

## Can Be Beauty Calculated?

*Andrej Demuth, prof., PhD.*

Trnava University in Trnava, Slovakia

*Slavka Demuthova, assoc. prof., PhD.*

University of Ss. Cyril and Methodius in Trnava, Slovakia

---

### Abstract

In this study we focus on three historical concepts of using of mathematical approach to beauty and aesthetic (taste) standard of mathematical thinking in early formation of modern aesthetics of the eighteenth century. The first is Hume's idea of statistical standardization and the significance of rareness and excellence, as a desire for specific positive deviation. Second model of aesthetic thinking is Reid's aesthetic realism. In this theory of taste and art the attention is paid to the study of the parameters and attributes of objects, as well as to the fact that a beautiful object contains cognitively significant information. Those who perceive it are, or should be, able to deal with and understand this information. Important part of these considerations is the analysis of ontological status of beauty and the term of excellence. In the conclusion of this study, we try to highlight the mathematical algorithm of aesthetic standards creation and ideal in Kant's *Critique of Judgment*. We attempt to suggest the potential of all three approaches in contemporary scientific cognitive aesthetic research.

---

**Keywords:** Beauty, statistics, standard, taste

### Introduction

Beauty and options for its research represent an ancient philosophical issue, combining not only questions of methodology, but also a significant number of metaphysical questions and obstacles. One of those essential questions is definitely: what is beauty and is it possible to objectively examine beauty? If yes, then how?

This study tries to describe three historical approaches to continuity and the mathematization of beauty, which can be identified in the analyses of beauty in the period when aesthetics was formed as an independent philosophical field, and which can be observed in approach to the mathematics of aesthetic experience research even today.

The very first and essential approach to this field is Hume's "mathematization" of taste and his search for objective aesthetic standards.

### **Hume and Standardization of Standards of Taste**

If we are to understand Hume's work *Of the Standard of Taste*<sup>1</sup>, we have to take into account, that for the British school<sup>2</sup> taste is one of the key human intellectual skills<sup>3</sup>. Aesthetics, labelled *Criticism* in Hume's nomenclature, could have become a Newton-type science if the subject of its research had been the analysis of mind patterns, the ways in which we think or the ways in which we perceive beautiful things and how our mind processes information in this regard. However, some philosophers associated taste with rational skills and a certain natural skill of judgment. As an empiricist, Hume believed that the only way to examine this skill – undoubtedly interesting and important in everyday life – is through experience and observation. It could be either introspection, analysing one's own experience of beauty, or it could be an objectification of the aesthetic experience of other individuals.

Hume was aware that the perception of beauty was connected to sensibility under the influence of Lockean epistemology and Hutcheson's aesthetics. His sensualism results in the fact that the subject of an aesthetic judgment is not something external, but, on the contrary, the impression we perceive as subjects. Therefore, the quality of our perception is not the quality of the object. That leads to polemics regarding the nature of secondary qualities.

Similar to Berkeley, Hume believed that taste judgment, the attribution of qualities to objects, is a result of rational generalization and abstraction. However, it can often be incorrect. That, which is infallible and true, is our perception. Therefore, if we claim that some object is beautiful, we cross the boundary of sensual experience and emotion in our judgment

---

<sup>1</sup>Hume's essay *Of the Standard of Taste* is an elaboration of his ideas from *An Enquiry Concerning the Principles of Morals* and was issued as a part of *Four Dissertations* (together with the essay *Of Tragedy*) in 1757. It is also a reaction to the decision of the Edinburgh Society for Encouraging Arts, Sciences, Manufacturers and Agriculture in Scotland, which awarded the essay of Alexander Gerard „*Dialogue on Taste*“ with the title of “best essay on taste” in 1755 (Hume was a member along with Adam Smith, Lord Kames, William Robertson, Alan Ramsay and Adam Ferguson) which was issued together with three similar dissertations by Voltaire, d’Alembert and Montesquieu in the seventh volume of *Encyclopédie* in 1759 after Hume's prompting (compare: Jones 2011, 431 – 432).

<sup>2</sup>After Shaftesbury, its main proponents were F. Hutcheson, G. Turbull, J. Harris, W. Hogarth, E. Burke, A. Gerard, H. Home - lord Kames, A. Smith, J. Beattie, J. Reynolds, T. Reid, A. Alison, D. Stewart and D. Hume.

