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NATURALIZED RATIONALITY – A GLANCE AT BOLZANO’S PHILOSOPHY OF MIND

ABSTRACT: Bernard Bolzano’s philosophy of mind is closely related to his metaphysical conceptions of substance, adherence and force. Questions as to how the mind is working are treated in terms of efficient (causal) faculties producing simple and complex representations, conclusive and non-conclusive judgments, and meta-representational attitudes such as believing and knowing.

My paper outlines the proximity of Bolzano’s account of “mental forces” to contemporary accounts of faculty psychology such as Modularity Theory and Simple Heuristics. While the modularist notions of domain specificity and encapsulated mental faculties align with Bolzano’s allotment of domain specific tasks to correspondingly specified psychological forces (e.g. judging to “judgmental force”, inferring to “inferential force” etc.), the emphasis of Simple Heuristics on accurate “fast and frugal” processes aligns with Bolzano’s views regarding cognitive resources and the importance of epistemic economy.

The paper attempts to show how Bolzano’s metaphysics of mind supposes a conception of bound rationality that determines his epistemology. Combining the rationalist concern for epistemic agent responsibility in the pursuit of knowledge with a strong confidence in the reliability of causal processes to generate the right beliefs, his epistemology shows close affinities with contemporary Virtue Epistemology. According to Virtue Epistemology, knowledge requires that true beliefs be generated by reliable processes

typical of a virtuous character. The thesis that Bolzano anticipates virtue epistemological considerations is corroborated by his discussion of heuristic principles that set the norms for the acquisition of knowledge. The paper explores possible relations between such principles and the presumed low-level heuristics of cognitive processes.

1. THE RATIONAL IDEAL AND THE EPISTEMICALLY REAL

The rational ideal of knowledge – the central epistemological value – holds that knowledge of $[q]$ can be ascribed to subject S if 1) the epistemic efforts S made with regard to “ q ” satisfy the conditions of truth-conformity and 2) these efforts and $[q]$ ’s being true are connected in a non-accidental way. Ideally, knowledge should be fully rational, and, due to its objectively flawless grounds, infallible and indefeasible. Consequently, S ’s knowing that $[q]$ requires that S be in a position to assess the truth-conformity of her judgment (assertion) “ q ” by evaluating not only the epistemic reasons leading her to believe that $[q]$, but also the objective reasons for $[q]$ ’s being true. In order to characterize the way in which we achieve knowledge Bolzano uses the metaphor of an ascent: after having asserted $[q]$, S comes to know $[q]$ by way of “ascending” through a flight of “objective grounds” to the ultimate ground of $[q]$.

As it is usually presented – and whether this applies to Bolzano is precisely what is in question here – ideal knowledge implies that an epistemic agent S knows $[q]$ when she has fully ascended, that is, when she has succeeded in flawlessly singling out the right number and order of pertinent reasons, such that all the steps of ascension are fully transparent to her. And as it is usually presented, *ideal* knowledge need not take into consideration pragmatic constraints, or the confinement of the natural boundaries of the mind. It takes it for granted that a rational mind operates somehow in an abstract space of logical and semantic coherence where time restrictions and situational constraints do not affect its work. The epistemic reality, however, looks different. Actual epistemic agents, though well intentioned and aware of their rational responsibilities, rarely (if ever) ascend in the ideal straightforward way from an assertion (belief) “ q ” through a flight of objective grounds to an ultimate ground of $[q]$ that would provide the added value of knowledge to their belief “ q ”. Agent S may indeed start ascending, but she

will typically soon get lost in a host of possible grounds for $[q]$ that seem equally good or equally wanting when it comes to grounding her belief that $[q]$. More often than not, S will feel restrictions of time, of memory, etc., which make her wonder how she should decide between the different options that are available to her when it comes to justifying her belief. In the best case, S will arrive at an acceptable level of grounding for “ q ”. In the worse scenario, rather than ascending, S actually finds herself descending, doubting now what she asserted before. When it comes to epistemic reality, it appears that human rationality is not unbounded rationality, but rather restricted by the limits of its resources.

Against this background, a number of philosophers claim that human rationality needs to be “naturalized”, that is, accounted for in terms of reasoning processes that are reliable enough, but also fast and frugal enough given the demands of a normal human life. It is claimed that actual minds – being embodied entities – depend on the properties of the processing systems and the informational resources of their physical supports. The rational capacities of human minds cannot be construed in terms of unlimited faculties, but need to be understood as essentially bound. There are two main types of binding factors: rationality is bound, on the one hand, by the naturally available potential of human brains and/or neuronal systems, and, on the other hand, by pragmatic constraints. The label “Naturalized Rationality” literally refers to the first class of constraints, suggesting that rationality must be assessed in accordance with the properties of its physical support. Naturalized Rationality encompasses, however, also considerations that pertain to the second class of constraints. Among these, research in the field of what has come to be known as “Simple Heuristics” has been receiving growing attention. Taking into consideration pragmatic constraints on rationality, Simple Heuristics deal with the epistemic principles rational agents apply when they have to decide between $[p]$ or $[q]$ under temporal or other kinds of constraints of urgency. Suppose that S asserts “ q ”, where $[q]$ stands for *[There is immediate danger for S]*. Given the content of her assertion, S cannot quietly deliberate on the reasons that warrant her asserting $[q]$ in an idealized rational space. In this emergency situation, rationality requires her to draw on selective principles that provide the justification needed in a way that is “fast and frugal”

