is perspective P that specifies a sequence of instructions of how to prioritize qualities in order to get a certain 'grasp', a concept accessible from an 'intellectual working position' with respect to an object of inquiry.

The reduction function R_P, translates into a temporally unfolding procedural sequence of refining a perspective to ontospace A, which can be expressed as P = [p_1,...,p_n] consisting of different real numbers from the set {1,2,...,n}, or from the set [0,1]. In that sequence, number p_i expresses the priority of the quality Q_i, the bigger the number the lower its priority. Concerning the dependency of R_P on perspective P, it is stipulated that *the higher the priority of a dimension, the more globally it dominates the spatial organization of the items* due to it being executed earlier. Thus if $p_i < p_j$, then quality Q_i has a more globally determining role in the organization of the spatial cluster hierarchy than quality Q_j, and correspondingly the effects of Q_j on it are more local. We can suppose that the priority p_g of "genus" quality Q_g is the highest. The perspective is built dynamically starting from Q_g thereafter searching new qualities, taking into consideration previously chosen ones, iteratively leading to the sequence of qualities [Q_g,Q*,Q**,...]. Any quality added to the sequence will result in further subdivision and contribute to an increasingly homogeneous local *concept*, which at the same time belongs to a broader *conceptualization* based on the entire sequence.

We adopt *orthogonality* from linear algebra and statistics as an analog to perpendicular positioning towards objects in concrete labor. We stipulate that quality dimensions whose distribution is as orthogonal (statistically independent) as possible *with respect to the superdimension* are the distinctors technically best suited for making iteratively finer distinctions among elements of an ontospace. The rationale is that it is the superdimension that determines the object of the current inquiry, that is, the criterion that distinguishes the subconcept within its

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[2] Such clusters are also convex by nature, fulfilling the condition Gärdenfors stipulated (2000)

superconcept. Therefore it is least desirable that the next distinctor should covariance strongly with the previous, and maximally desirable that it would be as orthogonal as possible. That this should be the case may become quite intuitive from the point of view the use of attributes in language. There, the case of maximal covariance and minimal orthogonality between two qualities would equal to synonymity or redundancy and refer to more or less same items. Choosing a maximally orthogonal subdivisive distinctor is a way to avoid intellectually void concepts. For example, it would not add any information to the description of 'the bold' to talk about at the "hairless among the bold". However, picking, say age, a dimension more orthogonal with respect to 'boldness' would result in two potentially useful subconcepts, namely "the young bold" and "the old bold", whose comparison might well be a key to understanding the phenomenon better.

However, the maximally orthogonal alone does not guarantee that the distinction contributes to the practical analytical task that intention p aims to solve. Neither is it guaranteed that it reflects the continuously changing concrete world in a relevant way. We go further and suggest that in addition to orthogonality, the distinctor needs to contribute to the analytic intention.

The optimization of orthogonality and intentionality can be described in terms of a two-dimensional grid (Image §).

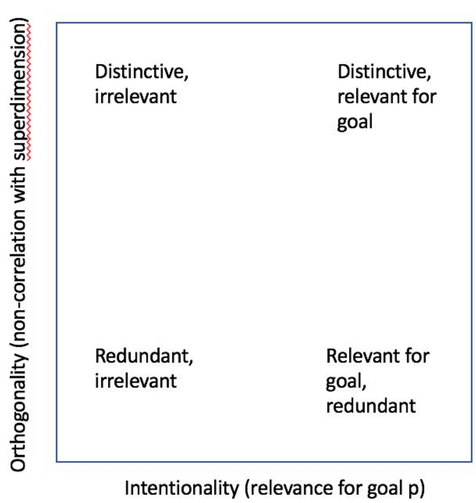

Figure 2. Optimization of intentional (relevance for goal on the y-axis) and inferential (distinctiveness vs. redundancy on the y-axis) considerations in the choice of subdividing criterion. The most desirable choice is as close as possible to the top-right corner.

In order to relate the two considerations, namely the *inferential* and the *intentional,* to *practical* action we adopt *practical syllogism* as the decription.

Practical syllogism as the recurrent logic of analytic inquiry

Practical syllogism is a logical means to bind together intention, knowledge (conceptual structure) and action. It differs from deductive inference where the result is a necessary consequence of premises. In contrast, the result of practical syllogism is non-conclusive, that is, not a necessary conclusion but rather one of options. We interpret this aspect in a dynamic manner, regarding the result of the syllogism as a feedback for another iteration, and involving choices among alternatives, altogether forming an open dynamic system directed towards a goal by means of intentions. Formally, there might be a sequence of actions $a_1,\ldots,a_k$, so that a_1 is the first step and a_k is the intended final step to reach the intended target.

