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Le problème de l'incommensurabilité, un demi-siècle après

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# Incommensurability and Dynamic Conceptual Structures

*Hanne Andersen*

University of Copenhagen

**Résumé :** Un problème important à propos de l'incommensurabilité est d'expliquer comment des théories qui sont incommensurables peuvent néanmoins entrer en compétition. Dans cet article, on examine brièvement le compte rendu kuhnien de la différence entre transitions conceptuelles révolutionnaires et non révolutionnaires. On argue que l'approche taxonomique kuhnienne et le principe de non-recouvrement qui le sous-tend ne suffisent pas à distinguer entre ces deux types de transition. On montre que cette approche s'appuie principalement sur des analyses de corrélations entre traits, alors qu'il est nécessaire de prendre de plus en considération les explications en vigueur de ces corrélations entre traits. Ceci met l'accent sur les théories, un élément qui n'a joué qu'un rôle modeste dans le travail que Kuhn a consacré aux lexiques scientifiques des années 1980 au début des années 1990. On argue que sur la base de ce compte rendu élargi des structures conceptuelles, l'incommensurabilité correspond à des corrélations qui d'un côté portent sur des traits présentant des recouvrements et de l'autre sont subsumées sous des explications différentes.

**Abstract:** One important problem concerning incommensurability is to explain how theories that are incommensurable can nevertheless compete. In this paper I shall briefly review Kuhn's account of the difference between revolutionary and non-revolutionary conceptual developments. I shall argue that his taxonomic approach and the no-overlap principle it entails does not suffice to distinguish between revolutionary and non-revolutionary developments. I shall show that his approach builds mainly on analyses of feature correlations, and that it is necessary to include explanations of these feature correlations as well. This puts emphasis on theories; an element which has played only

a humble role in Kuhn's work on scientific lexicons from the 1980s and early 1990s. I shall argue that on the basis of this extended account of conceptual structures, incommensurability can be understood as overlapping feature correlations that are covered by different explanations.

## 1. Incommensurability: the main challenge and the standard replies

When Kuhn in *The Structure of Scientific Revolution* claimed that “the normal-scientific tradition that emerges from a scientific revolution is not only incompatible, but often actually incommensurable with that which has gone before”, he ignited a series of debates about scientific change, theory choice, and the status of scientific entities. One of the main challenges of the incommensurability thesis has been to explain how theories that are incommensurable can nevertheless compete. As Shapere formulated the challenge in one of the first reviews of *The Structure of Scientific Revolutions*: “if they disagree as to what the facts are, and even as to the real problems to be faced and the standards which a successful theory must meet — then what are the two paradigms disagreeing about? And why does one win?” [Shapere 1964, 391].

This is a serious challenge that has shown very difficult to handle. Even Kuhn have let himself confuse by the issue when at the beginning of the 1990s he claimed that new subspecialties and the specialty from which they emerged were also incommensurable ([Kuhn 1992, 19f/120]; the second pages mentioned in the references of Kuhn correspond to [Kuhn 2000]). Ironically, this hits the core of Shapere's old, but still unanswered question: how to make sense of the idea that incommensurable theories are actually competing. Intuitively, one would say that the fact that there is no or only little communication between different subspecialties — like solid state physics and neural nets research — reflects only that they address ‘something different’, that they are not ‘about the same thing’. But for such theories as the oxygen theory and phlogiston theory one would indeed say that they are ‘about the same thing’ and that they therefore compete on offering the better account of their common domain — even though it has remained an open question what should be understood by ‘common domain’.

In the discussions about how to understand the common domain of incommensurable theories, realists have tried to meet the challenge inherent in Shapere's question by claiming that later theories are better descriptions of the same entities that earlier theories referred to, and that the common domain can be established through this referential stability

[Putnam 1975a]. On the opposite side, non-realists have argued that although object-domains cannot be understood in any theory-neutral way, incommensurable theories do in some sense share object domain. None of these attempts to meet the challenge seem to pay due respect to the incommensurability thesis insights. The realist approach seem to discard the historical observation inherent in the incommensurability thesis that, occasionally, scientific terms *do* change reference. However, if realists start allowing referential change, they seem to be slowly sliding away from their unchangeable natural kinds populating the world. On the other side, when non-realists call for a shared object domain they seem to be slowly sliding in the direction of fixed world populated by unchangeable natural kinds. Apparently, both realists and non-realists seem to be sliding away from their original position towards that of their opponent, but none of them providing a satisfactory solution to Shapere's question.

