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Abstract patterns and representation: the re-cognition of geometric ornament

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Citation

Crucq, A. K. C. (2018, May 17). *Abstract patterns and representation: the re-cognition of geometric ornament*. Retrieved from <https://hdl.handle.net/1887/62348>

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Issue Date: 2018-05-17

3. The competence of representation

3.1. Introduction

Besides number and geometry that allow humans to recognize and make the formal properties of geometric decorative patterns there must be another constituent allowing humans to recognize those geometric decorative patterns as representations. That constituent concerns the competence to make the necessary inference enabling a subject to consider one as referring to, or standing in the place of, another.

As stated in the general introduction I do not regard abstract motifs such as geometrical motifs as non-representational by definition. The difference between representational and non-representational is not the same as the difference between abstract and non-abstract. In other words, any type of visual shape has the potential to refer to, or represent, but the ways *in which* a visual shape refers to, or represents, depends on the shape's formal properties. In this chapter I will show that just like stylized and naturalistic motifs, abstract motifs are representational but in a special way. It will become clear that the nature of abstract motifs is exemplary for showing how the formal properties of motifs and patterns affect the extent to, and the ways in which, shapes and patterns can be representational. Using semiotics I will distinguish four kinds of signs that are connected in different ways to what an artefact can refer to, or make present something else: the icon, the index, the symbol and the exemplification.

I will then proceed by describing in a logical, deductive way the cognitive competence implied by the recognition and making of geometric decorative patterns. Once arrived at this description, which must take into account this third constituent, I want to return to the discussion in Chapter 2 on the extent to which present day cognitive psychology and neuroscience provide empirical evidence in support of the existence of a competence that may be regarded as a competence to represent, or whether, in addition, another body of knowledge is needed. A body of knowledge that can show how and on what ground humans make the inference that something refers to, or stands for something else, and how humans accomplish that in particular contexts such as when humans recognize and make geometric patterns applied as

ornament. First, I want to recapitulate the definition of representation as provided in the general introduction to outline the theoretical framework from which I will describe how geometric decorative patterns are endowed with and function as representations.

3.2. Definition of representation

There is no general agreement across the humanities and social sciences on what the concept of ‘representation’ means and this is an issue to be dealt with when carrying out the interdisciplinary research needed to describe the cognitive competences that allow the recognition and making of geometric patterns as representational. Art historians have different ideas about the concept of representation than cognitive scientists. In the use of the term within the context of art and artefacts, representational often denotes those images and artefacts that depict ‘natural’ objects and bodies, for instance, in the form of landscapes or portraits. The viewer recognizes these depictions as those of bodies and objects because they resemble a number of essential formal properties of these objects and bodies, for example, their form and colour. By using this means of depicting, nature is imitated.¹ Used within the context of ornament this definition would dictate only naturalistic motifs are representational in the true sense.

In his argument about the origin of art, John Onians distinguishes the prehistoric patterns and forms that were the result of engraving and shaping, from the prehistoric linear depictions that mimicked the shapes of natural objects and bodies, which he refers to as representational art. Because Onians argues that the latter form of art is based on the foundations of the first, his main question concerns how and why this transition from patterns to so-called representational art took place.² Perhaps the answer to that question is that the engraved patterns have always already functioned as representational and as such could have formed the foundation for other ways of representing. When the imitations of the forms of bodies and objects from the natural world became more advanced their use was probably more economical in some contexts, given the relative ease with which, on the basis of their formal resemblance

¹ Glare 1982, p. 1621.

² Onians 2006, pp. 412–113.

with natural bodies and objects, they could be interpreted *as* their representations. However, that does not mean abstract shapes and patterns are non-representational.

Therefore a definition of representation is needed that captures the broad use in which images function as such and this can be found in the quite literal meaning of ‘representation’ as denoting the power to make immediately present again, in other words the effect of bringing something, which might have occurred in the past or which is about to happen, *to* the present.³ From the perspective of representation in the sense of making present, representation by means of resemblance and imitation should be considered as one of many possible visual means applicable to make something manifest and to make something present to the mind.⁴

In classical rhetoric the act of bringing something to the mind by means of visualization draws the intention towards the visualized and therefore Quintilian regarded visualization as a means of embellishment. It is from this rhetorical context the function of ornament, including geometric decorative patterns, should be considered as a visual means to draw intention to itself, which, as I will argue throughout this chapter, also endows ornament with the potential to draw attention to, i.e. refer to and make present something else.⁵

Representation thus appears to denote the act of making something clearly (visually) present (again) with a degree of immediacy and does not necessarily concern the specific ways in which this can be accomplished. Representation just requires something that represents and something that is represented. That something which represents is referred to as a sign; signs make present when they stand for, in the place of, a person, a thing, a group of persons, or a group of things. Cultural artefacts, such as visual patterns can be signs and as such refer to something else. By means of that reference they make that something present. The ways in which signs can do this has been the subject of study of the field of semiotics and it is this field to which I will turn in order to distinguish those different ways. This will enable determination of whether and how geometric decorative patterns function as signs.

³ Walde & Hofmann 1954, p. 355.

⁴ Glare 1982, p. 1621.

⁵ Quintilian, *Institutio oratoria*, VIII.3.61.

3.3. Definition of a sign

The theory of signs by Charles Sanders Peirce, with its distinction of three different kinds of signs is still valid and relevant, and will help to understand under what conditions geometric patterns are representational. According to Peirce's definition, a sign is always connected to its object and its interpretant. It is therefore necessary to define these terms first. Simply said, the object is that which the sign refers to.⁶ With object Peirce means anything that humans can talk about. Object is thus not limited to concrete objects in the world but includes ideas and fictitious objects and persons as well.⁷ With 'interpretant', derived from the scholastic Latin 'interpretans', not from the English 'interpreter', Peirce means the effect that is the mental apprehension, cognition, and recognition, the sign will cause in the interpreter.⁸

According to Peirce's definition, literally anything has the potential to become a sign. Something becomes a sign when that something is related to both an actual object from the world, (which as already noted can be concrete objects, as well as ideas etc.) and to an interpretant, i.e. the effect produced in a subject, in such a way that the resulting cognition (interpretant) stands in the same triadic relation to the object, as the

⁶ 'Object' (pub. 12.08.13–19:49). Quote in M. Bergman & S. Paavola (Eds.), *The commens dictionary: Peirce's terms in his own words*. New edition. Retrieved from:

<http://www.commens.org/dictionary/entry/quote-chapter-ii-categories-2>. Peirce distinguished two kinds of objects: the dynamic object is the object outside the sign that structures the sign such that the sign becomes the way it is; the immediate object then, is the object such as it implies the dynamic object within the sign, i.e. it is the object such as it is represented within the sign. A sign can never directly grasp a dynamic object such as the object naturally is but only by means of representation can a sign indicate the object. It is up to the experience of the interpreter how the sign will be identified. In his discussion of Peirce's semiotics linguist Tony Jappy gives a clear example of how cowboys, through their, experience are able to identify the presence of Indians from the identification of certain smoke rings. See Jappy 2013, pp. 4, 14–15. Peirce 1998, p. 498. Although these cowboys are perfectly able to distinguish these smoke rings from smoke indicating a forest fire, the Indians producing the smoke rings as a means of communication will likely identify the smoke rings very differently. In other words, the identification of the immediate object within the sign depends on previous experience with the dynamic object outside the sign.

⁷ 'Object' (pub. 12.08.13–19:58). Quote in M. Bergman & S. Paavola (Eds.), *The commens dictionary: Peirce's terms in his own words*. New edition. Retrieved from:

<http://www.commens.org/dictionary/entry/quote-reflections-real-and-unreal-objects-cp>.