Von Wright's formulation of practical syllogism (1971, 96) serves well this intepretation. Here two *premises* imply a resulting action as follows:

1. *A intends to bring about p*
2. *A considers that he cannot bring about p unless he does a.*
3. *Therefore agent A sets himself to do a.*

Below, practical syllogism in von Wright's terms is paralleled with what we see as the conditions of grasp-targeting cognitive action, and the model-algorithmic steps (Table 1) we propose to correspond to these. Components 1 to 3 constitute the *intentional, inferential and practical* considerations involved at each iterative cycle of the refining conceptualization. Here we suppose that the considerations in the table are related to a phase in interative process $a_1,...,a_k$.

	Practical syllogism (von Wright 1971, 96)	**Aspects of cognitive distinction**	**Steps of model algorithm**
1	*Intentional consideration.* *"A intends to bring about p."*	On the basis of previous result, the cognizer: Evaluates whether intended p is to be maintained (In terms of Lewis, hypothesis confirmed), or whether the target has been reached. Refocuses the intention to the subconcept among those determined at previous step (practical action) that is most relevant for the intended p.	The model assumes the cognizer's input; -> End condition judgment -> Refocus decision
2	*Inferential consideration*: *"A considers that he cannot bring about p unless he does a.*"	The cognizer makes hypothesis-forming inferences of the domain based on current conceptualization: Identifies the obstacle ("cannot grasp the intended p...") and consequent need for further analysis ("...without doing further analysis") Considers (likely intuitively) the most distinctive options for action "a" for subdividing the current concept (best 'operative position') Chooses the one among the best distinctor options that should optimally serve the intention of grasping p.	Model-algorithmic correspondent: -> Assumed as input The model forms a heuristic for the most distinctive variables by means variables that are most orthogonal against the distinctor of the previous iteration (superdimension) within the cluster in focus (determined at step 1). -> Assumes the cognizer's choice
3	*Practical action*: *"Therefore agent A sets himself to do a."*	Chosen distinctor applied to concrete instances, resulting in new subconcepts.	Algorithmic subdivision of the cluster in focus based on the distribution of elements on the chosen subdivider dimension (at step 2).

Table 1. Synopsis comparing practical syllogism (von Wright 1971) (left) to stipulated cognitive action (middle) and steps of proposed algorithmic model (right).

Formally, to describe the stipulated sequence as a whole, and a single action a_t within it, we adopt the following notation for the partial transformation. Let M be a sequence of quality dimensions from the list $Q_1,...,Q_n$. The order of quality dimensions in M expresses also the order of application of qualities, so it's a perspective. Let R_P be a reduction function. Then R/M refers to the restriction of R_P only to qualities in M. Say if $M = [Q_1,Q_3]$, then R/M takes into consideration only qualities Q_1 and Q_3, in that order. In the iterative process of conceptualization, the projection from ontospace into perspectival space is elaborated stepwise in terms of a series of partial function $R/M_1,\ldots,R/M_k$ where the set of relevant qualities in $M_1,\ldots,M_k$ increases. At each step, the application of quality dimensions of M in preferred order will produce a hierarchical cluster structure, referred by C_M. In terms of action theory, these categorisations are evaluated on the base of the prospects they open for action (compare the premise 2 of practical syllogism).

In the following we walk through four subsequent steps applying the described model to a concrete data set, in order to demonstrate the model in relation to a readily conceivable case.

Iteration example

We apply the described iterative subdivisive procedure to a dataset aggregated from a number of sources that describes indicators of social progress in various countries (Social Progress Imperative 2017), reflecting each step in terms of von Wright's practical syllogism.
Assume as the general intention of the analysis *p* to bring about new insights to poverty, more specifically, to determine which qualities distinctively characterize countries in which access to basic human needs is low. This goal might be motivated by a desire to improve life conditions in those countries.

Step 1

Intentional: The initial subdivision (action a_1) is determined by the mentioned practical aim only, since there is no previously determined superdimension that would allow orthogonality heuristics to be calculated.