enough to confront the danger in due time and with proper means. Throughout their existence, embodied minds find their rationality subject to multiple restrictions that are inflicted on them by the conditions of their nature. Therefore, it seems appropriate to deflate the notion of rationality by adapting its conditions of application to the factually given. In the field of naturalized epistemology, Virtue Epistemology attempts to reconcile an externalist position on justification with internalist normative requirements. The notion of a virtue as a “praiseworthy personal characteristic” licenses applications both to physical excellence and skills and also to traits of character. Responsibilist epistemologies take the virtues relevant to justification to be character traits that subjects bear responsibility for developing. Therefore, failing to display virtue makes a subject blameworthy, whereas lacking physical excellences and skills does not have the same ethical consequences. Because they are essentially value-oriented, virtues motivate agents to take certain measures to attune a situation to a given pattern of values. The methods chosen may be standard or non-standard, driven by norms or not. Accordingly, an epistemically responsible agent’s path to knowledge is not primarily norm-governed but rather value-driven. According to one account, for instance, it is the virtue of her love of truth that motivates an agent to apply the most reliable methods in her pursuit of knowledge, while it is assumed that reliable processes will deliver results that bear the status of knowledge. For Virtue Epistemologists, knowledge claims are bound by the cognitive equipment involved in agent responsibility.

2. THE NATURAL MIND: ‘FACULTY PSYCHOLOGY’

Bolzano’s philosophy of mind is in many ways defined by features similar to those we find in theories that attempt to naturalize rationality and the mind. In particular, it involves aspects of so called “faculty psychology” as this is found in accounts of Modularity and Simple Heuristics. Commitments to faculty psychology and bound rationality influence the position one takes on epistemological questions. For example, they favor reliabilist accounts of knowledge, accounts that are traditionally opposed to the ideals of rationalist epistemology. In light of his achievements in the development of logical semantics and analytic method-

ology in philosophy, Bolzano is usually taken to be a full-blown rationalist regarding epistemological requirements. Focusing on his seminal work on the properties of objective propositions and a variety of logical relations between them, one might too easily think that Bolzano's emphasis on, say, "deducibility" implies his commitment to a rationalist notion of knowledge, understood in terms of perfect deduction. This, however, is not the case. The tendency in Bolzano's epistemology is rather toward naturalizing rationalism, which results in a position that anticipates contemporary responsibilist reliabilism. This move is not motivated by a lack of appreciation for the values of rationalism, but rather by taking into account a metaphysics of the mind that is essentially monistic and that explains mental performances in terms of causal forces. This "naturalizing" approach to the mind strongly influences Bolzano's epistemology, in which he emphasizes the processual aspects of epistemic states. In his epistemology, Bolzano appears to be a reliabilist who navigates between, on the one hand, absolute reliability (ideal rationality) instantiated in inferences leading from true premises to true conclusions connected by relations of logical implication and, on the other hand, low-level reliability instantiated in processes underlying the spontaneous choice amongst limited options that may draw on "quick and dirty" heuristic principles (bound rationality). Furthermore, Bolzano's epistemological interest is not restricted to the question of the kind of justifications that make a belief "*q*" count as knowledge proper, but focuses also on how to explain the truth of [*q*] and on how to expand a given body of knowledge. In Bolzano's approach, matters of justification or warrant imply explanatory and heuristic principles, which are not independent of the mechanisms steering mental processes.

Mental Modularity is a term introduced by Jerry Fodor who characterizes his book *The Modularity of Mind* (1983) as "An Essay on Faculty Psychology". Fodor's modularism is a theory of the architecture of the mind, according to which the mind's cognitive processing is accomplished by a host of functional input-output systems subserving a central system of reasoning. The processing systems are modular in the sense that they are domain-specific and work in relative independence of each other. As regards domain-specificity, the idea of mental modularity corresponds to the traditional idea of the mind being constituted of different "faculties" each serving to carry out specific tasks. Contem-

porary modularist accounts view the domain-specificity of modules as essential to establishing a division of labor that enables embodied systems to efficiently deal with abundant information flows. Fodor claims that the need for a system to consider any arbitrary item of information in the course of processing would require arbitrarily complex algorithms that risk overburdening the system's resources. Because they are not computationally tractable, arbitrary complexity cannot be handled nor can it be mapped in any model or theory of the mind. Therefore, mental processes need to be construed in terms of encapsulated units whose operational range is limited. Encapsulation as the main hallmark of a mental module "concerns the class of representations that it can use as a resource" once it has been activated by the proprietary data exhibiting its input-specificity (Samuels 2005, 112). "Paradigmatically, encapsulation concerns the information encoded in memory that the mechanism is able to consult in the course of providing solutions to the particular inputs that it receives" (*ibid.*). The information-frugality of mental modules is supposed to be supplemented by the processing-frugality of algorithms tailored to the demands of their task-specificity. Reducing expensive search and assessment procedures, domain specificity and encapsulation enhance fast and mandatory processing. Being relatively autonomous, mental modules are dissociable and exhibit specific breakdown patterns. Examples of task-domains assigned to distinct mental modules include the recognition of faces or the representation of three-dimensional objects.¹