However, a different approach to the problem of incommensurability has been taken by [Shapere 1989], [Shapere 2001] and later adopted by cognitively inclined scholars, such as [Nersessian 1984], [Nersessian 2001]. Shapere has argued that the problem of incommensurability has often been seen as the problem of how to compare individual concepts from two theories, in isolation from all other considerations. However, on his view, the interesting issue is not that of such side-by-side comparisons, but that of "tracing the reasons for adoption of successive alterations which result in the appearance of radical, 'incommensurable' change" [Shapere 2001, 199]. Such an approach makes it possible both to recognize the depth of the change and to explain how it has taken place.

This approach has been developed further by Nersessian in her studies of the micro-processes of conceptual change seen as a problem-solving process. On her view, conceptual changes — such as the disappearance or creation of concepts, or the absorption of significant aspects of apparently eliminated concepts into other concepts — are continuous but not simply cumulative [Nersessian 1984], [Nersessian 2001].

The chain-of-reasoning connections may thus explain continuity and the possibility of comparison, but this calls for an analysis of possible differences between revolutionary and non-revolutionary change. In this paper I shall briefly review Kuhn's account of the difference between revolutionary and non-revolutionary conceptual developments. I shall argue that his taxonomic approach and the no-overlap principle it entails does not suffice to distinguish between revolutionary and non-revolutionary developments. I shall show that his approach builds mainly on analyses of feature correlations, and that it is necessary to include explanations

of these feature correlations as well. This puts emphasis on theories; an element which has played only a humble role in Kuhn's work on scientific lexicons from the 1980s and early 1990s. I shall argue that on the basis of this extended account of conceptual structures, incommensurability can be understood as overlapping feature correlations that are covered by different causal explanations.

## 2. Kuhn's account of conceptual hierarchies

In *The Structure of Scientific Revolutions* incommensurability was characterised broadly as a difference in the set of problems and standards for problem solutions, in ontological commitments, and in meaning. However, Kuhn later focussed explicitly on concepts and conceptual structures in defining incommensurability. In his writings from the 1980s, Kuhn identified revolutionary developments with those that demand a *restructuring* of the conceptual structures, in contrast to developments that imply only *additions or refinements* to an existing structure. This distinction was based on the view of a conceptual structure as a multidimensional network in which concepts are tied together or distanced from each other by the criteria that can be used to identify referents of the terms in question. On this view, incommensurability is the result of developments that change the constitutive linkages between concepts, whereas conceptual refinements or other developments that preserve the overall structure do not imply incommensurability [Kuhn 1983aa, 683/52].

In discussing incommensurability, Kuhn's main focus from the 1980s and onwards was on taxonomic terms, or kind terms, that is, terms "which refer to the objects and situations into which a language takes the world to be divided" [Kuhn 1990b, 4]. The taxonomic conceptual structures was seen as 'categorisation modules' [Kuhn 1990b, 5] in which "certain sorts of expectation about the world are embedded" [Kuhn 1990b, 8]. On this view, incommensurability denotes the relation that "some of the things which can be conceived and described using one [lexicon] can't even be imagined with the other. They require a different lexicon which would in turn render unimaginable some of the things permitted by the first" [Kuhn 1990b, 9].