Inferential: The most natural choice for the subdivision criterion is quality dimension Q [Satisfaction of] *Basic_human_needs*.
Practical: Applying perhaps the simplest possible clustering method, namely setting the widest gap in the distribution of countries described by the data set as the break point [Image §), the following cluster subdivision results:

Higher- Basic_Human_Needs:
Korea Republic_of Poland Hungary Greece Italy
Chile Serbia Bulgaria Costa_Rica Uruguay
Albania Turkey Romania Tunisia Panama
Thailand Kazakhstan Ukraine Moldova Russia
Mexico Ecuador Kyrgyzstan Morocco Peru
Brazil Sri_Lanka Colombia Bolivia Indonesia
Dominican_Republic Nicaragua El_Salvador Philippines Guatemala
Botswana Nepal Honduras Bangladesh Mongolia
India Senegal Pakistan Cambodia Ghana

Lower- Basic_Human_Needs:
Zimbabwe Liberia Uganda Sierra_Leone Malawi
Kenya Cameroon Côte_d'Ivoire Tanzania

This cluster division can be considered as the most highest level conceptual structure, further constraining the continued analysis.

Step 2

Intentional: At the first iterative step (action a_1), the *practical aim* dictates that it is the cluster with lower rather than higher *Basic_Human_Needs* that is of interest, and consequently the exploratory focus of further analysis is narrowed down to this cluster.

Inferential: The following inference then seeks to find an optimal 'operative position' for the analytic subdivision of cluster *Lower- Basic_Human_Needs.* According to our model, what can be mathematically describes orthogonality against superdimension generates hypotheses of which dimensions might make a difference in a semantical/pragmatical sense. The top ten of 74 variables ordered by descending orthogonality against the superdimension *Basic_human_needs* amount to the following heuristic:

Primary_school_enrollment [choice]
Corruption
Tolerance_for_homosexuals
Freedom_of_religion
Press_Freedom_Index
Foundations_of_Wellbeing
Level_of_violent_crime
Suicide_rate
Household_air_pollution_attributable_deaths
Mobile_telephone_subscriptions_-_capped
[list truncated]

In this case, assume that the cognizer forms a hypothesis, reminiscent of the kind Lewis supposed, namely that the cluster of countries with a high average value on quality dimension (variable) Q* =*Primary_school_enrollment* would have more positive social progress indicators than those with lower average. In terms of our formula, assume that this choice is M = [*Basic_Human_Needs, Primary_school_enrollment*], as the added subdividing dimension Q*.

Practical: The correspondent epistemic action is to test the hypothesis concerning the practical benefit of the chosen Q*, presupposing cluster (concept) M, corresponding *action* in practical syllogism. This is done by means of applying a dimension *Primary_school_enrollment* as the criterion to subdivide cluster defined by the dimension *Lower- Basic_Human_Needs,* which can be considered to represent the relevant and assumedly relevant sample. Applying the method described in Iteration 1, the resulting subdivision occurs:

***Lower- Basic_Human_Needs**:*
Higher- Primary_school_enrollment:
Zimbabwe Liberia Uganda Sierra_Leone Malawi Kenya Cameroon
Lower- Primary_school_enrollment:
Côte_d'Ivoire Tanzania

Step 3

Intentional: The resulting subdivision aims to judge whether the subdivision resulting from Iteration 1 provides a sufficient 'grasp' to the domain of inquiry, that is, whether dimension *Primary_school_enrollment* serves as the hypothesized distinctor.

This can be studied in terms of in terms of comparing the resulting clusters, allowing the scrutiny of how variables co-vary within the supercluster in focus (chosen at Iteration 1) between its newly distinguished subclusters *Higher- Primary_school_enrollment,* and *Lower-Primary_school_enrollment*. In table 2 variables of the data are ordered by their ascending covariance (equal to descending orthogonality) with the previously applied distinctor dimension, (superdimension) Q* within the supercluster, and the comparable average values of each subcluster, scaled between 0 and 1, are given in columns.