Mental modularism ought to be considered against the background of evolutionary psychology: mental structures and processes are established as a function of low-cost strategies for the system's resources and high-yield strategies for its adaptiveness. Accordingly, encapsulation is considered diachronic in the sense that the informational closure of the mechanism essentially obtains throughout its entire history. However, there is also a sense in which encapsulation is synchronic, to wit "if, at any time, there is at least some (kind of) information possessed by the organism that is inaccessible to [the mechanism]" (Samuels 2005, 112). The notion of synchronic encapsulation is weaker than that of diachronic encapsulation and allows counting "any deterministic computational device that does not engage in exhaustive memory search" as encapsulated. Furthermore, it could even be applied to a reason-

ing mechanism “whose access to information is mediated via a limited working memory” (*ibid.*, 113).

This application of the term ‘encapsulation’, although it is not the one ordinarily used, seems to be at stake in Bolzano’s discussion of the way in which the requirements of ideal inference collide with the reality of embodied minds. For an inference to be rationally proper it is required, according to Bolzano, that all the premises needed in order for a judgment “*q*” to be conclusive be “present to the mind” in their entirety at the moment of inferring. However, the mind’s limited capacities for holding actual representations often causes agents to fail to achieve this ideal. Take the well known example of simple consistency-checking: the task of checking a candidate new belief according to rational requirements demands an epistemic system to consult more information than it can handle in real time. Going through the set of all stored beliefs in order to determine whether one holds beliefs that contradict the candidate belief is obviously not feasible for human minds. The amount of time and working memory needed to complete such a task would go up exponentially with the size of the chosen belief-set. Besides, inference demands that the agent determine which of the coherent beliefs themselves rest on evidence in order for the candidate belief to be conclusively supported. Consequently, it might be the case that, due to limited working memory, either the inference is not implemented – in spite of the agent possessing the substantiating knowledge in dispositional form – or the inference runs by dint of heuristic rules that are “quick and dirty” from the point of view of rational ideals (see, for instance, WL §§300.2; 308).² While the former option obstructs the increase of knowledge, the latter concerns the problem of determining the conditions of warrant for knowledge. The inclusion of more frugal procedures amongst those capable of supplying credentials for knowledge makes knowledge achievable at the price of increasing fallibility.

“Simple Heuristics” is the fruit of empirical research on the means people actually use in view of a given epistemic goal. This approach is based on the idea of replacing “the image of an omniscient mind computing intricate probabilities and utilities” with that of “a bounded mind reaching into an adaptive toolbox filled with fast and frugal heuristics”.³ This mental “toolbox” is supposed to contain different kinds of rules, such as search rules, stopping rules or decision rules, which di-

rect agents in their practical and epistemic endeavors. The somewhat surprising fact is that these rules – although qualified as “quick and dirty” in comparison to the traditional principles of rationality – provide equally satisfying results in almost all experimental settings. Attractive examples for simple heuristic rules are *recognition* and *satisficing*. In *recognition* the directive is: select the one you recognize. If people are asked, for example, to tell which of two cities – say New York or Luzern – is bigger, their decision usually draws on the name they recognize. Although this strategy is highly fallible, the success rate is surprisingly high, even in settings where the decision concerns investment policies. The expression “*satisficing*” – a neologism introduced by Herbert Simon – is used to indicate a strategy that does not involve striving to get the optimal solution, but, rather, a solution that *achieves* the intended goal in a *satisfying* way. An example of this strategy might be seen in the choice of a marriage mate: if Maria dreams of marrying George Clooney, she might never reach her goal of marriage. If she follows the strategy of satisficing, she will get married as soon as there is a suitable candidate who resembles George Clooney in a satisfying way. Satisficing is a stopping rule, a rule that prevents agents from getting lost in extremely complex hosts of possible options. In the practical domain, satisficing may well have contributed to the survival of our species; in the epistemic domain it is a strategy that frees reasoning from the potential regress into interminable quests for more and better grounds. Calling it a strategy does not imply that satisficing is deliberative thinking. Rather, it means that there are specific patterns determining which values and parameters to incorporate or to disregard in a decision step. On the other hand, the term ‘strategy’ suggests that these patterns can be detected and spelled out as explicit rules. The power of strategies such as satisficing seems to lie, however, precisely in the fact that they best work on subliminal levels. Satisficing is a strategy that subserves some of the epistemic directives that Bolzano framed in the Heuristics of his *Theory of Science*.