⁸ Jappy, pp. 17–18. Peirce & Welby-Gregory 1977, p. 111. This term should be explicitly distinguished from the interpreter, the one experiencing the effect. In turn, Peirce distinguished three kinds of interpretants: immediate, dynamic and final. According to Peirce the immediate interpretant lies in the determination that each sign must be interpretable in the first place before it can reach an interpreter. The dynamic interpretant is the experience coming forth from the individual interpretation and differs from any of the others while the final interpretant concerns the effect the sign will have on each interpreter, that is, if the sign has been sufficiently considered.

sign which stands for it.⁹ I think this can be illustrated best by how traffic signs work. In the Netherlands, a round blue metal plate with a white bicycle will function as a traffic sign because, as a sign, it relates both to bicycles and to the idea of riding the bicycle (object) and has the effect (interpretant) that the subject (interpreter) knows she/he is allowed to ride the bike (object) beyond the signpost. This example also makes clear that something will only function as a sign once it is visible, in other words, once it has taken a concrete shape in a material sense.¹⁰ The preconditions for a sign to function are thus the existence of a world of objects and the existence of a subject who can make or recognize signs, and on whom a sign can have an effect. The notion that a sign has an effect on the subject presupposes a cognitive competence by means of which that effect can occur in the first place, namely the competence to recognize that something can refer to something else, whether it is an object, idea, situation, or event, which that something itself is not but which by means of referring to or standing for is able to make present.

⁹ Peirce 1940, pp. 99–100. See also Jappy p. 13. Peirce's definition literally reads: "A *Sign*, (...), is a First which stands in such a genuine triadic relation to a Second, called its *Object*, as to be capable of determining a Third, called its *Interpretant*, to assume the same triadic relation to its Object in which it stands itself to the same Object. The triadic relation is *genuine*, in that its three members are bound together by it in a way that does not consist in any complexus of dyadic relations." See further Lubbe & Zoest 1997, pp. 14–21. Peirce uses the concepts of a First, a Second and a Third in his definition and those are connected to three distinct categories. Peirce distinguishes Firstness as the category of the possible, of the potential, Secondness as the state of being of the actual, the real, the concrete, while Thirdness is the category of the necessary, of the conventional, that which is universally valid. The criterion on the basis of which to subsume a phenomenon under one of these categories is its relational status. Something that exists autonomously is a First. These include properties and essences (for instance redness, straightness etc.) that are independent of any concrete object and therefore have a potential, for instance, the potential to become a property or an essence of a concrete thing. This category therefore appeals to the possible. A phenomenon is a Second when there is a relation with something else. Peirce refers to a Second as dyadic. One could say it is the category in which properties are realized within concrete things. It is therefore the category of that which exists. When a Second is brought into relation with another Second a Third emerges when a new relation is added, which will make the relation triadic such as in Peirce's definition of the sign. A Third is a phenomenon, which has the status of universal validity within human experience of the world. Phenomena like laws, conventions and habits belong to the category of Thirdness. It should be clear Peirce's definition of a sign cannot be separated from the triadic relationship in which the sign functions, that between sign, object and interpretant. Peirce consequently relates these elements to the three categories of Firstness, Secondness and Thirdness as well. As part of the triadic relationship a sign is a First in the sense that as a sign it has the potency to refer to anything. The object, however, is a Second in the sense the object to which the sign refers is an actual concrete thing. The interpretant, or the effect the sign has on the interpreter should be regarded as a Third in the sense the interpretation is considered to be universally valid.

¹⁰ Lubbe & Zoest 1997, p. 16.

3.3.1. Modes of representation

Something can become a sign on the basis of a formal or material property, on the basis of a relation with a concrete object, living being, situation or event, or by means of convention.¹¹ The way a sign functions, i.e. the way it represents something it is not, is defined by Peirce as three ways of representation; in other words, there are three different conditions under which representation occurs. When there is a resemblance between the sign and the object denoted, Peirce refers to the sign as an icon; when the sign points to the object it denotes in the sense that there is a physical-spatial relationship between the sign and the object, the sign is referred to as an index; a symbol is a sign that denotes an object by virtue of convention.¹² Each will now be discussed briefly.

3.3.1.1. Icon

Peirce used the term icon for those signs that refer to the object they denote by means of one or more of the characteristics of the object. Anything can be an icon of anything when it is like the thing and when it is used as a sign of the thing.¹³ Cherub motifs do not exist as absolutely identical actual things in the real world. Still, the icon refers to the cherub by virtue of the specific formal and material properties defining the thing as

¹¹ Lubbe & Zoest 1997, pp. 19–20. Peirce also distinguishes three categories in order to make clear the criteria by means of which a sign is a sign. This categorization in itself relates to the categories of Firstness, Secondness and Thirdness. There are signs, which function on the basis of a certain quality and which Peirce refers to as qualisigns. Because these signs are signs on the basis of a quality, they are a First. Van der Lubbe & Van Zoest argue such signs become signs because a subject departs from a certain feeling by means of which the subject judges something to be suitable for a certain semiotic signification. They mention for instance the example of colours, like red, denoting danger or white denoting purity. Of course it could be argued whether a colour is not a sign but an abstraction. The latter is certainly true. However, I think it is important to emphasize Peirce's distinction between the sign and the material manifestation of it. Sinsigns are signs, which function as a sign on the basis of the fact they are present within reality. These are the specific individual signs such as someone's specific voice or the sounds that come forth from specific events. As opposed to the former category of signs this category does not concern the potential to become a sign but the specific relationship between the sign and the object. The final category is the kind of signs, which function as sign on the basis of a universally applicable convention and Peirce refers to them as legisigns. Traffic signs and language signs are striking examples of this category. Language signs are legisigns by definition.

¹² Jappy 2013, p. 103.

¹³ Peirce 1940, p. 102.

a cherub and a cherub only. The icon thus revolves around the likeness between the sign and the thing denoted. The term as appropriated by Peirce should be regarded within its full etymological extent within which also signifies ‘portrait’ or ‘image’.¹⁴ W.J.T. Mitchell argues likeness appears regardless of the material difference between the icon and that which it is an icon of. A human being executed as a stone statue, looks like a human being of flesh and blood by virtue of its shape. According to Mitchell mimesis and visual imitation are thus iconic ways of representation.¹⁵ However, one should be careful with the term resemblance within the context of representation. Nelson Goodman has noted resemblance is reciprocal while representation is not: ‘(...) B is as much like A as A is like B, but while a painting may represent the Duke of Wellington, the Duke does not represent the painting.’¹⁶

3.3.1.2. Index

An index has a demonstrative character and it guides the eye to the object. As such, it establishes a relationship between the object and (a) subject(s). Other than that it does nothing. As an example Peirce describes the letters of a geometrical diagram that denote certain values without explaining what the value is about. The index just points out towards.¹⁷

An index by definition implies a twofold relationship; without an object there is no index because an index by definition refers to an object. However, only when there is an interpretant as well, the index becomes a sign.¹⁸ Causal (physical) relations observed in nature are also indexical as there is a direct connection between the index and the object or phenomena it indicates. Still, according to T.L. Short an index is never purely naturally established in such a straightforward way. Some sort of convention is at least required to draw the subject’s attention to the indexical relation.¹⁹

¹⁴ Jappy 2013, p. 82.

¹⁵ Mitchell 1990, p. 14.

¹⁶ Goodman 1968, p. 4.

¹⁷ Peirce 1931–1958 vol III, p. 361.

¹⁸ Jappy 2013, p. 103.

¹⁹ Short 2006, pp. 220–221.

A frequently mentioned example is that wherever there is smoke there is a fire. In this case smoke is the obvious index of fire, based on the physical contiguity that an index implies even though smoke can occur without a fire.