	Lower	Highe	
Primary_school_enrollment	0.202	**0.709**	**GIVEN**
Deaths_from_infectious_diseases	0.754	**0.83**	**Unexpected**
Early_marriage	0.056	**0.059**	
Access_to_Basic_Knowledge	0.152	**0.419**	
Maternal_mortality_rate	0.382	**0.483**	**Unexpected**
Personal_Safety	0.436	**0.467**	
Child_mortality_rate	0.578	**0.605**	**Unexpected**
Homicide_rate	0.130	**0.065**	
Household_air_pollution_attributable_c	0.74	**0.721**	
Tolerance_and_Inclusion	0.372	**0.345**	
Secondary_school_enrollment	0.115	**0.194**	
Secondary_school_enrollment_-_capp	0.162	**0.272**	
Globally_ranked_universities	0.000	**0.005**	
Globally_ranked_universities_-_bucket	0.000	**0.001**	
Percentage_of_tertiary_students_enro	0.000	**0.143**	
Access_to_improved_sanitation_faciliti	0.067	**0.182**	
Freedom_of_expression	0.241	**0.241**	
Greenhouse_gas_emissions	0.389	**0.549**	**Unexpected**
Greenhouse_gas_emissions_-_cappe	0.374	**0.538**	
Level_of_violent_crime	0.651	**0.601**	
Quality_of_electricity_supply	0.014	**0.009**	
Gender_parity_in_secondary_enrollme	0.001	**0.002**	
Wastewater_treatment	0.010	**0.005**	
Freedom_of_religion	0.85	**0.83**	
Inequality_in_the_attainment_of_educ			

Table 2. Comparison of selected average values of variables (scaled between 1 and 0), ordered by descending covariance with *Primary_school_enrollment*, between subclusters *Higher- Primary_school_enrollment* and *Lower-Primary_school_enrollment.* This list is truncated, and interpretative commentaries are added on the left.

These results may turn out to be rather surprising, even counterintuitive. It might not be expected it to hold that the higher *Primary_school_enrollment* the higher average

Deaths_from_infectious_diseases, but according to the observations this is the case within the cluster defined by *Lower- Basic_Human_Needs.* The rather straightforward practical judgment may be in this case that *Primary_school_enrollment* does not suffice to provide the aimed grasp to the domain, requiring a more refined analysis.

Assume that the agent may make the decision to focus to the countries within cluster *Higher-Primary_school_enrollment* at the next step*,* due the arising unexpected results that relate particularly to it rather than the *Lower-,* hypothesizing that this might serve the overall analytic goal *p*.

Inferential: As in step 1, the variables are ordered by descending orthogonality against superdimension *Primary_school_enrollment* as a heuristic for next cluster subdivider.

Opportunity
Access_to_electricity
Biodiversity_and_habitat
Access_to_Information_and_Communications
Press_Freedom_Index
Depth_of_food_deficit
Rural_access_to_improved_water_source
Depth_of_food_deficit__capped
Mobile_telephone_subscriptions
Mobile_telephone_subscriptions__capped
Access_to_piped_water [choice]
[truncated]

In this case, let us assume dimension (variable) *Access_to_piped_water* is chosen among alternatives. The choice might be based, on one hand, based on the practical considerations following from the unexpected finding at step 2 and the consequently updated focus, as well as the reasoning that in case it makes a significant different, piping is a practical measure to improve the situation of those countries, rather than just an observable symptom.

Practical: Applying quality *Access_to_piped_water* as the new criterion Q** to subdivide Higher- Primary_school_enrollment, results in the following subdivision hierarchy.

Higher- Primary_school_enrollment:

Higher- Access_to_piped_water:

Zimbabwe Kenya Cameroon

Lower- Access_to_piped_water:

Malawi Sierra_Leone Uganda Liberia

Step 4

Intentional: Variables that co-vary with *Access_to_piped_water* between the new subclusters within the supercluster [*Lower- Basic_Human_Needs, Higher- Primary_school_enrollment*] can be scrutinized with a comparison table introduced earlier (Table 3).

	Lower	Higher	
Access_to_piped_water	0.028	0.200	CRITERION
Women's_average_years_in_s	0.201	**0.537**	**Superior**
Adult_literacy_rate	0.534	**0.774**	**Superior**
Adult_literacy_rate_-_capped	0.560	**0.791**	**Superior**
Availability_of_affordable_hous	0.001	0.002	
Shelter	0.113	0.294	
Gender_parity_in_secondary_(	0.002	0.002	
Access_to_Basic_Knowledge	0.317	**0.555**	**Superior**
Political_terror	0.393	**0.714**	**Arising issue**
Secondary_school_enrollment	0.110	**0.305**	**Superior**
Secondary_school_enrollment_	0.154	0.429	
Perceived_criminality	0.500	**0.833**	**Arising issue**
Access_to_electricity	0.125	0.387	
Satisfied_demand_for_contrac	0.536	**0.738**	**Superior**
Press_Freedom_Index	0.245	0.334	
Suicide_rate	0.043	0.076	
Internet_users	0.058	0.216	
Access_to_Advanced_Educati	0.127	**0.290**	**Superior**
Access_to_improved_sanitatio	0.107	0.281	
Foundations_of_Wellbeing	0.112	0.199	
Access_to_Information_and_C	0.159	0.294	
Religious_tolerance	0.833	**0.667**	**Arising issue**
Water_and_Sanitation	0.164	0.225	
Deaths_from_infectious_disea	0.819	**0.859**	**Remaining issue** ai

Table 3. Comparison of selected average values of variables between the new subclusters *Higher*- and *Lower-Higher- Access_to_piped_water* within cluster *Primary_school_enrollment,* with commentaries on the left. Font-size denotes the value, while bolding indicates the choice of focus.