3. THE BOLZANIAN ‘MIND’: SOUL, SUBSTANCE AND FORCE

In Bolzano’s writings there is no clear-cut distinction between the terms “soul” and “mind”. One way to specify the two notions is to say that

the soul is clearly characterized as being a substance, while the term ‘mind’ – or, rather, the predicate *mental* – is used to indicate the main function of the soul, namely thinking.⁴ This is not to say that the soul is nothing but a thinking thing, or that substances that are not souls do not have the ability to think. Bolzano defines substances as being simple enduring entities that have the force of representation. In Bolzano’s use, the term “force of representation” subsumes different specific faculties such as the “force of thinking”, the “force of feeling”, the “force of willing/wanting” and the “force of desiring”.⁵ This division corresponds to classical versions of faculty psychology such as Aristotle’s functional division of the mind, still alive in the contemporary notions of cognitive, volitive, conative and affective intentional modes. Although Bolzano in his logical writings uses the more specific notion of a representation as a non- or sub-propositional part of a proposition, in his metaphysics and his epistemology “representation” is “the general name for an occurrence (*Erscheinung*) in our soul/mind (*Gemüt*).”⁶ That these two uses of the expression “representation” – the “objective” and the “subjective” – are not unconnected is apparent in the fact that Bolzano in his “Theory of Elements” treats objective and subjective representations explicitly “in union”, taking for granted that “both have the same rights to be accommodated in the teaching of logic”.⁷ Bolzano does not have an elaborate theory of the relations between representations generated by the “force of feeling” or the “force of desiring” and representations generated by the “force of thinking”. His distinction between representations that are “intuitions” and representations that are “concepts” implies, however, that he adopts the idea that some kinds of thinking are non-conceptual. Bolzano’s “intuitions” are defined as conceptually empty or “naked” representations that are directly caused by their object and determine their reference through the *deixis* of a demonstrative link. Since thinking – in a minimal sense – is the ability to produce simple representations, even the occurrence of non-conceptual representations can count as thinking.⁸ But given this it seems to follow that all substances are thinking things, since substances are defined as those simple things that have the force of representation.⁹

On the other hand, thinking seems to be the central function of those substances that are souls or minds. Since not all substances are souls or minds, we are confronted with a more restricted sense of ‘thinking’

attributable to soul-substances only. Bolzano accounts for the soul in terms of a substance that is related to other substances in the specific way of “ruling” over them. In virtue of their intrinsic “forces of attraction”, substances cluster into aggregates in which a certain substance can become the determining part, due to its stronger attraction forces. Such a determining or ruling substance within an aggregated complex of substances is called the “soul” of the complex, while the rest of the aggregate counts as its “body”. As constituents of a body, the non-ruling body-substances are rather characterized by functions of “forces of locomotion” and “vital forces”, while the soul-substance in its role as “ruler” takes the function of the thinking part for the complex.¹⁰ In this context, the term “thinking” is used in a richer sense, referring to the activities of producing simple and complex representations, as well as conclusive and non-conclusive judgments. In addition, a soul’s function of thinking includes self-evaluative activities as exemplified in the cognitive meta-level attitudes of Bolzanian believing and knowing. Keeping in mind both this rich sense of thinking and the essentially relational nature of Bolzanian souls, we might define the soul in the following way:

- (1) x is a soul \equiv : x is the thinking thing S_i in a complex of substances C_S constituted by S_1, S_2, \dots, S_i .

Given that ‘thinking’ means having representations and processing them in reasoning, this *definiens* of the concept ‘soul’ maps the conception of the mind in terms of representation and computation that is central in contemporary cognitive science. Paul Thagard, for instance, uses the shorthand notation CRUM (computational-representational understanding of mind) to express the view that thinking can best be understood in terms of representational structures and computational procedures that operate on those structures (Thagard 1998, 10).

Let me emphasize again that a substance S_i will be the dominant or the thinking part S_i in a complex of substances making up, for example, a human being, in virtue of this substance’s relevantly stronger forces. In Bolzano’s essentially monist understanding of body and soul, it is an important point that the notion of force accounts for the difference between soul-substances and body-substances. Accordingly, cognitive and epistemic achievements are accounted for mostly in processual terms that reflect this understanding of properties as dynamic and efficacious

entities. Bolzano understands the central elements of his epistemology in terms of activity and asks: *What is going on when agent A is judging that p?* rather than: *What is a judgment?* This way of proceeding is in line with the focus on processing and computing in contemporary cognitive science. It is also in line with the emphasis, in epistemology, on the dynamics of knowledge acquisition rather than on mere static conceptions of justification. Such claims are pervasive, for instance, in Virtue Epistemology where deliberative and reflective processes are considered to bear epistemic value.¹¹ Bolzano's strong emphasis on the ethics of knowledge and virtuous epistemic agency is not unconnected with his functional metaphysics of the mind, according to which different tasks of mental performance are accomplished by means of task-specific forces (faculties). Driving the necessary processes, these forces subserve an epistemically virtuous character in their striving to form beliefs that attain the status of knowledge. Distinguishing a force of representing, a force of coming to know, a force of imagining, a force of remembering, a force of judging, a force of concluding (inferring) and many other related forces, Bolzano approaches the conception of an architectural modularity of the mind. A simple act of judging, for example, is supposed to involve at least three distinct forces:

- Imagining: brings about simple representations;
- Connecting: generates complex representations (non-propositional, propositional);¹²
- Asserting: enforces the assertion of the propositional complex.