<sup>3</sup>In the introduction to his *Treatise*, Hume states four basic disciplines – philosophical fields (logic, morals, criticism and politics), describing the mind and its abilities or researching the phenomena that are connected to these skills (compare: Hume 2012, s. 6 – 7).

and we attribute qualities to something that we might perceive incorrectly. Emotion (opinion, *impression*) is the only real and epistemically infallible thing and thus taste judgments should apply only to perception. “*Among a thousand different opinions which different men may entertain of the same subject, there is one, and but one, that is just and true; and the only difficulty is to fix and ascertain it. On the contrary, a thousand different sentiments, excited by the same object, are all right: Because no sentiment represents what is really in the object. It only marks a certain conformity or relation between the object and the organs or faculties of the mind; and if that conformity did not really exist, the sentiment could never possibly have being*” (Hume, 2008, 136). The subject of our thoughts should be thus perception and a certain taste psychology. According to Hume, the ontology of beauty is (referring to Shakespeare's *Beauty is in the eye of beholder*) a matter of impression, it “*is no quality in things themselves: It exists merely in the mind which contemplates them [...]*” (Hume, 2008, 136).

It thus seems that aesthetics are based on perceptions and therefore there is a risk that it must be fundamentally subjective and relative. The reason why it is so lies in the fact that we do not have receptors that are developed at the same level of sensitivity, or they might be contaminated and thus the resulting perceptions can be very different. In addition, we are also very different in the question of preference, and thus “*each mind perceives a different beauty. One person may even perceive deformity, where another is sensible of beauty; and every individual ought to acquiesce in his own sentiment, without pretending to regulate those of others.*” (Hume, 2008, 137). Can a science about beauty and the “pleasant” even exist? Or can we only provide descriptions of our own subjective emotions?

If Hume wanted to give succour to aesthetics as a science, the judgments of which could claim objective validity, he could opt for at least two solutions. He partially opted for both. The first solution was the analysis of “beautiful”, that is, the thing which beautiful emotions and the objects that cause them have in common.

Hume (2008, 134-135) realized that despite the indisputable diversity of our tastes, it is possible to find objects and crafts that appeal to almost everybody in various observation contexts within history and across cultures. These classics are beautiful because our subjective tastes probably have something in common. The “Statistical intersection” of individual tastes could be a solution to the search for a potential general taste if it exists, or at least general attributes of what we like. It is obvious from the nature of his epistemology that what we like are not the objects themselves<sup>4</sup>, but the

---

<sup>4</sup>“*Though some objects, by the structure of the mind, be naturally calculated to give pleasure, it is not to be expected, that in every individual the pleasure will be equally felt.*” (Hume, 2008, 140).

structure or form of our emotions. And thus we have to rivet our attention to them. However, Hume does not analyse “beautiful” objects by means of certain phenomenology of the perception of appealing objects, that is, what we experience when we like something, or through the intersection of attributes of objects we perceive as “beautiful”, and not even through of our desires (for what purpose do we like something?) when we like something. He pays attention to another aspect of the subjective perception of beauty – its atypicality and *excellence*<sup>5</sup> in comparison to other, up until that point, aesthetically neutral objects.

The term excellence is to philosophy, special. On one hand, excellence is everything which is not common, that is rare. And thus our preferences in perceiving various aesthetic objects can be rare. Hume is aware that there are individuals who might like things which others do not like or even that disgust them. He assumes that this anomaly in taste could be caused by sickness or an individual oddity. Individual anomalies in taste are more likely to be an error than the standard. Hume expects that the majority would reject such an unusual taste judgment because it is in contrast to a certain generally accepted standards of perception. And here is the core of the issue. We consider everything which is excellent to be beautiful, however, this excellence is considered (or might be considered) beautiful by the majority of those who perceive it. It seems that our nature forces us to search for generally accepted standards of perception in our judgments (Hume 2008, 136). The question is: does such a standard even exist and how are these aesthetic standards established?