As the result of the sequence of implementation [*Basic_human_needs, Primary_school_enrollment, Access_to_piped_water*] has been determined, while the focus of the inquiry has followed the analytic intention in the following manner. We interpret this as an order of dimensions constituting the perspective P, according to our definition.

High- Access_to_piped_water within the
High- Elementary_School_enrollment within the
Low- Access_to_Basic_Human_Need

Considering the cluster defined above in terms of actionabily, it can be interpreted this concept, , which might be in everyday communication become named *"Tap countries"* by the last and most local distinction, that allows an actionable 'grasp' in terms of comparison to *Low-Access_to_piped_water*, turning out to be superior to the latter with respect to many significant average dimensions, to mention some *Maternal_mortality_rate, Depth_of_food_deficit* and *Child_mortality_rate*.

The identification of this concept within the conceptual structure it belongs to, constitutes a rather practical grasp, implying for example water infrastructure projects in contrast to *"Without-tap-countries"* (for short). Therefore it may seem justified for the agent to judge the intended goal p being met and to terminate the iteration.

Discussion

Our chapter can be regarded as an attempt to describe the cognitive dynamics of how concept-defining perspectives and perspective-relative conceptual structures come about. This amounts to suggesting an *iterative subdivision model of conceptualization.* This approach builds on three theoretical pillars. First, the Conceptual Spaces theory (Gärdenfors 2000) via its perspectival interpretation of it (Kaipainen & Hautamäki 2015) allows the means to describe analytic cognition as being conditioned by perspectives, that is, foci and dimensions that correspond to situations, contexts and conditions of human activity. Secondly, it is the line of argumentation for *embodied cognition* that justifies the analogue of such perspectives to the concrete interplay of the hand and the eye. From this paradigm we fetch the metaphor of *concept as a grasp*, as well as the one of *operative positioning* with respect to an object of manipulation. The core suggestion we have put forward is that just as a *perpendicular* position toward an object to be manipulated is often the most practical and accurate, it provides the most distinctive conceptual perspective to assume a quality dimension (variable) that is *orthogonal* with respect to a the dimension applied previously to define the object of inquiry. This assumption implies first, that accumulated experience, modellable as data, provides the elements needed to infer optimally distinctive terms for an analytic task, and secondly, it in itself implies iterative analytic inquiry in terms of reference to the previous step.

However, human cognitive functions in concrete world cannot be exhaustively described as closed computational systems, since there is always an undeniable intentional component involved. To clarify the relation between the intentional and the inferential considerations to epistemic actions, we apply von Wright's articulation of practical syllogism as a structure our iterative subdivision model..

Approaching this issue from the point of logic, we relate to the non-causality of practical syllogism. Wright issues a warning (1971, 95; 97) against interpreting practical syllogism being causal, because of the complexity of the cognitive-volitative component (in our view concerning the intentional, partly inferential aspects) that does not qualify as a cause, at least in the Humean sense of being a cause independent of an action as the effect. Therefore, our model may be explicit when it comes to inferential considerations and practical action, but when it comes to intentionality, coupled to the full scale of situational and embodied input from the world, the complexity is beyond our model. It is tempting to speculate that this might be the ultimate limit also for any artificial intelligence, unless machines would be built that are like humans with respect to their bodily implementation, ergonomy, situatedness, historical disposition among other factors that would motivate their intentions and will.

To conclude, despite not reaching beyond that limitation in describing analytical inquiry, we have nevertheless suggested a way to connect the classification-oriented theory of conceptual spaces to intentional and embodied dynamicity. We have also put forward a proposal of how practical syllogism can feed back to itself, implying a dynamical evolution of intentions. Finally, our work migh also imply a practical data-analytic approach based on a dialogue of what is inherently human, that is, situated and world-enactive intention, and that which may be better performed by a machine, namely mechano-rational inferences about best analytic distinctiveness.

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