This barrier to certain kinds of ontological enrichments is deeply embedded in Kuhn's theory of concepts. One of the major premises for this theory is a mutual dependence between concepts and objects which Kuhn expressed through the rhetorical question "Does it obviously make better sense to speak of accommodating language to the

world than of accommodating the world to language. Or is the way of talking which creates that distinction itself illusory? Is what we refer to as ‘the world’ perhaps a product of a mutual accommodation between experience and language?” [Kuhn 1979, 418/207]. However, Kuhn’s ontological viewpoint may be difficult to extract from his writings which suffer from a tension between two different meanings of key terms such as ‘world’ in passages like “though the world does not change with a change of paradigm, the scientist afterward works in a different world” [Kuhn 1970a, 121]. To resolve this tension, [Hoyningen-Huene 1989] has suggested a reconstruction in which two concepts of ‘the world’ have to be distinguished: the *world-in-itself* which is a “hypothetical fixed nature” [Kuhn 1970a, 118], [Hoyningen-Huene 1989, chapter 2.1], and the *phenomenal world* which is a “perceived world” [Kuhn 1970a, 128], that is, “a world already perceptually and conceptually subdivided in a certain way” [Kuhn 1970a, 129]. The subdivision is not read off from the world itself, but is a structure which is imposed on the world by means of the concepts applied to it. On this point Kuhn rejects the realist idea that ‘the world can be cut at its joints’. Instead, different conceptual structures may constitute different ontologies.

The conceptual structure is established by relations of similarity and dissimilarity between perceived objects. In accounting for the constitution of the phenomenal world through relations of similarity and dissimilarity, Kuhn ascribes a special importance to dissimilarity, that is, the features which differentiate between instances of *contrasting* concepts. It is important to note that in including dissimilarity in the account, his interest is not in dissimilarity between members of any pair of arbitrary categories. Instead, what is of interest is the relation of dissimilarity that holds between *members of categories which can be mistaken for one another*. Such instances of categories that can be mistaken for one another must be more similar to one another than to instances of other concepts. Hence, these categories again form a family resemblance class at the superordinate level. Or, if seen from the other direction, this superordinate can be exhaustively decomposed into the set of non-overlapping categories formed by the contrast set. On this analysis, family resemblance concepts form hierarchical structures in which a general concept decomposes into more specific concepts that may again decompose into yet more specific concepts, and so forth — in other words, taxonomies<sup>30</sup>.

On this taxonomic view, the decomposition of a superordinate concept into a group of contrasting concepts is determined by sets of fea-

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<sup>30</sup>For a full a detailed analysis of Kuhn’s family resemblance account of concepts, see e.g. [Andersen 2000].

tures. Thus, as emphasised by Kuhn, “to each node in a taxonomic tree is attached a name (...) and a set of features useful for *distinguishing* among creatures at the next level down. (...) Attached features are not shared by named creatures. They function as *differentiae* for the next level down” [Kuhn 1990b, 5] (emphasis in the original).

The emphasis on contrast sets and the features that differentiate between the individual categories in the set may seem as if Kuhn is taking recourse to definitions *per genus et differentiam*. However, this is not the case; the subdivision of a superordinate into a set of contrasting concepts is not defined by particular *differentiae specificaе*, but by patterns of dissimilarity that may be overlapping and criss-crossing, and which may differ for different speakers. This is in consonance with a point which Kuhn has noted throughout his writings on conceptual structures, namely that there are no restrictions on *which* characteristics that may be used to judge objects similar or dissimilar. For Kuhn, there is no distinction between defining and contingent features. By the same token, different people may draw on different features when identifying instances of a category, as long as they successfully ascribe any given instance to the same category<sup>31</sup>.

One may also note that this view was developed in an effort to reject the traditional realist position that the world can be cut at its joints. In consonance with that, features should not be interpreted in a simple realist way either. Features may come into existence as the result of our interaction with the world, for example by the introduction of a new instrument that reacts in different ways in different situations ([Andersen 2000, 321]; similar views can be found in [Lakoff 1987] and [Buchwald 1992]).

### 3. Vindication from cognitive psychology

Similar views of concepts as based on a network of similarities and dissimilarities have also been developed by cognitive psychologists, most

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<sup>31</sup>It is important to note that Kuhn's point here is very different from the division of linguistic labor introduced by [Putnam 1975a]. Putnam argues that “the features that are generally thought to be present in connection with a general name (...) are all present in the linguistic community *considered as a collective body*; but that collective body divides the ‘labor’ of knowing and employing these various parts of the ‘meaning’ of ‘gold’” [Putnam 1975a, 228]. On that view, for a person to use the concept ‘gold’, he or she does not need acquire the method of recognizing if something is or is not gold. On Kuhn's view, on the contrary, different speakers may draw on different features in recognizing if something is gold, but it is a prerequisite for being a member of the relevant language community that gold is recognized correctly as judged by the rest of the community. I shall return to this issue in section 6 below.