We believe that Hume’s fundamentals of aesthetic judgment are more or less mathematical. Hume assumes that perceptual standards as well as standards of taste really do exist. He documents it by the statement that “*If, in the sound state of the organ, there be an entire or a considerable uniformity of sentiment among men, we may thence derive an idea of the perfect beauty; [...]*” (Hume 2008, 140). The idea of beauty could therefore be derived statistically from the unity of feeling of pleasure in the perception of the same object by different individuals, “*in like manner as the appearance of objects in day-light, to the eye of a man in health, is denominated their true and real colour, even while colour is allowed to be merely a phantasm of the senses*” (Hume 2008, 140). But in what manner are the aesthetic standards established?

Regarding the famous example of Sancho Panza tasting wine, it is obvious that our taste is standardized by practice and the quantity of observations. Even individual taste is, in fact, a result of the standardization

---

<sup>5</sup>Hume uses the term *excellence* in two meanings. Firstly, it conveys rareness – uncommonness as an opposite to usualness (standard). Secondly, it conveys rareness in the sense of perfection.

of judgments. If the inexperienced individual is to deal with some notion, he compares it with the notions he has already experienced and therefore his individual taste might differ from that of others. “A man, who has had no opportunity to compare different kinds of beauty, is indeed totally unqualified to pronounce an opinion with regard to any object presented to him. By comparison alone we fix the epithets of praise or blame, and learn how to assign the due degree of each.” (Hume 2008, 140). Therefore, our perception is a standardization of our experiences. Our scale for beautiful and ugly develops with a quantity of material “already perceived”. We consider beautiful, those things, which are not average and in this manner they meet or even exceed the established standards. This is just the first part of Hume’s solution – the less visible one. The second one is the standardization of tastes between individuals.

If our experience is limited to only some types of objects, it is obvious that our taste will be determined and limited by this particularly narrow experience. This is valid for each individual and therefore by sharing aesthetic experiences and taste judgments (and comparing them!), it is possible to rectify the individual taste and thus it is possible to establish generic taste and aesthetic feelings for a community or nation on the same principles of comparison and standardization. The standardization of standards of taste is therefore done on an individual as well as an inter-individual level by the same means.

It could seem that the result of such standardization would, in the end, be an average of the aesthetic judgments. However, we would only face this situation if each person had completely different individual aesthetic judgments. The truth is that we like the same things, thanks to various – for instance historical or social – influences. Thus, Hume believes that beauty is everything that exceeds the standard and therefore (like the Gaussian distribution of intelligence and genius) everything which is (positively) perceived as rare, not only by a single individual, but also by a group of observers. The inter-subjective taste is formed by a process of standardization and synchronization of individual tastes. Practice, education and expert opinions play a vital role in this process.

Hume’s philosophy is often criticized because his definition of taste, as stated by experts – critics – is circular (Guyer 2014, 129; Broadie 2010, 289). However, considering previous thoughts, it is obvious that the relevance of any taste judgment is dependent on the level of experience of the person who perceives it. According to Hume, the opinions of critics are more authoritative than the opinions of inexperienced or partially experienced individuals. Although it would be sufficient, this is not caused only by the expertise of the critic in his field and having incomparably more experience in it and therefore better overview of the matter. The greater and

more diverse set of aesthetic experiences the critic has, the more reliable his judgment is.

The second important factor of Hume's preferences in experts' opinions lies in the subtlety and education they use in their judgments. Hume presents the example of the perception and judgment of flavours (Hume 2008, 142). It is clear that almost everybody is able to identify the significant and common flavours. However, the critic is able to identify not only the rare and uncommon ingredients, but he can also sense them with greater (or greatest) subtlety. It is the subtlety and the ability to distinguish that is necessary for taste relevancy and expertise. The subtle senses and imagination are given by physiology as well as by education and practice.

The task of the experts, for authoritative opinions, is not only to classify and organize our experiences, but for their experiences and subtlety to also compensate for our missing individual experiences, which we are unable to perceive due to our absence of subtle receptors or imagination. Thanks to the value of their experience, our individual standard of experience becomes closer to the expert's standard. We believe that somewhere here (in these mathematical evaluations of individual experience with the experience of experts) lies the source of Kant's ability to distinguish between high and low art and the experts' task for the development of taste.