A third feature that connects Bolzano's account with contemporary theories of the mind consists in the recognition that the limited resources of mental forces calls for processing rules that combine the epistemically desirable with the cognitively feasible. This awareness is especially exhibited in Bolzano's discussion of heuristic principles, a discussion that combines well with some of the recent results in "Simple Heuristics" concerning "fast and frugal" processes whose accuracy satisfies epistemological *desiderata*.

Generally speaking, Bolzano's metaphysical notion of mental forces establishes a bridge between the idea of specific task domains and the idea of processes determined by certain regularities and/or processing

rules. In this respect, the metaphysics of mental forces and processing strongly calls for a reliabilist epistemology, as do the heuristic principles he defends. More specifically, Bolzano's strong rationalist *desideratum* allies him with responsibilist versions of reliabilism that emphasize epistemic agency and responsibility. In my view, Bolzano's reliabilism incorporates the following properties:

- On the 'overt' epistemic level, heuristic principles *guide* the *acting* of epistemologically *responsible* agents (rational normativity);
- On a 'subliminal' epistemic level, simple heuristic rules *determine* the agents' *behavior*, warranting its adjustment to the system's resources;
- On the physical level, these two-fold heuristics are realized in causal regularities.

In the following, I shall investigate some principles of Bolzano's Heuristics in order to support these assumptions.

4. BOLZANO'S HEURISTICS AND RELIABILISM

Bolzano's epistemology is centered around the concepts of *judgment* (*Urteil*) and *cognition* (*Erkenntnis*) – corresponding to the contemporary labels *belief* and *true belief* – as well as on the concept of inference. The primary epistemic act is judging, which amounts to asserting a given proposition, or, in Bolzano's terms, "taking it for true". Judging can be either "immediate" or "mediated" by other judgments in an inferential chain. "Believing" (*Glauben*) and "knowing" (*Wissen*), however, are terms that Bolzano applies to second-order states. Bolzanian believing and knowing are meta-attitudes taken by epistemic agents towards their own judgments (see WL §321).¹³ They are introduced as attitudes resulting from assessing the truth-conformity of one's judgments in terms of their fallibility. While an "immediate" judgment is supposed to have fallibility 0 – or default infallibility – the fallibility of inferred judgments depends on the way they were inferred. If the inference was a "perfect deduction", starting from correct assertions and following deductive rules properly, the resulting judgment is taken to be infallible. If, on the other hand, there is uncertainty concerning the correctness of

the premises asserted or proper rule following, the inferred judgment is taken to be fallible.¹⁴ Consequently, the reflexive attitude towards such a judgment is Bolzanian believing, while Bolzanian knowing reflects the assessment of one's judgment as infallible:

- (2) *A knows that q* iff A asserts “q” & A *truly evaluates* her asserting “q” as *infallible*.
- (3) *A believes that q* iff A asserts “q” & A *evaluates* her asserting “q” as *fallible*.

From this perspective, it seems as if the assessment of truth-conformity in one's judgments were driven by reasons of justification only. This is not the case however, at least not in Bolzano's approach, which takes the desire for insight, understanding and explanation to be the engine of one's search for an assertion's objective grounds. The aim to increase knowledge widens the scope of the search for justification to include the search for the objective grounds of the propositions asserted. It is this explanatory endeavor that plays the constitutive role in Bolzano's conception of knowledge, and it is this explanatory endeavor that requires methods that do not grant infallibility. The epistemic principles set out in the “Heuristics” section of the *Theory of Science* include inductive and abductive reasoning, both being roads to knowledge that are considered “inverted” – compared to the “natural” road of proper deduction – and “amiss” in that they involve “haphazardness” and favor “serendipity” (WL §330). But Bolzano is confident that the potential of fallibility inherent in our methods of explanation will not result in a substantial faultiness of judgment or the impossibility of knowledge. If an agent's primary aim is to achieve truth-conformity, this aim will motivate her to assume her epistemic responsibilities and to cultivate the virtues required to achieve the best available results.