notably Eleanor Rosch and her collaborators. Beginning in the 1970s they made a series of studies of how individuals from different cultures and in different situations group objects into categories [Heider 1972], [Rosch 1973a], [Rosch 1973b], [Rosch & Mervis 1975], [Rosch *et al.* 1976]. They found that individuals classify objects not only as members of particular categories but also as better or worse examples of the category. This variation in the goodness of example became known as “graded structures” of concepts. The existence of graded structures showed that classification was not a matter of sharing a list of defining features, since on such a view all concepts falling under a concept would do so in virtue of sharing the same list of features and would therefore have to be equal as instances of the concept. Based on empirical explorations of the hypothesis that the members of categories which are considered most typical are those that share the most features with other members, Rosch and her collaborators concluded that family resemblance offers an alternative to criterial features in defining categories. By the mid-1980s, the replacement of the classical account of concepts in terms of definition with a family resemblance account was referred to as “the Roschian revolution” [Neisser 1987, vii]<sup>32</sup>.

On Rosch’ view, family resemblance is a matter of overlapping attributes that reflect “the correlational structure of the environment in a manner which renders them maximally discriminable from each other” [Rosch & Mervis 1975, 575]. Thus, “combinations of attributes of real objects do not occur uniformly. Some pairs, triples, or  $n$ -tuples are quite probable, appearing in combination sometimes with one, sometimes another attribute; others are rare; others logically cannot or empirically do not occur [Rosch *et al.* 1976, 383]. Further, just like Kuhn emphasized the role of dissimilarity and contrast sets, Rosch also stressed that concepts “do not occur in isolation. Any time one places an item into one category one is simultaneously not placing it into other contrasting categories” [Rosch 1987, 157].

Kuhn’s favorite example of concepts based on similarities and dissimilarities between instances were the categories ‘duck’, ‘goose’ and ‘swan’. This contrast set forms part of a taxonomy in which the category ‘bird’ is attached to a set of features that can be used to distinguish among its subordinate categories ‘waterfowl’ and ‘songbird’. Among

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<sup>32</sup>Although the replacement of the classical account with a family resemblance account was widely accepted, its detailed structure is still a matter for debate. Thus, a variety of different accounts have been introduced that generate phenomena like graded structures in different ways. For detailed accounts of the development, see e.g. [Lakoff 1987], [Barsalou 1992], [Margolis & Laurence 1999].



these distinguishing features are, for example webbed/unwebbed feet, rounded/pointed beak, etc. To the category ‘waterfowl’ is attached a new set of features that can be used to distinguish among the subordinate categories ‘duck’, ‘goose’ and ‘swan’. Among these distinguishing features are

Fragment of a lexicon for physical things

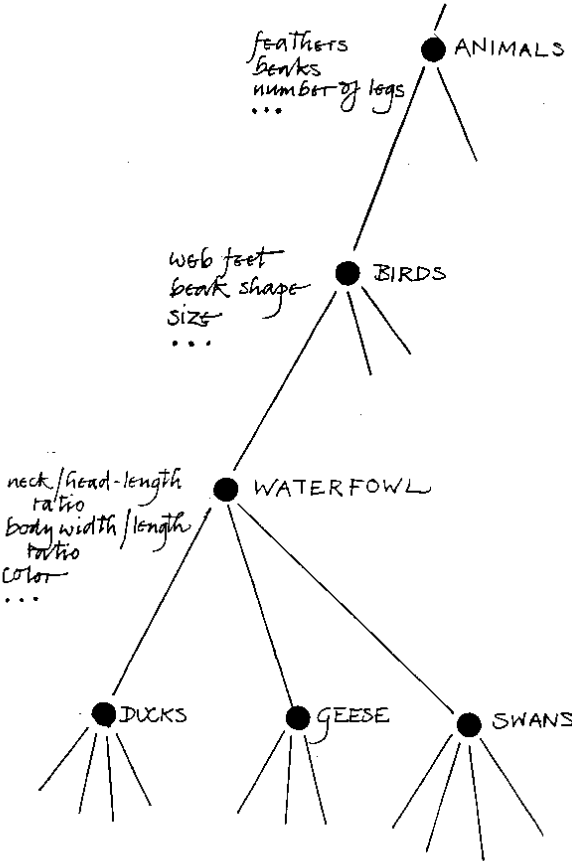


Figure 1: Partial taxonomy covering waterfowl. From [Kuhn 1990b]. Reproduced with permission from the MIT Institute Archives and Special Collections.