3.3.1.3. Symbol

Symbols refer to or represent objects of a general nature by means of convention but they somehow do depend on iconic and indexical references in relation to what they symbolize.²⁰ How does that work? From the example of the traffic signs with a bicycle it can be argued that the shape of the bicycle is iconic and this picture of a bicycle becomes an icon as soon as the effect of the picture on the subject is similar to the effect of the object on the subject by means of resemblance of one or more properties between the picture and the depicted. That effect is, that by recognizing the similarities between some of the formal properties of the depicted bicycle with some of the formal properties of the object of a bicycle, the subject will make the inference the depicted bicycle refers to, or stands in the place of the object, of a bicycle. The picture of the bicycle on the signpost in turn becomes an index when it points to a specific object, in this case, a specific situation and that is what traffic signs do. The difference can be summarized as follows: in the situation of an icon the inference is *a* is like *b*, in the situation of an index the inference is *a* leads to *b*. Traffic signs become a symbol because by means of convention the picture of a white bicycle on a blue background on the signpost has the effect of being interpreted as referring to or standing for that convention which tells that beyond the post one is allowed to ride the bicycle. The traffic sign still contains an index because in one of the instances the sign indicates a specific object, namely a specific traffic situation involving bicycles (in other instances traffic signs might point to other specific traffic situations), which in turn contains an icon in the sense the sign resembles one or more formal qualities with the object (in this case bicycles). In the case of symbolic signs a series of inferences occur: the subject recognizes that *a* looks like *b* (bicycle), infers that as such *a* points to *c* (a place and situation involving bicycles), and further infers that *a* means *d* (ride/do not ride a bike).

²⁰ Peirce 1940, pp. 102–103.

One of the oldest and clearest examples comes from Vitruvius' *De architectura*. It tells about the Socratic philosopher Aristippus who arrives at the beach of Rhodos after suffering a shipwreck. As soon as he spots geometric figures drawn in the sand he cries out there is hope because there are traces of the presence of men.²¹ The anecdote is cited by Kant who argues that someone encountering geometric figures in a seemingly unpopulated area cannot but assume reason to be the logical cause for the existence of such figures and therefore the indicator of the presence of man.²² In this case, the geometric figure functions as an index, which not only refers to the presence of humans but also evokes the idea of man, and in Kant's case specifically the idea of Reason, for which the geometric figure now also stands as a symbol. Even though a symbol is conventional it will always contain something of a specific indexical reference because otherwise it could not be considered in relation to specific things. Because it has a specific reference it has by definition as well some qualitative resemblance with what the symbol stands for. In the case of the geometric figure the qualitative regularity of the figure could resemble, probably at least according to Kant, the unity of the principle of Reason to which it refers.

3.3.1.4. Exemplification

Adding to three modes as defined by Peirce another one, which was recognized by philosopher Nelson Goodman, exemplification could be seen as an extension and refinement of the possible modes of representation. In his theory on symbols Goodman describes exemplification by the example of a tailor's booklet containing fabric samples. He argues that in this example the sample as a symbol exemplifies certain properties such as the type of fabric, the weave and colour, but not the size, weight or the eventual value of the costume to which it refers. Goodman therefore states that exemplification means possessing and referring: the sample shares some of the properties with that to which it refers.²³ This clearly differs from an iconic reference in which there is a formal likeness between one or more of the properties of the sign

²¹ Vitruvius, *De architectura*, Book VI.1

²² Kant, *Kritik der Urteilskraft*, AA 370.

²³ Goodman 1968, pp. 52–53.

and the object. The picture of the bicycle on the signpost corresponds to the shape of an actual bicycle and as such is able to refer to, or stand in place of a bicycle. In the case where a piece of aluminium tube functions as a sample for the bicycle frame in a bicycle factory then this tube is an exemplification. Yet something needs clarification. Goodman argues the sample is a symbol exemplifying certain properties but I have just discussed that symbols are based on convention while exemplification appears to be based on the shared possession (between the sample and that to which it refers) of certain properties. Goodman argues that the possession of properties without reference would be mere possession while a reference without sharing properties would imply some other kind of reference than exemplification. It is by means of sharing certain properties that a sample can exemplify and thus refer to an object in the first place. Goodman rightfully argues this is only possible because the sample functions within a system of symbolization.²⁴ This means that only within the context of being used as a sample the sample will function as such and will be able to exemplify properties of what it is a sample of (to what it refers). Goodman argues that when stored in the tailor's drawer, the sample is just an object exemplifying the properties of a particular material but it does not have the property of exemplifying such properties with regard to an actual object of reference.²⁵

Being a sample depends on a certain context and it is within this context the sample is a symbol exemplifying something else by means of sharing one or more properties of that something. How would this work with regard to abstract signs such as geometric motifs? A geometric figure such as a triangle can be understood as exemplifying triangularity. However, this raises a problem. Goodman argues that a triangle exemplifying triangularity, which by nature is always trilateral, does not necessarily always exemplify trilaterality. Most people would usually regard different

²⁴ Unlike Peirce, for whom a symbol is one specific way amongst others in which signs can refer to, or stand in the place of something else, Goodman regards all forms of reference as symbolization by definition in the sense that all forms of reference are based on convention. This is an important difference, which should not remain unnoticed, however, it is beyond the scope of this thesis to elaborate further on this issue. Besides, even though Goodman has a point, I think it is still possible and enlightening to distinguish the different conditions under which a sign can function as an icon (by means of resemblance), index (by means of referring), symbol (by means of convention) and exemplification (by means of likeness, reference and convention in a certain context). See Goodman 1968, p. 52.

²⁵ Goodman 1968, pp. 53–54.

properties to be coexistent but not identical, however, in this case triangularity and trilaterality *are* identical. This kind of exemplification is only possible if the relationship between the symbol and the object is not understood from the perspective of a literal sharing of properties. The sample of the tailor exemplifies because it is made of the same material of the suit but at the same time it is not part of the suit. I think this can only be understood by acknowledging that, according to Goodman, reference is a way of classifying by means of labels. Taking that perspective, the properties (wool) of the object (suit) rather correlate with those of the label.²⁶

The concept that referring is classifying by means of labels is essential to Goodman's theory. However, with regard to the main topic of this thesis I think for now it is enough to determine that geometric motifs exemplify concepts such as triangularity and that exemplifying implies a reference to something else, which means that from the observation geometric motifs are not random but founded on abstract concepts such as triangularity, symmetry, parallelism, etc., it can be argued that geometric motifs are referential by nature.

3.3.2. Geometric decorative motifs as referential signs

Decoration is often regarded as a situation in which geometric motifs are applied mainly with the purpose to embellish an object and not so much with the purpose to refer to something else. The anthropologist Alfred Gell, however, argues that within decoration something of greater importance takes place; decoration perpetuates a relationship between the decorated object and the subject. In any case, decoration makes the object special and draws the subject's attention towards the object. For Gell, this drawing of attention to, is already part of the function of decoration and therefore he rejects another traditional distinction: the one between the decorative and the functional. Gell argues: (...) 'decoration *is* intrinsically functional'.²⁷

²⁶ Goodman 1968, pp. 57–68.

²⁷ Gell 1998, pp. 73–74. Sometimes ornament quite literally expresses the relationship between the decorated and the subject. A recurrent theme in which ornament almost literally points to the function of the decorated is when handles are for instance rendered in the form of claws. See Leeuw 1963, p. 157. In many cases decoration perpetuates and makes explicit the relationship between an object and its owner. Peter S. Wells has shown how this relationship established by decorative patterns was an

I argued that abstract decorative patterns and ornaments (such as geometric decorative patterns) are anything but non-representational. They are representational in a particular way and this partly depends upon the nature of their formal properties. In any case, applied within a decorative context, the potential to draw the attention towards the decorated object is what makes decorative patterns indices; being applied to an object, decorative patterns as it were, point to the object and appear to ‘say’: here!