Bolzano's epistemology and heuristic is pragmatic insofar as it never loses sight of the fact that epistemic agents are embodied minds, bound by their natural resources. If “ascending to the grounds” of a given truth [*q*] is striving for its best explanation among possible competing options, this task requires abilities such as inventive talent, delight in exploration, patience, perseverance, humility and so on, that reach beyond the steadiness of strictly applying logical rules. These epistemic virtues are faculties by means of which actual epistemic agents

assume their epistemic responsibility in real time conditions while forcing the rational ideal of knowledge to adapt to its epistemic reality. Bolzano's “Heuristics” provides a collection of rules for one's “behavior in thinking”, amongst which figures, for example, the principle of “tentative supposition” also called the “indirect method” (rule no. 5, WL §329). This rule resumes the hypothetical method of “attempting to find truths by means of something that is not yet known to be true” (WL §329.1). Due to the involvement of the unknown in the process of explaining and coming to know a given truth [*q*], the hypothetical method seems “artificial” and “inverted” or “indirect”, compared to the “natural” method of deducing truth from known truths. Nevertheless, given the poverty of the natural method with regard to knowledge extension, epistemic virtue requires resorting to the hypothetical method, although it is “amiss” in that it involves “haphazardness” and favors “serendipity”. Successfully extending knowledge depends on mastering the art of combining both “natural” and “inverted” methods in a maximally beneficial way, an art that is highly determined by epistemic skills and virtues. Bolzano emphasizes that the faultiness inherent in the application of the hypothetical method is minimized when tentative suppositions are chosen “with proper skillfulness” and their examination is performed “in all ways available to us” (WL §329.2). Epistemic skillfulness manifests itself in an agent's selecting propositions that are potentially expedient as hypothetical grounds for a given statement. “Proper skills” for this task may evaluate the probability of the candidate propositions, their simplicity or their convenience for experiments with regard to the statement to be grounded and the circumstances of investigation. Within the set of selected propositions, they can further establish a hierarchy that determines the order of examination (WL §329.3). The soundness of the potential *explanans* might be examined progressively by checking the truth-values of propositions entailed by it, or again regressively by applying the hypothetical method to the hypothetical grounds themselves. For general statements, induction is another appropriate method of examination that implies various epistemic and experiential skills (WL §329.8). Sometimes, so Bolzano claims, it may even suffice to “think” the proposition to be examined “as clearly as possible”, including representing it “in words or signs of another kind”. This may lead us to “see” its evidence or to remember other occasions

when we already considered its truth or falsity. Bolzano does not exclude subjective evidence as a relevant factor for truth-conduciveness; rather he shows that epistemically virtuous agents will not unconditionally rely upon it.

It is clear that the successful application of the skills mentioned draws on processes and mechanisms that are not subject to willful control and, therefore, do not properly fall in the scope of agentive responsibility. It seems, however, plausible to assume that such processes and mechanisms are not unrelated to certain normative attitudes an agent holds. Consider, for example, stopping rules such as are exemplified in the satisficing strategies revealed in Simple Heuristics research. Generally, rules of this kind operate on subliminal levels. They are not explicit directives of epistemic acting, although they can be spelled out and used as explicit directives. Agents might be surprised to learn that they acted on these principles when they came to believe a certain proposition $[q]$. Within a merely process reliabilist epistemology, however, such agents could be properly said to know $[q]$, since their belief was produced by a sufficiently reliable process. In contrast, responsibilist reliabilism defends the rationalist claim according to which attributions of knowledge require the subject of knowledge to be an agent, presupposing that she is aware of her practicing epistemic activity and consciously following patterns and rules directing such activities. In this perspective, success and failure to achieve the goal of knowledge are not simply due to the external fact that certain mechanisms functioned well or broke down and disturbed the reliability of the processes liable for knowledge achievement. Rather, achievement of knowledge as well as shortcomings with regard to this aim focus on the agent's responsibility to use epistemic skills properly, that is, in accordance with rational norms and rules. Therefore, the relation between agent responsibility and the reliability of knowledge-conducive processes is accounted for in terms of motivational force. Consider, for example, the following account:

Epistemic behavior motivated by the motive for truth has value in addition to the value of the truth that is thereby attained. Success in reaching truth [...] is not guaranteed [...], but I assume that when it is attained, the behavior that is successful in attaining it gains value that it would not otherwise have. [...] Reliabilists are right to focus on reli-

ability as a critical feature of the relation between believers and truth, but they are wrong if they think it is constitutive of that relation. [...] If I am right that the value of knowledge in addition to truth is that the truth is reached *because* of the motive for truth and reliable cognitive behavior, then there is a definitional connection between the two values as well (Zagzebski 2000, 120f).