When distinguishing between ducks, geese and swans some speakers may use the combination of the two features neck/head-length ratio and body width/length ratio, while others use the combination of the two features colour and neck/head-length ratio. Each of these sets of features are jointly sufficient to identify instances of the contrasting concepts, but none of the features are individually necessary.

In discussing taxonomic structures constituted through relations of similarity and dissimilarity between instances, Kuhn never went beyond simple examples like that of waterfowl. Based on these examples he claimed that “the same technique, if in a less pure form, is essential to the more abstract sciences as well” [Kuhn 1974, 313]. For example, bacteria and vira form part of a taxonomy in which the category infectious agents is attached to a set of features that can be used to distinguish among its subordinate categories (figure 2)<sup>33</sup>:

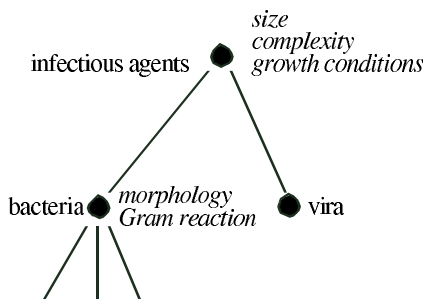


Figure 2: Partial taxonomy covering infectious agents.

One may note that in the analysis of taxonomies, the various features are not all equal. Instead, some features are values of others. For example, the feature ‘feet’ is an attribute of birds that can take the value ‘webbed’ or ‘unwebbed’. Thus, it is differences in values that distinguish between contrasting categories, but all are values of the same attribute. As argued by [Barker, Chen & Andersen 2003] this kind of taxonomy is easily represented by means of frames. Figure 3 is a partial frame representation of ‘bird’.

<sup>33</sup>For detailed analysis of scientific examples, see [Barker’s 2001] analysis of the Copernical revolution or [Andersen & Nersessian 2000]’s analysis of electrostatics.

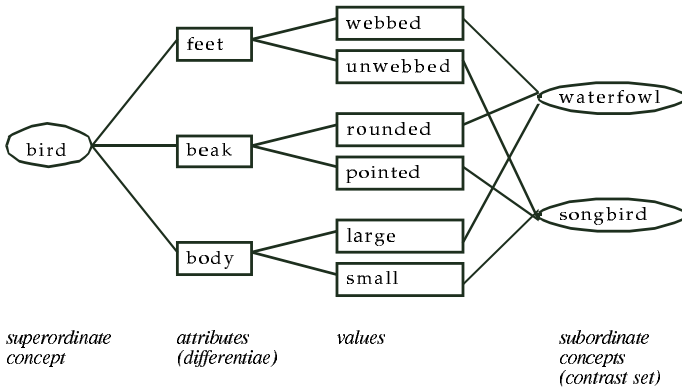


Figure 3: Partial frame of 'bird'

Further, one may note that although Kuhn stressed that features function as differentiae, they serve this function because they are shared by instances of contrasting concept on the next level down. Both Kuhn's and Rosch' views are therefore based on the idea that instances of a category in a contrast set share a bundle features that at the same time distinguishes them from instances of other categories.

The frame representation shows how all instances of the concepts in a contrast set share some features, and how these common features are related to the features that can be used to differentiate between them. In the above frame representation of the concept 'bird', all exemplars of 'bird' share the attributes 'feet', 'beak' and 'body', but the values of these attributes vary between the subordinate categories 'waterfowl' and 'songbird'. However, the distinction between attributes and values is not to be understood as a distinction between features that are different in kind as such, but as a distinction that shows how features of a given concept are related to each other with respect to this particular concept and taxonomy of which it forms part. Thus, while the concept 'bird' has the attribute 'beak' whose different values can be used to distinguish between various subordinates, the concept 'animal' has the attribute 'mouth parts' which can have different values such as 'beak' or 'lips'.