Gell articulates how decorative patterns do that:

‘Decorative art involving the use of ‘patterns’ exploits the particularly (visually) salient part-to-part relationships produced by the repetition and symmetrical arrangement of motifs.’²⁸ Therefore, geometric patterns are representational in the following ways. Representations contain signs that can refer to or make present something other and outside the sign itself that is not necessarily present at the moment the act of representation or reference takes place. Geometric patterns emphasize the phenomenon of reference itself. Without explicitly referring to objects in the world geometric patterns show how the system of referring from one sign to another works.

In Chapter 1, I discussed that patterns can be generated from basically four kinds of transformations, namely, reflection, translation, rotation or glide reflection. Both band patterns as well as flat surface ornament are made up from combinations of one or more of these transformations. Gell considers the translation of the motif as the movement of the pattern, as its animation as it were, which the subject follows from motif to motif shifting the focus from motif to motif as well. According to Gell, this is how humans come to see the pattern’s symmetry, to see its ‘patterned-ness’.²⁹ It would not do, for example, to look at a single motif only, even though all the motifs in the pattern are each other’s replica. Repetition is required and repetition implies movement. While following the pattern from motif to motif the subject becomes involved in the hierarchy of the pattern.

important means of communication in pre-literate and pre-historical societies. See Wells 2012, pp. 115, 121–122.

²⁸ Gell 1998, pp. 76–77. In entering a relationship with its neighbouring motifs, the motif brings alive the pattern and with it the decorated object. Gell eventually comes to a formula of what he refers to as the index of the decorative patterns. The formula comes down to the basic notion that one motif is an index for another motif which is an index for another motif and so on, while at the same time, this array of motifs is an index for the whole which is an index to the recipient.

²⁹ Gell 1998, p. 77.

Once involved, humans want to understand. Gell assumes that human beings cannot help but want to know how the pattern is constituted and therefore want to grasp the complexity of the pattern. Because patterns appeal to the human cognitive effort of trying to grasp the pattern's complexity and becoming as it were stuck to it, patterns become agents, or at least testimonies of intentionality, and by virtue of that alone, representational. Gell makes this clear with the example of so-called apotropaic patterns, which are made to protect the maker against intruders such as evil spirits. These kinds of patterns are common in many cultures around the world. Celtic knot-work patterns for instance, which at first sight might appear as obviously clear but on second thoughts are hard to grasp logically. These are the kind of patterns that would have this apotropaic effect; the belief is that an evil spirit becomes fascinated and puzzled by the pattern to such extent that while trying to untangle its logic becomes captured by the pattern and no longer able to harm the pattern's agent (Fig. 30).³⁰

Gell's example of apotropaic patterns make even more clear the general effect that patterns exercise upon a subject; to want to understand the pattern's internal structure; perhaps even to *need* to understand the pattern's internal structure. Therefore, when patterns are deployed in a decorative context and applied to objects this is not merely in order for the subject to have an experience of 'beauty', although the fact patterns elicit this want or need might contribute to such an experience.³¹ Patterns appeal to the subject's cognitive resources. They appeal to the human ability to understand order and structure.

The structure of the pattern is what makes humans regard the pattern as being (part of) a self-referential system of which humans try to discern the hierarchy of the motifs, which when functioning as signs refer to one another. Looking at patterns implies a cognitive activity and because patterns are applied to objects the evocation of this cognitive activity establishes the relationship with the object. The question is to

³⁰ Gell 1998, pp. 83–86. Another example provided by Gell, which is the maze-pattern further illustrates the above. The maze-patterns such as used on Roman floors for instance provide the subject again with a cognitive obstacle. It appears as if there is no way out of the maze and only by long and tedious cognitive effort the riddle might be solved although there are even examples of mazes in which the navigational solution is simply not there. According to Gell this is another example of how the subject's attention is captured by the pattern and how the subject is almost mesmerized by the pattern. Gell 1998, pp. 88–90.

³¹ Gell 1998, pp. 81–83.

what extent geometric patterns are indeed always self-referential. After all, there are plenty of examples in which geometric patterns *do* refer to something outside the pattern itself. This is the case, for instance, with the patterns on woven baskets of North American Indians (Fig. 31).³² Also, decorative patterns in a sense always refer to the ways in which they were manufactured such as the weaves of fabrics do for example.

Still, it is about the ways in which geometric patterns refer. In the case when an obvious reference between the sign and an object seems absent, the abstract signs almost appear to demand signification by the subject. Suddenly, seemingly abstract shapes appear to be able to denote concrete objects and bodies such as mountains and birds. It is clear that an iconic representation of a bird contains a certain resemblance with one or more properties of the actual animal but subjects are apparently also able to see concrete things and bodies, known from daily experience, in abstract constellations of lines and dots. There has to be something else in addition to the competences that enable humans to fulfil the formal preconditions of representation such as the competence to understand number and shape; something that enables humans to see a shape or number of shapes as standing for or denoting this or that.

3.3.3. Geometric decorative patterns and reference

The example provided by Vitruvius made clear that geometric shapes index a maker and in doing so index an assumed intention. It is therefore important to find out what aspects of geometric shapes enable a subject to regard them as indices and how these aspects contribute to that. A possible answer could be that this occurs through a process of abduction. Alfred Gell argues abduction is a form of inference, which arises from the particular, from the still unknown, to argue that a general law must constitute this particular circumstance. The result is that for the time being a certain law is assumed to be applicable to the phenomenon even though there is no concrete causal evidence other than the index itself. Abduction in this sense may thus be regarded as the basis of all hypothesizing. In other words: the special circumstance that occurs

³² Mason 1988, pp. 178–212. See also Boas 1955, pp. 91, 96, 102.

when one sees smoke and the inference made holds that there must be fire. Even though the subject knows this may not necessarily be true and cannot be ruled out for certain, fire is assumed as the cause for smoke. Hence, through the process of abduction smoke as a sign acquires its meaning as an index of fire. For Gell abduction is at work when drawing those inferences, which leads to the assumption of an index indicating a social agent. In the case of smoke indicating a fire the causal relationship does not indicate social agency in the sense that the burning of material will inevitably lead to smoke but where smoke is an index of people making a fire, smoke is both the index of a social agent as well as of a natural cause.³³ In other words, it could be that through a process of abduction humans assume the geometric pattern in the sand must mean something even though a meaning is not obviously and immediately visually deducible from the pattern, other than the fact they recognize the pattern has formal properties of such a kind that it can only have been made by an agent.

It appears that the order of the pattern appeals to the human cognitive need to want to understand this order while simultaneously through a process of abduction the subject infers the pattern must have been the product of an agent.³⁴

The art historian Oleg Grabar is concerned about yet another aspect. He states that in their surface decorations of buildings, mosques and tombs, early Muslim decorators wanted to achieve an effect similar to that of the carpets and rugs which

³³ Gell 1998, p. 14. There might even be an analogy with the neurophysiological level. Neurophilosopher Paul Churchland argues the activities of the brain are characterized by abduction. Each step from a lower to a higher level in the neuronal pathway is abductive. Churchland explains: '(...) such abductive transformations as do get performed, (...), yield the materials for a further abductive inference at the next rung up, (...), until the uppermost rung yields its own 'interpretative take' on the *already much-abduced* presumptive information that lands at its doorstep.' See Churchland 2012, p. 71. This process, '(...) involves not one, but a succession of distinct abductive steps, (...), each one of which exploits the relevant level of background knowledge embodied in the peculiar cadre of synapses there at work, and each one yields a representation that is one step less stimulus-specific, one step more allocentric, and one step more theoretically informed than the representation that preceded it in the processing hierarchy.' See Churchland 2012, p. 71.