Similar ideas on how to relate process reliabilist considerations with the rationalist intuition that agentive responsibility is constitutive to knowledge are found in John Greco's account of knowledge as "credit for true belief" (Greco 2003). What seems important in these accounts is that they meet the intuition that sound rational requirements for knowledge need to be reconciled with the kind of rationality proper to those epistemic agents we are acquainted with: human beings. In this respect it is worth noting that Bolzano's metaphysical claims are bound to conceptual rigidity. Substances and their faculties are subject to identical constraints in all possible worlds. There is no world conceivable in which a soul- or mind-substance could overstep its natural boundaries. Any conception of minds constituted differently must clash with the concept of substances and their forces, and is, therefore, not about real entities.¹⁵

Within the framework of a naturalized conception of the mind, natural mechanisms and processes must play a decisive role in epistemic achievement. On the other hand, rationality requires accounting for knowledge in terms of justification and explanation; both of them are bound to operate according to logical and semantic laws. Bolzano's heuristic rules point to the way in which agents 'translate' the normative requirements of rationality into viable pragmatics, making use of the resources available in the processing system upon which their rationality relies. Applying heuristic principles as epistemic guidelines involves various decisions that seem to evoke regress problems: In order to decide which supposition is worth being considered, or on whose judgments one should rely or in what circumstances experience may provide valuable reasons, more and finer grained rules and principles are needed. This conflates the epistemic task in a way that cannot be managed at the level of awareness. Consider, for example, the rule stating that judgments shall be tested only in cases in which "we see that a test is possible without assuming propositions that have less reliabil-

ity than [these judgements] have themselves” (WL §332.7) If the latter is the case, we could at best corroborate the tested judgments but not refute them. Hence, if their eligible reasons are less reliable propositions, we can “confidently desist from such testing” (*idem*). This rule strongly relies on features of the logical relations between propositions, famously laid open in the Bolzanian conceptions of “probability”, “deducibility”, and “ground-consequence”.¹⁶ From a logical or ideally rational point of view it is obvious that a proposition $[q]$ whose probability is $P < 1$ cannot gain a higher probability if the proof for $[q]$ consists in propositions whose probability is $P' < P$. The question, then, is how we can “see” the degrees of propositional probability that are relevant to reasoning. Admittedly, in many cases, evaluation of higher or lesser probability will be a matter of estimation and depends on decisions contingent on an agent’s experience. Following the rules commanded by rationality involves specific evaluative agentive faculties, comparable to those by which artists apply the appropriate brushstroke or fit in the right word, or those by which wise people are aware of where to initiate or to stop certain efforts. Demonstrating such faculties belongs more to the domain of habitual behavior than to the domain of willful action. It is typical for this kind of behavior that it cannot be explained by indicating the criteria in virtue of which the decision was reached, although it bears on reliable mechanisms and is successful in achieving the intended aim.

On the overt level of their epistemic activity responsible agents attempt to apply rules and principles commanded by laws of logic and rationality. In doing this, they use methods and skills instructed by their epistemic experience. These methods and skills are operational mainly on a subliminal level. Responsibilist reliabilism claims that epistemic agents mobilize, so to say, their computational and creative resources in order to assume their responsibility towards rationality. Their endeavor in the pursuit of this aim and their diligence in attempting to apply their skills in the best possible way entitles them to regard their asserted beliefs as knowledge.¹⁷ The added value of knowledge over true belief does not rest, in the first place, on the reliability of the truth-conducive processes but on the satisfaction of the agent’s motivation to use them in a responsible way that is committed to the values of truth and goodness. If her love of truth motivates an agent to resort to her

best means to reach the aim of judgments conforming to truth, it will explain why her judgments are produced by reliable processes and give them the commendation of knowledge.

Bolzano’s epistemology ranges over his logics and his metaphysics of the mind, reconciling rational requirements with the demands of physically constituted natural minds. His notion of knowledge allows for ways of evaluating truth-conduciveness that overcome the problem of regress of justificatory belief without resorting, however, to a category of foundational belief. An important category with respect to valuable epistemic evaluation is affectivity. Bolzano defends the idea of a “feeling for truth” and he claims that the concept of such a feeling is “indispensable for logic and many another science” (WL §316, Note 1).

Moreover, he grants trust and trustworthiness a most prominent place: he not only develops a notion of “confidence” (*Zuversicht*) that allows him to define a specific relational property of subjective propositions, but also encourages epistemic agents to trust their own epistemic faculties and those of others. It is not surprising, then, that consulting the judgments of others as well as experience figures in his “Heuristics” as rule no. 7 (WL §331). Heuristic rule no. 7 suggests that an important factor in making proper decisions regarding the ways and length of explanatory investigation is the experience from shared epistemic practices. Under the concept of “common sense” (*gemeiner Menschenverstand*), Bolzano subsumes performances of consensus and common semiotic systems that bottom out in trustworthy evaluations of judgments and explanations. One manifestation of “common sense” is consensus, considered by Bolzano as “a particular indicator of a judgment’s truth”, especially when “the proposition itself is not doubted in spite of dissent about its ground” (WL §315.6). The claim that a consensual assertion “ q ” indicates its truth-conformity is admittedly pregnant in those cases where the reasons given for an assertion are not only different but also conflicting. Cases of convergence in judgment in spite of diverging reasons seem to be paradigmatic of the need to search for the best explanation of the asserted truth. Insofar, reliance on consensus is not just the naïve “faith of optimists” or the contingent “fashion” of a “party spirit”. Rather, Bolzano’s inclusion of consensus in matters of epistemic evaluation and warrant seems to make use of ideas that are similar to those worked out in the Lehrer-Wagner model of consensual

trust, which depicts a structure of mutual trust and trustworthiness. In Keith Lehrer's approach to trust, the interrelations between trustworthiness, self-trust and mutual trust are supposed to play a key role in accounting for reason and its involvement of individual and collective factors, as well as for epistemological concerns.¹⁸