### **Thomas Reid and Mathematization of Objects**

According to Gordon Graham (2014, 225), Hume's theory of taste expects that our perception of beauty is firstly the expression of emotions, subsequently processed by rational judgments. Beauty is thus something sensed and a domain of emotions. Thomas Reid opposed Hume's epistemology and assumed that our perception is not the perception of emotions, but rather of objects. His epistemological approach is that of a direct realism, influencing his understanding of beauty. Reid does not understand beauty as an expression of emotions originating from notions, but as a real quality of objects which we perceive. *“When a beautiful object is before us, we may distinguish the agreeable emotion it produces in us from the quality of the object which causes that emotion. When I hear an air in music that pleases me, I say it is fine, it is excellent. This excellence is not in me; it is in the music. But the pleasure it gives is not in the music; it is in me.”* (Reid, 1969, 754). He believes that the subjects of our aesthetic evaluation are directly real objects with which we deal by means of

perception. And so the beauty is not in the *eye of the beholder*<sup>6</sup>, but rather directly in the object<sup>7</sup>.

Reid's aesthetic realism implied another possible approach to the study of beauty and beautiful objects – the analysis and mathematization of the parameters of a beautiful object itself. As he states, "*The sense of beauty may be analysed in a manner very similar to the sense of sweetness. It is an agreeable feeling or emotion, accompanied with an opinion or judgment of some excellence in the object, which is fitted by nature to produce that feeling. The feeling is, no doubt, in the mind, and so also in the judgment that we form of the object; but this judgment, like all others, must be true or false. If it be a true judgment, then there is some real excellence in the object.*" (Reid 1969, 599). The sensation of beauty is produced by the qualities of the object and thus beauty can be observed by focusing on qualities like rarity and perfection<sup>8</sup>.

But what is rarity? We assume that in dealing with it, a certain mathematical quality is involved. The fact that a specific object is rare<sup>9</sup> is based on our ability to deal with its qualities and to compare it with other objects and to come to the conclusion that it is not average or common. Thus rarity presupposes it is uncommon. According to Reid, rarity itself is a natural standard of beauty. Namely, beauty itself is rare. Reid is aware of beauty's diverse forms and that they very often differ from one another, but their uniqueness and exclusivity connects them despite all their differences. It is not just any type of uniqueness, however. At the same time, beautiful things are perfect in their form. While exclusivity presupposes only the ability for statistical calculations between the common and extraordinary, perfection presupposes yet another type of calculation – a determination of a certain inner proportionality, harmony, symmetry and completeness. But there is still the question of which specific attributes are those that characterize the perfection and excellence of the object.

While it is possible to find several opinions on the matter of the ability to differentiate between the separate attributes of the qualities that

---

<sup>6</sup>For discussion of certain obstacles to Reid's aesthetic realism see: Jaffro 2008.

<sup>7</sup>Reid thus clearly opposed Hutcheson's subjectivist aesthetics stating "*there is no beauty in any object whatsoever; it is only a sensation or feeling in the person that perceives it.*" (Reid 1969, 755).

<sup>8</sup>Jaffro suggests that Reid's aesthetics contain another two interesting levels of research of beauty besides the examination of the qualities of the objects: perception and our natural ability to perceive beauty. We assume that the core of Hume's essay on taste lies in the perception of the pleasant, and the analysis of our ability granted by Nature is a metaphor of foundations of Kant's research of beauty, as we will show later on (compare Jaffro 2008, 136).

<sup>9</sup>Similarly to Shaftesbury, Reid suggests three kinds of aesthetic qualities. Contrary to him, however, he prefers novelty, magnificence and beauty (compare Guyer 2014, 221).

cause the perception of affection in the history of aesthetics, Reid's approach is clear, at least in terms of their existence. Reid believes that as in the same way that we cannot equate colour with the idea when we think of it, colour in fact is the physical quality of a thing that causes our idea of colour, beauty is a real quality of a subject that causes affection in those who perceive it. As far as having knowledge of it is concerned, though, he is more reserved and states that *"in objects that please our taste, we always judge that there is some real excellence, some superiority to those that do not please us. In some cases, that superior excellence is distinctly perceived, and can be pointed out; in other cases, we have only a general notion of some excellence which we cannot describe."* (Reid 1969, 760). Therefore, Reid believes that certain attributes, which make objects beautiful, can be clearly identified<sup>10</sup>. This specific approach is the method of choice for a part of cognitive aesthetics<sup>11</sup>.