#### 4. Correlations and anomalies

Obviously, Kuhn's claim that the similarity and dissimilarity relations may be based on different features presupposes an empirical correlation between all features in the bundle attached to a given category. As only some of those co-occurring features are necessary to use a given concept

correctly, adding further features will say something not just about how to pick out instances of the concept, but also something about how an object already picked out will behave. The conjunction of all features can therefore be seen as a hypothesis about the behavior of the instances of the corresponding concept. In this way conceptual structure is linked to projectibility. For a concept to be projectible, the expectation must exist that the total set of features that are involved in the relations of similarity and dissimilarity involve more features than needed to pick out instances of the concept, and that the classifications which the different sets of jointly sufficient features give rise to must be co-extensive<sup>34</sup>.

It is a key premise of Kuhn's position that the claim whether this correlation between features holds has an important objective component. Although the features may be the result of our interaction with the world, once they have been posited, they cannot be correlated arbitrarily. The world will show if an alleged correlation does not hold, since in that case instances that violate the correlation will eventually be discovered<sup>35</sup>. Hence, although a conceptual structure has proved to be a fully consistent division of the object domain for all previously known objects, a new object may still reveal it as inconsistent.

Claiming that the question whether the bundle of features attached to a given category is actually correlated has an objective component, Kuhn introduces a resistance against giving arbitrary structures to the phenomenal world. If one tries to impose arbitrary structures to the phenomenal world, situations will appear in which it becomes clear that objects do not behave or situations do not develop as prescribed by the current conceptual structure. As Kuhn expresses his view: "nature cannot be forced into an arbitrary set of conceptual boxes. On the contrary (...) the history of the developed sciences shows that nature will not indefinitely be confined in any set which scientists have constructed so far" [Kuhn 1970b, 263]. Similar views are expressed by cognitive psychologists who also emphasize that "the environment places constraints on

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<sup>34</sup> Again, the lack of distinction between defining and contingent features is crucial since that dissolves any clear distinction between the knowledge of which objects exists and the knowledge of how they behave. See also [Hoyningen-Huene 1989, chapter 3.7].

<sup>35</sup> Kuhn ended up ascribing this objective component to the world-in-itself. Admittedly, he first tried to avoid the use of Kantian things-in-themselves [Kuhn 1979, 418f./207], but later changed his mind: "Underlying all these processes of differentiation and change, there must, of course, be something permanent, fixed, and stable. But, like Kant's *Ding-an-sich*, it is ineffable, undescribable, undiscussible. Located outside of space and time, this Kantian source of stability is the *whole* from which have been fabricated both creatures and their niches" [Kuhn 1990c, 12/104] (italics added).

categorisations. Human knowledge cannot provide correlational structure where there is none.” [Rosch *et al.* 1976, 430].

This claim that there is some kind of resistance against giving *arbitrary* structures to the phenomenal world does not rule out that features can be correlated in different ways. Instead, different sets of similarity and dissimilarity relations may assume correlations between different sets of features which carve different joints in the phenomenal world. Thus, one may note that the claim is a purely negative claim that not any arbitrary bundling of features is possible; it is not a positive claim about the existence of a privileged set of features bundles constituting the world’s real joints. The claim is therefore far from a traditional realist position [Andersen 2001].

Since the conceptual structure is constituted by the relations of similarity and dissimilarity and the bundles of features that result from these, an object which challenges the decomposition of the superordinate into a contrast set of non-overlapping subordinates will call this structure into question. This is what Kuhn introduced as the *no-overlap principle*:

no two kind terms, not two terms with the kind label, may overlap in their referents unless they are related as species to genus. There are no dogs that are also cats, no gold rings that are also silver rings, and so on, that’s what makes dogs, cats, silver, and gold each a kind. Therefore, if the members of a language community encounter a dog that’s also a cat (or, more realistically, a creature like the duck-billed platypus), they cannot just enrich the set of category terms but must instead redesign a part of the taxonomy [Kuhn 1990b, 4/92].