³⁴ Grabar 1992, pp.136, 141. As another possible answer to the question why geometric patterns are so pervasive Oleg Grabar argues that the use of geometry, especially for decorating surfaces, has both practical as well as psychological advantages. The fact geometric patterns are measurable and calculable contributed to the control of expenses. After all, on the basis of the number of different parts needed for the pattern, one can easily calculate the costs, for instance of a marble patterned floor. Besides being well suited for covering large surfaces relatively easily, Grabar also points out patterns probably allowed for organizing and controlling labour just as easily. Moreover, once learned, the geometric motif was easy to repeat even for the illiterate worker. Furthermore Grabar explains how regular patterns can emphasize the proportional ratio of buildings and objects, thereby also underscoring their physical stability and function in support of all sorts of philosophical considerations and ideals.

were typical of early Islamic art. Geometry would not have been an end in itself but a means with which to achieve in one medium an effect from another, and thus a reference from one medium to another. In this case geometry as ornament also functions as an intermediary to a different technique. According to Grabar it does not have to represent that technique literally but it expresses the essence of it; the repetition of geometric motifs would for instance characterize the repetitive nature of the technique of weaving.³⁵ In this case geometric decorative patterns do not literally stand in the place of a weave but they are based on the same principles and as such are able to express the essence of it.

Grabar states: 'Geometry is a perfect intermediary, for it attracts not to itself but to other places or to other functions than itself.' He continues: '(...) geometry is a passage, at best a magnet, to something else that it does not identify (...).'³⁶

Ornamental geometric patterns are an intermediary because they are made up of indexical signs. But there is another important point to that. According to Grabar geometry as intermediary allows the viewer an exceptional kind of freedom, which language characters for instance do not seem to offer. He states: 'It forces one to look and to decide what to think, what to feel, (...) it rarely forces us to do anything precise and concrete (...). The penalty of freedom in the arts is loss of meaning. Its reward is accessibility to all.'³⁷

The reader might now wonder how it would be possible to support the assumption geometric patterns are representational, and can therefore denote something else, and therefore can have meaning, with an argument, which seems to point in the opposite direction, namely to their loss of meaning? I think what Grabar meant to say with 'a loss of meaning', is a loss of a fixed meaning. When everyone

³⁵ Grabar 1992, p. 142. The reference to something else by expressing the essence of that which they refer to seems obvious when one pattern expresses the essence of patterns derived from weaving but it can also be imagined this principle is applicable in cases of geometric motifs and by the nature of their specific shape express the essence of an object in the world. Perhaps it is not completely arbitrary that a triangle as a symbol on a map refers to a mountain or a circular shape refers to a lake even though these symbolic meanings do seem to come forth from convention.

³⁶ Grabar 1992, p. 151.

³⁷ Grabar 1992, p. 154. Humans are thus not only attracted to geometrical patterns because like Gell already argued they evoke the cognitive reconstruction of their internal order and thereby simultaneously tie the subject to the decorated object, but also in extension, and partly perhaps even as a result of this internal order, geometric patterns make subjects automatically wonder about their supposed meaning without the pattern being loaded with cultural specific content a-priori.

would suddenly apply his or her own meaning to the word 'tree', the word could mean anything and thereby in fact does not mean anything; it loses meaning.

But that is essentially not a problem for the capacity to make something present as such. A sign represents when the sign takes the place of something or someone else even in the case when the nature of that something or someone is not obviously clear, or open to interpretation, such as in the above-mentioned example. A sign will also work as a sign when interpretation is based on the subject's very personal emotions and thoughts. Rectangles would already elicit different meanings amongst subjects and this process of meaning making can also take place relatively independent from cultural bias.³⁸ The point here is not so much *what* meaning they illicit, but the fact they *do*. This is what makes geometric patterns in a decorative context so exceptional: their potential to signify, and not significance itself, and it is the conditions and constraints of this potential that could reveal how the competence to recognize and make representations actually works.

3.3.4. Re-definition of a geometric decorative pattern

Returning to the kinds of signs as defined by Peirce and Goodman and considering the ways in which geometric patterns can refer to, denote or make present something else, it is possible to arrive at a re-definition of geometric decorative patterns. They are iconic in so far as they visually correspond to one or more properties of what they refer to. In the case of geometric decorative patterns these will correspond to the formal geometric properties of the objects the patterns refer to. At the same time, the motifs of the pattern are an index of each other within the pattern's self-referential system. This self-referentiality activates in the subject the cognitive activity of discerning the pattern and this brings with it the possibility to establish a relationship between the subject and the object. Motifs and patterns as a whole are also an index of a maker and thereby of an intention. From this humans infer they must have meaning. Therefore I think it is possible to propose the following definition: a geometric decorative pattern is a representation of a mental act of a repetitive arrangement of one or more kinds of

³⁸ McManus & Wu 2013, pp. 136–139.

geometric motifs along one or more axes in which the motifs of the pattern index each other within the pattern as part of a self-referential system. The motifs have the potential to refer to something outside the pattern in indexical, iconic or symbolic ways to use Peirce's terms, or exemplify something outside the pattern, to use Goodman's concept.

3.4. A logical deductive argument for the competence to represent

The purpose in Chapter 1 was to distinguish geometric decorative patterns within the larger domain of ornament on the basis of a survey of their formal properties. On the basis of Grabar's arguments it can now be stated that geometric decorative patterns are ornaments because they function as an intermediary; not the formal properties of a picture or an object make it an ornament but the way it appears to function. Ornaments do obviously have formal properties and therefore they can be categorized on the basis of those properties; something that has been done extensively in art history. However, the properties do not define the essence of ornament but formal properties do determine the ways *in which* ornament performs its function as intermediary. From that perspective, one could say geometric motifs are the most elementary, the most economic way, in which ornament can be an intermediary.

However, in order to arrive at a description of the cognitive competence to recognize and make geometric decorative patterns, I think as a first step it has to be determined what formal conditions a geometric decorative pattern must meet in order to be still called a pattern. In other words: what are a pattern's basic and constitutive elements and what do they do? When is a motif still a motif and how many are needed in order for a constellation of motifs to be a pattern? Therefore one should execute a thought experiment in which one discards as many elements from the pattern as possible in order to arrive at its core. Geometric decorative patterns might be reducible to just a few lines and dots in order to be still a geometric pattern. For its motifs to be a geometric shape it needs at least three lines, for instance, to make a triangle. Quite literally a simple grid of horizontal and vertical lines is a geometric pattern and so are all the cross-hatchings applied on pots and vases in different cultures around the world.

To make a (one-dimensional) geometric pattern one could argue at least three adjacent and relative points are needed (two would just form a pair). A second parallel row of points would form a two-dimensional pattern.

When reduced to such an elementary basis one can of course argue about the extent to which a pattern is still decorative but that is not the concern for now. The point is to show only a few dots and lines are needed to make a pattern. The next question would regard the nature of those dots and lines and how they affect the subject. But before that I want to make another reduction. What if one would eliminate as much reference from a sign as possible? What would remain as the least possible reference in order for the sign to be still a sign? In order for a sign to be a sign, the sign in any case always evokes the notion: this *must* or *can* mean something, that is, show traces of intentionality and reference.

This again recalls the example of Vitruvius, paraphrased by Kant, and in which the shipwrecked suspected the presence of beings endowed with Reason on the basis of geometric figures drawn in the sand. It is a telling example in which a sign on the basis of its regular formal properties is connected to thought, knowledge, and the competence to be able to express this knowledge with a presumption of intent: the competence to intentionally express internal knowledge by means of an external sign that meets certain formal requirements. If humans were ever to discover extra-terrestrial intelligence, it will probably be recognized as such on the basis of some sign of which no-one knows anything of its meaning and its maker, other than that it must have some sort of significance.