### **Kant and the Cognitive Basics of Aesthetic Judgment? The Idea of Standard and Mathematical Composition**

Reid's attribution of cognitive aspects to aesthetic judgments seems to be in contrast with Kant's requirement for intellectual purity in aesthetic judgment. Kant is considered to be a philosopher who rejects any rational interventions in taste judgments<sup>12</sup>. Pure aesthetic judgment is a matter of reflective judgment (in contrast to a defining one) which is deprived of terms or intellectual purposes.

If we look into Kant's thesis about beauty and ideal, we will come to the conclusion that the idea of beauty is a rational and the ideal is a vision identical with this. But how do we come to the ideal of beauty? A priori or empirically?

In his *Critique of Judgment*, Kant suggests a notable psychological explanation: *"Notice how in a manner wholly beyond our grasp our imagination is able on occasion not only to recall, even from the distant past, the signs that stand for concepts, but also to reproduce [an] object's image and shape from a vast number of objects of different kinds or even of one and the same kind. Moreover, all indications suggest that this power, when the mind wants to make comparisons, can actually proceed as follows, though*

---

<sup>10</sup>"A work of art may appear beautiful to the most ignorant, even to a child. It pleases, but he knows not why. To one who understands it perfectly, and perceives how every part is fitted with exact judgment to its end, the beauty is not mysterious; it is perfectly comprehended; and he knows wherein it consists, as well as how it affects him." (Reid 1969, 574).

<sup>11</sup>In the case of music, we identify its beauty in expression, in the beauty of melody and in the beauty of harmony (Kivy 2010, 274).

<sup>12</sup>On the other hand, he preferred the thesis of beauty's role in mathematics until 1790, however, he later rejected it (compare Wenzel 2001).



*this process does not reach consciousness: the imagination projects, as it were, one image onto another, and from the congruence of most images of the same kind it arrives at an average that serves as the common standard for all of them”* (Kant 1987, 82). What is more, from the image of the standard origin of a handsome man’s stature, Kant specifies in his analysis of the origin of the standard idea: “*Someone has seen a thousand adult men. If now he wishes to make a judgment about their standard size, to be estimated by way of a comparison, then (in my opinion) the imagination projects a large number of the images (perhaps the entire thousand) onto one another. If I may be permitted to illustrate this by an analogy from optics: in the space where most of the images are united and within the outline where the area is illuminated by the colour applied most heavily, there the average size emerges, equally distant in both height and breadth from the outermost bounds of the tallest and shortest in stature; and that is the stature for a beautiful man”* (Kant 1987, 82).

Therefore, the standard idea originates from an unconscious mathematical calculation. The unconsciousness is documented not only by the mentioned conviction about *the real comparison* (though *insufficient for the consciousness*), but also by Kant’s note that “*The same result could be obtained mechanically, by measuring the entire thousand, adding up separately all their heights and their breadths (and thicknesses) by themselves and then dividing each sum by a thousand. And yet the imagination does just that by means of a dynamic effect arising from its multiple perception of such shapes on the organ of the inner sense”* (Kant 1987, 82). It could be said that this act is carried out intuitively with an unspoken algorithm for the solution (Démuth 2009). However, Kant clearly unfolds this mathematical algorithm. Our creation of aesthetic standards is tied to mathematical operations of which we are unaware because they are performed by the imagination.

Nevertheless, the significant issue is whether it is done on the basis of previous experiences (as suggested by Hume) or *a priori*. Although Kant states that the creation of the ideal is determined by previous experience (according to Kant, the Chinese ideal is different to the European one) based on the perceptions that one might encounter in his or her environment. This fact is valid not only for the standards of human physique, but for all aesthetic standards and patterns (for instance the standards of horses, dogs, etc). On the other hand, at the same time he says that “*this standard ideal is not derived from proportions that are taken from experience as determinate rules. Rather, it is in accordance with this ideal that rules for judgment become possible in the first place”* (Kant 1975, 73). The creation of an

algorithm of aesthetic standards probably takes place *a priori*<sup>13</sup>, but its material is obtained by experience.