According to this principle, a conceptual structure is challenged if an object is discovered that on the basis of different differentiating features can be ascribed to different contrasting categories, since it then reveals that the bundlings of features implied in the contrast set was not projectible.

However, a set of differentiating features may generate a large field of potential feature bundles and associated concepts in the form of all possible combinations of the features. Of these potential feature correlations only some will be found empirically. The question is whether the discovery of an instance with a previously unseen combination of features within this conceptual field is therefore ruled out? Or if only some of the yet unseen combinations are ruled out, while others can be discovered without calling for changes in the conceptual structure. We may have discovered that birds living in water have webbed feet and that

big waterfowl with long necks are white, but does that suggest that it is as severe to discover the first black swan as it would be to discover a bird that lives in water but which has unwebbed feet? There seems to be a need for a distinction between possible but yet undiscovered correlations and impossible correlations.

## 5. Explanations

A possible distinction of this sort may be based on the existence of *explanations* of the correlations. As a reaction to the family resemblance account of concepts developed by Rosch and her collaborators, critics have argued that if the categories should divide the world simply on the basis of features appearing together in bundles, “there are so many possible correlations that it is not clear how the correct ones get picked out” [Murphy & Medin 1985/1999, 430]. As a solution to this problem Murphy and Medin pointed out that people tend to deduce *reasons* for feature correlations, claiming that “feature correlations are partly supplied by people’s theories and that the causal mechanism contained in theories are the means by which correlational structure is represented” [Murphy & Medin 1985/1999, 431].

This view offers a distinction between theoretically possible and theoretically impossible correlations based on whether they can be covered by the currently accepted explanations. Thus, the discovery of an instance with a previously unseen combination of features that can either be explained or at least does not violate currently accepted explanations of feature correlations may lead to the introduction of a new category as a mere refinement of the conceptual structure. On the contrary, combinations of features that violates accepted explanations of feature correlations constitute such anomalies that they call conceptual structure into question. For example, given a theory involving evolutionary explanations of the correlation between birds having webbed feet and living in water, the discovery of a bird with unwebbed feet living in water will be a severe anomaly. In contrast, without explicit explanations of the correlation of colour and e.g. neck length, the discovery of a black swan may be surprising, given that all previous examined exemplars have been white, but the new subcategory may be added to the taxonomy unproblematically. Or, to take more recent scientific examples, while the discovery of new bacteria or vira with e.g. variant morphological features may lead to the unproblematic addition of a new concept subordinate to ‘infectious agent’, the discovery of an agent that can transmit disease, but which shows features usually associated with proteins rather than

features associated with nucleic acid is very anomalous indeed. Again, the difference may be found in the existence of explanations of feature correlations, such as the central dogma of molecular biology that links replication with nucleic acid<sup>36</sup>.

This account may also help explaining why anomalies are not all equally severe. It is a well-known aspect of family resemblance accounts of concepts that different instances of a particular concept may vary in how good an example of the concept they are. Thus, some instances may be better examples than others by being more similar to each other or more clearly dissimilar to instances of contrasting concepts. This variation in the status of instances is called a concept's graded structure. These differences in goodness-of-exemplar may affect whether an anomalous object questions the conceptual structure. Thus, if an object is encountered that judged from different features is a *good* example of two contrasting concepts it clearly questions the adequacy of the conceptual structure. On the other hand, if an object is encountered that judged from different features is a *poor* example of two contrasting concepts it may not call the conceptual structure in question as such. Instead, it may just suggest that further research may be necessary to find out whether a new category exists, or if the existing categories may show some additional features that allows the objects to be unequivocally assigned to one of them. In the former case, the object is a severe anomaly, in the latter case it is not.

Often the theories that has been elaborated to explain the feature correlations inherent in the conceptual structure will also determine which features are considered central [Ahn 1998], and by the same token which instances of the concept are judged as good and poor examples according to their possession of central features. The severeness of an anomaly — and thereby the triggering of conceptual change — is therefore closely linked to the theory explaining feature correlations<sup>37</sup>.