In summary, only a few dots and lines are needed to make a pattern, which at least indicates it has the potential to mean something. What allows one to be able to also recognize the pattern as a pattern?

I have already discussed how a geometric decorative pattern consists of motifs (and can consist of sub-patterns) and that a motif implies shape, and shape geometry, accordingly, in order for a pattern to be made or recognized as a pattern, a concept of number is needed (because at least more than two motifs and a competence to distinguish those as individual features is needed). Furthermore, I have also discussed that patterns can be regarded as representations. The argument must therefore proceed

with regard to what it is that makes humans regard patterns as representations and arrive at a logical description of the competence to recognize and make representations. Next, it is possible to determine the way this competence to recognize something as a representation must relate to the cognitive competences of number and geometry.

The nature of this cognitive competence to represent has already been described in Chapter 2 from a functional, psychological perspective. To recapitulate: geometric decorative patterns are made up of geometric motifs and these motifs are structurally arranged regularly to form patterns. A geometric motif obviously has a geometric shape. This means a cognitive competence that enables humans to recognize and make such shapes is required and I have discussed how core knowledge of geometry makes a functional description of that competence possible. I have also argued how Dehaene, on the basis of research by Tanaka, pointed towards the possible neurological basis for this competence.³⁹

To perceive different geometric motifs as part of a pattern requires a competence that allows humans to distinguish individual objects as quantifiable units. That competence must somehow also play a role in the perception and recognition of shapes since humans are able to distinguish a triangle from a square on the basis of the amount of angles.⁴⁰ The object tracking system as discussed in Chapter 2 provides such a functional description of that competence.⁴¹

3.4.1. Inference drawing

However, humans do not only recognize and make geometric patterns but they can also regard them as a sign, as standing for something else. Therefore, it could be argued that the aforementioned cognitive competences also underlie the making of visual sign systems and thus underlie the capacity to make representations.

With regard to visual patterns, it can be argued that with the competences of number and geometry so far only the formal preconditions in order for humans to recognize geometric patterns have been described. As outlined above, number and

³⁹ Dehaene 2009, pp. 137–142.

⁴⁰ See for instance Dillon, Huang & Spelke 2013.

⁴¹ Spelke & Kinzler 2007, pp. 257–264.

geometry do not yet clarify how humans can regard geometric patterns as standing for something else although obviously humans do need to be able to individuate one from another as a precondition in order to be able to regard one standing for another. It is now clear geometric patterns are employed within sign systems and, as signs, are capable of referring to or denoting something other than itself. I have discussed the different ways in which signs can refer to something else. Furthermore I have discussed how geometric patterns can refer as signs in any of these ways and how by means of abduction humans infer geometric patterns must index an agent, a maker. With this in mind, let me therefore return to the definition as formulated at the beginning of this chapter.

Departing from the elementary definition of representation then it can be stated humans need the competence to see something for something else or something denoting something else symbolically. That means in order for representation to be possible, humans need to be able to distinguish at least two things: some thing and another thing. This indicates number would underlie representation but, in itself, has emerged from the competence to individuate one object from another such as functionally described by the Object Tracking System in core knowledge theory. The inference would then be something like: if there is one, and there is another, then there must be others too. The same seems to apply to the geometric competence because when humans individuate an object as different from another object, these objects cannot be in the same position at the same time, which means that in order to be able to individuate, humans already need a competence allowing them to recognize position and distance. In a pattern of similar-sized black dots one cannot individuate one dot from another on the basis of their properties because the properties of one black dot appear to be identical to the other black dots. In this case, the subject can only individuate one dot from another because of the difference in the spatial position of the dots.⁴²

⁴² About the issue of identity and difference see for instance Leibniz Principle of identity of indiscernibles. Leibniz argues although humans appear to be able to differentiate between one thing and another thing when these things are separated in space and time, things must be discernible on the merit of their intrinsic properties principally and from this perspective it is not possible two things can exist at different locations and being qualitatively identical at the same time. However, with regard to a pattern of black dots of which the dots appear to be similar but each in a different position most

Core knowledge of number shows that the human concept of natural number emerges partly from the competence to individuate objects and events because humans need to be able to conceive something as a self-contained entity first before they can designate it as an object of quantity, e.g. as something to which someone can assign a number. Unless number is a pure abstraction but then the question would be: of what? Without objects or events there is nothing to quantify and quantifying is exactly what number enables humans to do. And this is only possible again when there is something or some event, which can be individuated in relation to other things. For that to happen there must be at least two things and because such a distinction does not allow two things to be in the same place at the same time, a subject already needs the competence allowing the subject to comprehend position, which in turn presupposes distance. What I am trying to argue is that in the case of visual patterns the competences underlying number and geometry, which were identified as constitutive for the recognition and making of those patterns are mutually interdependent.⁴³

3.4.2. Intentionality

It can be argued that the recognition of geometric patterns as patterns in itself already implies a kind of inference, namely the one enabling humans to reason that if there is a one there must be another. However, the reference from one motif to another implies the reference to the pattern as a whole and as such can be regarded as self-referential. By means of drawing the attention to the patterned-ness of the pattern, patterns applied

humans would by means of 'common sense' probably reason these dots are nevertheless identical other than that they are at different positions within the pattern and thus discernable by position. See further Look, Brandon C., "Gottfried Wilhelm Leibniz", *The Stanford encyclopedia of philosophy* (Spring 2014 Edition), Edward N. Zalta (ed.), URL =

<<https://plato.stanford.edu/archives/spr2014/entries/leibniz/>>.

⁴³ There might be another option and for this a thought experiment is needed. If one would propose a complete empty universe then literally there would be nothing: no beginning, no end, no middle, no object, nothing. Strictly speaking none of the words and concepts applied to that universe would really apply because there would be nothing to apply to. Suppose in that emptiness appears a point. Does it need another point in order to be individuated? Its position would still not apply because within the empty endless universe it would be impossible to determine where the point would be. For that, another point is needed. One could still not determine where the points are within the universe but it would be possible to determine the relative position between the points themselves. In this scenario individuating thus precedes spatial localization. The individuation of the first point has been possible because the point is something in relation to nothing, which to an extent has become something too, namely the conceptual sense of nothingness.

to objects are able to establish a relationship between the viewer and the object and thereby basically also refer to the object. Furthermore, the reference of the pattern to its patterned-ness implies intention. It can now be argued that their regularity and geometric order make patterns inherently intentional. How they function as signs that can either refer to some object outside the geometric pattern or to the intentions of their maker depends both on their formal properties as well as on certain convention. It is the power to recognize this intentionality on which the competence to recognize and make representations is founded. The power to recognize intentionality is probably innate. Empirical research shows that seven-month-old infants are already able to distinguish between biological and mechanical movement, which implies they are able to discern intentionality.⁴⁴

All the more remarkable is the ability to recognize intentionality in abstract signs. Both the recognition of intentionality in movements and in abstract signs indicates that the competence to recognize intentionality must be independent of the sensorial input. Whether it concerns the perception of movement, visual signs, sounds and smells, humans are competent to distil from these perceptions those of which there is reason to believe (and by which humans are perhaps also emotionally affected) concern intentionality and therefore an (other) agent(s). Regardless of whether humans are confronted with images, sounds or smells it is a certain pattern recognized in the object of human perception, which causes humans to suspect intention: for instance that of the orderly arrangement of geometric motifs applied within a decorative context or the specific sequence of sounds which humans are able to recognize as speech or music. With odours that is probably more complex; a fragrance is less easy to describe in terms of patterns, but the point is humans are also able to discern some smells as intentional. When a subject in a forest smells fire, it could indicate both a fire from a natural cause or a campfire. The smell in this case does not necessarily index intentional fire. However, if the subject in the forest would recognize a smell as a perfume the subject probably *will* interpret this smell as intentional and will thus suspect an agent wearing the smell as a sign.⁴⁵ Perhaps the sensation of smell is more comparable to that of

⁴⁴ Spelke, Philips & Woodward 1995, p. 159.