Investigating Bolzano's epistemology and Heuristics, we will not find a precept for a hierarchal order of truth-conducive methods. Rather, there is strong emphasis that we should never insist on having infallible access to knowledge, counterbalanced by the equally strong emphasis that we have excellent reasons to trust our epistemic evaluations. That the weights of these axes properly adjust is due to the desire or love of truth on which they turn. If this value-directed attitude is missing, epistemically relevant processes are not backed by a motivation that guarantees the agent responsibility appropriate to reason. The frame of Bolzano's logic and naturalist metaphysics of the mind allows – or even presupposes – that processes on a subliminal epistemic level essentially contribute to satisfying the rationality constraints on knowledge. They warrant, on the one hand, the rationality of the decisions taken in the ascending procedure, and, on the other hand, the adjustment of the procedure to the system's resources.

Notes

¹ The short overview on modularity theory laid out here is strongly committed to Samuels 2005 and Carruthers 2006. I would like to thank an anonymous referee whose substantial remarks made me improve this part.

² I will use the code 'WL' to refer to Bolzano's *Theory of Science (Wissenschaftslehre)*. There are two partial English translations of the *Wissenschaftslehre*, both of them titled *Theory of Science* (1972. R. George (transl. and ed.). Berkeley & Los Angeles: University of California Press; 1973. J. Berg (transl. and ed.) Dordrecht & Boston: D. Reidel). Since a part of the passages I refer to are not translated in either of these books, I mention only the original *Wissenschaftslehre* (WL).

³ Gigerenzer & Todd 1999.

⁴ "Bolzano uses 'mind' (or 'spirit' [Geist]) to refer to souls that are rational" (Chisholm 1991, 208).

⁵ Bolzano 1834, §75.2; Bolzano 1851, §51.

⁶ WL §48.3

⁷ WL §48.1

⁸ "Bolzano's use of the term 'Gedanke' is vastly different from Frege's. Bolzano applies it to mental events which are either judgments or subjective ideas" (Künne 1997, 207).

⁹ "What is required, *logically*, if an individual thing is eligible to have a conscious prop-

erty? And the answer is that very little is required [...]. It would be *logically* possible for a conscious property to be exemplified even if there were only one individual substance" (Chisholm 1991, 209f).

¹⁰ "The mental substances are identified with the ruling substances and the living substances with the organic wholes" (Berg 1976, 32 (*author's translation*)).

¹¹ "But there are other epistemic evaluations that are not static. We evaluate and regulate activities of inquiry and deliberation. I shall assume that inquiries (and deliberations) are goal-directed activities, attempts to find things out. These activities can be carried out well or poorly; and many important epistemic norms are concerned with how we should carry out activities of this kind. How reflective should we be when we carry out inquiries and deliberations? What form should our monitoring reflections take? What role have the concepts of *knowledge* and *justification* in the ways in which we regulate our inquiries?" (Hookway 2003, 193f).

¹² Bolzano assumes the existence of some unnamed forces such as an "activity of our mind – namely connecting – that is essentially distinct from the one that generates any simple concept", which accounts for the producing of "complex concepts" (WL §287.8).

¹³ "Some philosophers [...] may hold that 'knows' is a very specialized term of epistemic appraisal, with a role, perhaps, in identifying informants or reliable sources of testimony" (Hookway 2003, 201).

¹⁴ Bolzano defines doubt in terms of degrees of probability of confidence, and confidence as indicating either immediacy of judgment or the truth-probability of a conclusive proposition [q] in relation to a set of premises.

¹⁵ An exception might be seen in what Bolzano calls the "unconditional substance", God. Epistemically, the unconditional substance has the advantage of unlimited storing capacities for propositions and is not subject to time and urgency constraints. The unconditional substance is the ideal rational agent in that it not only knows all truths immediately, but also has the ability of indicating their grounds in ideally desirable completeness. The question is whether the notion of an unconditional substance is a coherent one.

¹⁶ For details on these relations see Sebestik 1992, 1999; Siebel 1996; Tatzel 2002.

¹⁷ "How observant I am will influence whether relevant evidence grabs my attention; and how intellectually honest I am will influence whether I generally come to doubt propositions once presented with sufficient counter-evidence to them. [...] If we possess virtue, and we are confident that we possess virtue, the fact that various reflective questions are not raised can be seen as a symptom of our rationality rather than as a sign of our reluctance to do what epistemic responsibility requires" (Hookway 2003, 200f).

¹⁸ Lehrer 2001, 1997 (see chapters 1, 3, 6).

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