## 6. A dynamic perspective

When an anomaly has questioned whether the purported correlations of features are actually projectible, conceptual structure must be changed. However, an anomaly only shows that a particular bundling of features is not projectible, it does not determine how they should be bundled instead. The requirement in examining alternatives is that in the new

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<sup>36</sup>A detailed study of this case lies outside the scope of this paper; for further details see e.g. [Keyes 1999a], [Keyes 1999b], [Poulsen & Andersen 2004].

<sup>37</sup>For a historical illustration of this point, see [Andersen, forthcoming].

conceptual structure the anomalous object will be ascribed to only one of the contrasting concepts. Such a change implies changes in the relations of similarity and dissimilarity and hence changes both of the bundlings of features and of the causal explanation of the feature correlations, where the guideline is that projectibility must be re-established by bundling the features such that the new combinations of features can be seen as hypotheses with some positive, but no negative cases. Hence, the conceptual structure will be changed to provide a new division which is consistent for the new, enlarged group of known objects. On this view, conceptual structures are clearly *dynamic* entities which under certain circumstances may be subjected to change.

This dynamic perspective is essential in analysing conceptual structures. On this perspective, a conceptual structure is always given in some form by the preceding generation which passes it on to the next. This was clearly emphasised by Kuhn, when he pointed out that novices always

find the world already in place. (...) Creatures born into it must take it as they find it. They can, of course, interact with it, altering both it and themselves in the process, and the populated world thus altered is the one that will be found in place by the generation which follows [Kuhn 1991, 10].

Hence, the important issue is not the synchronous constitution of a conceptual structure, but the process in which it can be transmitted over time. The analysis of correlations between features and explanations of the correlations should therefore not be read as an analysis of how a conceptual structure may be established from scratch, invoking the question of whether correlations or explanations are primary. On a dynamic perspective, the question of primacy vanishes since some correlations and explanations are always given from the historical setting, even if only in a primitive form. In the historical process they may from there again be transformed into other correlations and other explanations<sup>38</sup>.

## 7. Incommensurability and overlapping phenomenal worlds

It is possible to imagine several different changes of the bundling of features which all have some positive, but no negative cases. If these

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<sup>38</sup>For an elaborate version of this argument, see [Andersen 2000], [Andersen 2001]. A simple historical example of such a historical development of a simple conceptual structure can be found in [Andersen 2002].



different bundlings overlap, that is, share some but not all features in the bundle, then they can be seen as incompatible hypotheses, which are nevertheless all projectible. As the different bundlings carve different joints in the phenomenal worlds to which they give rise, although they are all projectible, they are projectible in different phenomenal worlds.

Given Kuhn's theory of the constitution of phenomenal worlds and their joints, *identical* phenomenal worlds are those which are carved into the same joints, that is, phenomenal worlds which share ontology. For phenomenal worlds to be carved into the same joints presupposes shared conceptual structure, and that again presupposes shared relations of similarity and dissimilarity. However, as argued above, the similarity and dissimilarity relations constitutive of the conceptual structure need not be attached by means of the same features by all speakers. Hence, it is shared structure, not shared features, that yields shared ontology. The only requirement is that in so far as features are not shared, it is expected that they are all compatible and covered by the same causal explanation of the correlations.

Hence, in so far as the features for a given set of contrasting concepts are not shared, it is expected that they can in principle all be bundled, that is, that all the different sets of jointly sufficient features used by different members of the language community are empirically correlated and included in the same causal explanations of the correlation. Only in this case will members of the language community who use different features to distinguish instances of a set of contrasting concepts categorize these instances in the same way.

But these phenomenal worlds do not differ in any arbitrary sense. They are not unrelated. The important point is that the different bundles are incompatible due to the shared features. Because of the underlying causal explanations of the bundling, the one bundle cannot simply be extended by the remaining features of the overlapping bundle. These are the features ruled out by the causal explanation of the bundling. That means that the feature bundles give rise to different phenomenal worlds that are also mutually exclusive. If you adopt one, you simultaneously reject the others. Hence, while it is shared structure and not shared features that yields shared ontology, when structure is no longer shared, it is shared features that provides the overlap between different phenomenal world necessary for them to compete in offering the better account of the world in the form of more successful or more promising bundlings.