⁴⁵ About smell and intentionality see for instance Lycan 2014, pp. 1 – 8.

colour. When a subject perceives a stain of colour on a piece of rock where such a colour would naturally not occur the subject will probably infer that the colour is applied by an agent with an intention.

Smell is a good example of the scope of the competence to recognize intention but of course the main concern here is geometric patterns and the suspicion of intentionality that such patterns are able to evoke. With respect to the latter, it can now be argued why the competences of number and geometry are so fundamental with regard to the recognition of geometric patterns, not only as visual patterns, but also as representations.

Together, these competences allow humans to recognize patterns and to discern from those patterns those that cannot be other than intentional. The competence of number allows humans to do that in two ways. First, by enabling humans to distinguish one from another, although this comes with the limitation that humans are not able to distinguish and track objects accurately beyond a total number of four. However, for the recognition of patterns that is not a problem.⁴⁶ Humans need to comprehend one element of the pattern as distinct from another but humans do not need to know the exact number of elements to recognize the pattern. Second, the competence of number enables humans to comprehend a large approximate number of elements as belonging to one regular and repetitive coherent assembly.

The competence for geometry enables humans to recognize and distinguish the regular shapes of geometric motifs but also enables the recognition of the elements of the pattern as dimensioned. And not unimportant, it also enables humans to manufacture such patterns. Together, the cognitive competences for number and geometry thus enable humans to recognize a collection of regular arranged geometric motifs not just as a pattern but, and perhaps also because intuitively humans know how such patterns are accomplished, these competences allow humans, from the recognition of the regularity of the arrangement, to make the inference this must concern a pattern

⁴⁶ Many hierarchically ordered decorative patterns consist of subgroups, which in turn do consist of a limited number of motifs, or a limited number of alternations of one or more kinds of motifs. With regard to the comprehension of a decorative pattern the Object Tracking System could enable to recognize such parts of the bigger pattern as an arrangement of an exact but limited number of motifs.

made by an agent intentionally: a pattern that therefore at least refers to this agent as well as to the practice of making.

3.4.3. Dimensioning and direction

The regularity of the pattern can be recognized on the basis of several properties. Some are concerned with the regularity of the motifs itself, some with that of the total pattern and obviously with the equal distances between the individual motifs. The regularity of the motifs and the pattern suggests intention and therefore accomplishes the reference from the motif and the pattern to a maker.

A single geometric shape can already be an index and therefore may have a referential function. One can indeed argue that a single motif is enough to perform the function of showing the way: quite literally, for example, when the motif of an arrow is used to show which way to go. In this case the direction to which the motif as a sign refers to is indicated by the arrangement of the lines within the motif.

But the arrangement of line within each motif always shows the way because that is what line appears to do psychologically. The lines of a simple triangle by definition point to its angles. As a whole the closed geometric shape such as a triangle or quadrangle, the demarcation of the shape as it were, works like a frame and as such shows the way from the periphery of the shape subsequently to what the shape may contain. Frames of paintings, which are always rectangular or in some cases circular closed shapes, work like that; they are demarcations focusing the attention on its content and indicate what is important and what is not (and what is in and what is out), hence they individuate a one from another and in doing so they are able to refer to one and another.

Most geometric patterns encountered in a decorative context are layered. They may have been built up for instance by means of larger geometric shapes which, in turn, are filled with smaller, often identical, geometric shapes.⁴⁷ Many ancient vases are applied with closed rectangular and triangular shapes, which can be considered to be frames filled with cross-hatchings (which are basically grids of diagonals) that in turn

⁴⁷ Gombrich 1979, p. 111.

create the interior patterns of those frames, often a checkerboard pattern, thereby creating a multi-layered texture of the vase's surface. In this way, the view is directed from the larger comprising motifs to the patterns that form their inner content.⁴⁸ Very early and relatively simple examples of such an application of patterns are the geometric Halaf vases from Northern Syria (Fig. 32). Those are far from the only examples. In many cultures around the world cross-hatchings are used as filling for larger geometric shapes. Examples are known from Costa Rica and Panama dating from as early as the first century AD (Fig. 33). In general, similar geometric patterns, such as triangles, lozenges, and spirals (perhaps even the most notable) used by the cultures from the Eurasian continent were also used in cultures in South America long before the Americas were 'discovered' by Europeans.⁴⁹

This layering of patterns in which some motifs that are part of groups of motifs may act as frames of smaller motifs, again emphasizes how references are established within the pattern as a part-to-part relationship by means of which the attention is not only drawn to the arrangement of and thus to the pattern itself, but also the condition is met for subjects to suspect intentionality. It could even be assumed that the more layered the pattern is the more complex and versatile the (possible) intentions.

Because in decorative patterns the motifs can be distinguished from the patterns (when we regard the pattern as the repetition of motifs) I also want to discuss the function of direction within geometric decorative patterns explicitly from the perspective of its repetition. It is precisely the repetition of elements within a successive arrangement in a certain direction from which dimension emerges. The dimensional arrangement of a succession of elements separated by means of equal distances is a fundamental property of manmade patterns. A pattern of geometric motifs such as can be encountered in ornament does therefore not only point from a motif as an index to another motif as an index within a self-referential structure, in the sense that the inner referencing from motif to motif refers to the pattern as a whole, such as Gell explained. A geometric decorative pattern also shows the way in a more literal sense by means of the perceived direction of the pattern, which extends in space along one or more axes

⁴⁸ Wells 2012, pp. 20, 27, 57

⁴⁹ Stone-Miller 1992, pp. 13–18.

and humans therefore see as following a line or constellation of lines. This evokes an illusion of movement, in the sense that the regular arrangement of equally distant motifs automatically seems to incite the subject to experience the pattern as going from one to another and so forth.⁵⁰

3.4.4. Constraints and conditions of the competence of representation

The constraints and the condition for the competence of representation can now be described as follows: it must be a competence that enables humans to recognize and make visual signs, for example, in the form of shapes and patterns that have the capacity to draw attention to itself and by means of that also have the potential to refer to something else. This capacity means that visual shapes and patterns are able to function as signs. There are four distinct ways in which signs can refer to something else and make that something else present in the mind of a subject. These ways can be described as the four conditions under which humans can recognize a sign as representing something: as an icon when a sign shows a formal resemblance with one or more of the formal properties of objects, bodies and phenomena; as an index when a sign refers to a specific object; as a symbol when a sign refers to, or stands in the place of something else, by means of a convention that prescribes a sign under this and that circumstance refers to, or stands in the place of this and not that; as an exemplification when a sign within a certain context exemplifies one or more of the properties of something else.