Nevertheless, there is Kant's other remarkable note, "*the standard idea is by no means the entire archetype of beauty within this kind but is only the form... Nor is it because of its beauty that we like its exhibition, but merely because it does not contradict any of the conditions under which a thing of this kind can be beautiful*" (Kant 1987, 82). What is more, he suggests an example in a footnote: "*It will be found that a perfectly regular face, such as a painter would like to have as a model, usually conveys nothing. This is because it contains nothing characteristic and hence expresses more the idea of [human] kind than what is specific in one person*" (Kant 1987, 82). However, as the numerous observations of psychologists and cognitive scientists show, people perceive faces that are the closest to Kant's described average as a standard of beauty as beautiful. This knowledge has been well-known since the times of Galton and his almost Kantian experiment with the composite images of criminals who were more attractive than the faces of individuals, but it was proved by repeated observations carried out by Langlois and Roggman (1990) and by many others (Perrett 2010, Rhodes 1998, 1999...). The explanation of why we like faces which are close to or identical to faces created according to the Kantian standard is not only mathematical, but also evolutionary. However, the fact remains that throughout the history of art (for instance in the Baroque period) opinions can be found that for "perfection", the perfectly average and symmetrical face very often requires the violation of symmetry and the average by means of a certain beauty spot which would make the object distinctive and unforgettable.

Kant's theory of the ideal paradoxically represents (concerning the overall anti-cognitivism of Kant's aesthetic judgment) a model of the creation of aesthetic standards and ideals by acquiring composite individual experience. Kant thus offered a potential insight into the unexplored secrets of cognitive aesthetics, into the creation of algorithms of aesthetic experience and judgments. The applicability of this approach is documented not only by numerous studies by contemporary cognitive psychologists and aesthetics, but also by the evolutionary reflection of the significance of beauty for the individual from the point of view of a beautiful object's participation in the creation of an ideal or type norm and the issues connected with it. At the same time, he made it possible to consider aesthetic experiences as a dynamic mathematical operation, which allows him to extend his views to other fields of perception and thought.

---

<sup>13</sup>Similar to "A judgment of taste rests on a priori bases" (Kant 1987, 67-68).

## Acknowledgements

This work was supported by the Slovak Research and Development Agency under the contract No. APVV-15-0294.

## References:

- Broadie, A. (2010): Art and aesthetic theory. In: Broadie, A. (ed.): *The Cambridge Companion to The Scottish Enlightenment*. CUP, 280 – 297.
- Calder, A. J. et al. (2011): *The Oxford Handbook of Face Perception*. OUP.
- Cleve, J. v. (2004): Reid's Theory of Perception. In: Cuneo, T., Woudenberg R., v. (eds.): *The Cambridge Companion to Thomas Reid*. CUP, 101 – 133.
- Démuth, A. (2009): *Poznanie, vedenie alebo interpretácia?* Pusté Úľany : Schola Philosophica.
- Graham, G. (2014). Aesthetics as a Normative Science. *Royal Institute of Philosophy. Supplement*, 75, 249 – 264
- Guyer, P. (2014): *A History of Modern Aesthetics*. Vol. 1., CUP.
- Hume, D. (2012): *A Treatise of Human Nature*. Create Space Independent Publishing Platform.
- Hume, D. (2008): *Selected Essays*. Oxford World's Classics, OUP.
- Jaffro, L. (2008): Some Difficulties with the Reidian Argument for Aesthetic Realism. *14th Conference of Japan-Korea Aesthetic Studies Society*, Japan. 129 – 142.
- Kant, I. (1987): *Critique of Judgment*. [Trans.: Werner S. Pluhar] HPC Classics Series. Hackett Publishing.
- Kivy, P. (2004): Reid's Philosophy of Art. In: Cuneo, T., Woudenberg R., v. (eds.): *The Cambridge Companion to Thomas Reid*. CUP, 267 – 288.
- Langlois, J. H, Roggman, L.A. (1990): Attractive faces are only average. *Psychological Science*, 1: 115 – 121.
- Perrett, D. (2010). *In Your Face*. Palgrave : Macmillan.
- Reid, T. (1969): *Essays on the Intellectual Powers of Man*. Cambridge, Mass : MIT Press.
- Rhodes, G., Proffitt, E., Grady, J., M., Sumich, A. (1998): Facial symmetry and perception of beauty. *Psychonomic Bulletin & Review*, 5: 659 – 669.
- Rhodes, G., Sumich, A., Byatt, G. (1999): Are average facial configurations attractive only because their symmetry? *Psychological Science*, 10: 52 – 58.
- Wenzel, CH, H. (2001): Beauty, Genius, and Mathematics: Why Did Kant Change His Mind? *History of Philosophy Quarterly*. 18 (4): 415 – 432.