At first observation it may seem that a geometric motif, unlike naturalistic and stylized motifs, does not resemble one or more formal properties of objects, bodies and phenomena and therefore cannot function as an iconic sign. However, geometric motifs can have a formal resemblance with bodies, objects and phenomena, but only in a very limited sense. There is always a formal relationship between geometric motifs

⁵⁰ Wells 2012, p. 27. As an example of such experimental research about the movement of lines see for instance Herczyński, Cernuschi & Mahadevan 2011, pp. 31–36 who mathematically investigated the flow of lines in the paintings of Jackson Pollock. Franz Boas already suggested decorative patterns to be the translation of the direction in which the rhythmic movement of weaving, hammering, incising, etc., occurred. In other words: decorative patterns translate the rhythmic labour in time into a rhythmic repetition in space. See Boas 1955, p. 40.

and the shapes of whatever objects and bodies because whatever the nature of the shape, shapes by definition have contour. Based on this very rudimentary resemblance it can be argued that there is always some iconic relationship between geometric shapes and other shapes. That does not make geometric shapes icons of other shapes because the resemblance is so limited and so general in order for a geometric shape to make something else, an object or a body, immediately present to the mind of the subject. Therefore geometric shapes need a convention that prescribes that they stand for a specific body, object or phenomenon in a specific context. The meaning of the geometric figures on the woven baskets of North American Indians show how they function as symbols, hence the given that members from the same tribe but from two different villages see different things represented by the same figures because they apply different conventions to the figure.⁵¹ But geometric shapes can also function as an index for example in the case when they function within the context of a map to refer to a specific location.⁵² In this context, geometric shapes are often both index and symbol for instance when a triangle points on the map to the location of a mountain but also stands as a symbol for a mountain.

Finally, the formal relationship between geometric, naturalistic and stylized motifs involves something else. In Chapter 1, it was concluded that every kind of motif, even the most complex naturalistically rendered acanthus leaf, is ultimately a constellation of lines. Therefore, abstract motifs can be regarded as the basis from which all other motifs can be constructed; a bit like how Biederman conceived the recognition of shapes as a matter of recognizing their constitutive parts first, or the other way around; as the most elementary motifs to which complex motifs can be reduced. In any case, there is at least always one formal property that abstract motifs share with naturalistic and stylized ones and that is that they are all constellations of lines. In that sense, geometric shapes are always an exemplification to some extent of shapes in general.

The extent to which an assembly of motifs in the form of a pattern is able to refer does not only depend on the formal properties of the motifs but the patterned-

⁵¹ Mason 1988, pp. 178–212.

⁵² Huang & Spelke 2015, pp. 81–96.

ness itself does something to how the motifs refer. A single naturalistic or stylized motif can be an icon but does a succession of motifs function as an icon as well? This can be illustrated by using a non-geometric example. Imagine for instance the Marilyn Monroe silkscreens by Andy Warhol. In the versions with a single Marilyn someone can still regard the image as a portrait resembling the actress Marilyn Monroe and by means of that resemblance the image is able to make her present to the viewer. In the silk screens in which her image is repeated, however, the emphasis starts to shift towards this repetition and somehow this adds up to the iconic status of the Marilyn image as a motif (Fig. 34). After all, the viewer becomes aware each portrait is identical to the other and this exchangeability underscores the nature of the motif as a sign. Again it becomes clear, this time on the basis of a non-geometrical example, that the reference in a repetition is not so much to an object outside the motif but from motif to motif. This appears to be the main characteristic of how patterns refer. Repetition draws the attention to the patterned-ness of the pattern regardless of the nature of the motifs of the pattern and when applied on objects as ornament indirectly to the object of ornamentation.

In the case of the Marilyn Monroe silkscreens there will always remain some reference to the actress at least because of the obvious resemblance with her. In the case of geometric patterns, where references to, and representations of bodies and objects external to the motif, are conventional, the principle of reference from motif to motif is exemplary. This recursiveness constrains the capacity for patterns to represent in the sense that a pattern, by definition consisting of one or more motifs, can therefore not index a specific object outside the pattern. It rather causes the attention to be drawn to the pattern itself since the reference takes place from motif to motif. Unless the pattern's recursive nature refers in a symbolic way to something outside the pattern which is also recursive by nature, for example, when a recursive pattern of zigzag figures refers to, or makes present, the waves of the sea. Of course one can question the specificity of this reference. One could argue that the zigzag pattern does not refer to a specific sea or a specific wave but refers to the common phenomenon of the repetitive way in which waves roll ashore and therefore it seems obvious that the reference in this case can only be accomplished by means of repetition as well.

It can now be argued that humans can recognize and make patterns because the competence to represent presupposes the competence to identify points, objects, and bodies as individual entities (object tracking), as well as the competence to think and see those entities within proportional relations (geometry). This allows humans to arrange those points within a structure by means of connecting points with lines which, in turn, enables the making of geometric shapes and patterns for example in the form of a grid. As viewers, humans assume the pattern to be intentionally organized as a result of the observation that each motif within the assumed structure not only proportionally relates to the other motifs but by means of this relation also refers to other motifs. Indeed, when subjects become aware of this reference the motifs function as indexical signs of the assumed inner structure and they allow the subject to discover and unravel this structure. At the same time, the motifs and the pattern as a whole index a maker and an intention, which allows the individual motifs as well as the pattern to be conceived as a sign at least denoting that it must mean something.

From the perspective of construction there is probably no difference between abstract patterns and naturalistic pictures. This distinction is just a matter of categorization. Both are essentially pattern-like. Based on similarities between the structure of bodies and objects, as represented on naturalistic pictures on the one hand, and the structure of those bodies and objects in 'reality', humans have learned to regard them as representations of. This structural similarity makes humans regard the reference as almost obvious. With regard to abstract geometric patterns the subject largely lacks the categories from 'reality' and therefore depends on the pattern's internal structure itself to seek for reference. But essentially I think the 'sense of order', as Gombrich called it underlies the design of all pictures, regardless of whether they are called 'abstract' or 'naturalistic'. Therefore within the context of designing patterns 'intention of order' might even be a better term.

3.5. Conclusion

Semiotics has helped to conclude geometric decorative patterns can be regarded as a sign or a constellation of signs and therefore can stand for something else or denote

something else, albeit it in specific ways. Geometric decorative patterns are therefore representational. It cannot be but assumed that there must be a cognitive competence allowing humans to recognize and make representations, e.g. geometric decorative patterns, because after all representations are made all around the world. This competence can be logically deduced before being observed empirically. Arriving at this description I concluded the competences for number and geometry are at least constitutive for making patterns and therefore also indirectly for the competence to recognize and make patterns as representations. Besides there is empirical evidence from cognitive psychology supporting the existence of competences for number and geometry, but there is also evidence these competences have their neural substrate in parts of the brain where distinct visual properties such as contour or line are processed. It can also be concluded that besides the cognitive competence to recognize patterns, humans are also able, by means of a mental process called abduction, to infer from the internal structure of these patterns that they must have an agent who made these patterns intentionally. The competence to recognize and make representations is therefore not only limited to the recognition of the formal aspects (number and geometry) but also included the necessary kind of reasoning in order to be able to consider an *a* to stand for a *b*.

However, in Chapter 2, I encountered what seems to be an ontological and methodological problem. Indeed, the reciprocal relation between perception and the forming of mental concepts seems a question of how the subject could ‘represent’ objects and events mentally, or and how the subject’s mental concepts constitute objects and events. Scientists demonstrate this relation with experiments in which they observe participants perform tasks in which they use pictures. But these pictures are exactly the representational embodiment of the assumed relationship.⁵³

Therefore, it must be considered first *how* concrete representations such as pictures actually work. This question cannot be answered by means of experiment only since an experiment on the effect of representations, and perhaps every experiment using pictures is inherently an experiment about the effect of representations, requires the use of pictures. However, there are available bodies of knowledge from art history

⁵³ Wartofsky 1980, pp. 131–133.

that show how pictures work and how pictures become representations. For this reason, Chapter 4 will turn to Leon Battista Alberti's *De pictura*, one of the earliest theoretical and practical treatises about pictures and representation, which shows the ways in which knowledge about the formal aspects of patterns and pattern recognition within representational systems determines scientific and philosophical theories about the relation between perception, representation and the forming of knowledge, i.e. the psychological mechanisms underlying the recognition and use of images as representations as.