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The evolution of the car: An investigation into product history. Similarities, contrasts and questions.

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Abstract

This paper investigates a selection of the points of similarity and contrast between biological evolutionary systems and the development of the car over the last hundred years or so. The suggestion is that publishing of car information, usually but not always in the form of demonstrating that a particular car exists, is what constitutes the equivalent of a gene pool for car designers. Areas of car layout and form are investigated using a set of examples that are analogous to fossils and hence are not intended to be representative. These data support the concept that car designers use car culture to provide significant design thinking, and track the way in which car layout and form have evolved. The suggestion that car evolution commenced with a series of unstable states followed by periods of significant relative stability has been supported, particularly by the layout data and the existence of a particular 'Vintage' car paradigm.

1 Introduction

Quite clearly cars are not living things. They are created by human effort and are developed through a programme of human endeavour. In casual conversation we talk about products evolving. We mean that change is going on and the social, historical and cultural environment affects the way that this takes place.

Since Darwin evolutionary thinking has become part of the fabric of our thinking so that we find no difficulty in understanding statements such as:

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Of course, cars do not have any DNA. We understand the metaphor because evolutionary thinking is entrenched within our societal paradigm. Simonton's [2] statement that "...primary Darwinism emerged triumphant in the scientific community" sums up the current scientific situation, and is mirrored in society.

2 Evolutionary systems

2.1 Primary evolution

This term is used for the evolution of biological life forms. It contains the following: 1) A reliance upon the genetic make-up of individuals; 2) The genetic make-up of parents combines to determine the genetic characteristics of their offspring; 3) Mutations achieve changes within the genetic make-up of individuals, and these mutations are passed on through generations; 4) The environment is hostile in that there is always a struggle for existence of any individual life form. This favours the survival and breeding from the more advantageous parts of the gene pool or mutations. 5) These changes that take place ensure that the genetic make-up of populations shifts to become more in tune with the environment and to have a better chance of survival. Microevolution is concerned with alterations of the individual examples of life forms, and macroevolution with the way the multitude of individual variations in life-forms effect changes within the overall population.

2.2 Secondary evolution

This is used when evolution is used to describe changes that are not directly attributable to the development of living things. What is being discussed is not evolution, but an analogous process. Simonton [2] states that the appearance of evolution is not the concern of the researchers, but that the existence of some evolution-like mechanism needs to be established.

Martindale [3] investigated the development of artistic expression and suggested that three elements were needed for similarities between evolutionary theory and (in his case) other developments to be valid. 1) There should be a reason for the variations; 2) there need to be selection criteria; 3) there should be mechanisms of retention – or reasons why memories of art should form part of the social culture analogous to the gene pool.

Simonton states that in a similar way to genes being used as units of transference of organic evolutionary information, things coined 'memes' are used as units of transference or cultural material. These include things like tunes, ideas, catchphrases, ways of making jewellery – or of designing cars, presumably.

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3 Processes of product development

It is Simonton's [4] premise that creativity does not function in a vacuum. The product design process has creative elements within it, and thus may benefit from the insights of those who develop ways to improve creativity such as Petty [5], Dewulf and Bailie [6], de Bono [7] and many others.

The methods used in product development vary significantly with the nature of that process. For products with entirely new principles the plan may be similar to that proposed by Pugh [8], Pahl and Beitz [9] and others, and will involve stages such as; 1) A product definition stage; 2) A conceptual design stage; (a creative stage) 3) An embodiment, layout, scheme or perhaps development stage; 4) Detail design stage where the product are finalised and defined for production. With a mature product area, the product may be the development of an earlier design. Knowledge of the product area is crucial and the design process may start effectively at embodiment stage. Creativity is indebted to previous products in the area. This has much in common with the process called 'trawling' by Petty [5] or with the Japanese process of Mastery [10].

3.1 Car development

What of the car? Cars are clearly a well-known generic product area. The process is of development and not radical change. Cars have been with us for over a century. Significant embodiment information exists for the product definition stage. The designers take this information and from it turn the proposal into concrete embodiments. The embodiment stage is crucial.

How about the car designers? Most designers are car enthusiasts. It has always been so. Cars stir the emotions, at least in car designers. But they want to create their own thing. This is sparked off, largely, by car culture. Car culture depends not on the existence of cars, but on evidence for those cars, which may be idea-based or published as much as the existence of real cars. Success or failure of a car depends on the influence that the published idea or car achieves rather than on market success.

3.2 Retention mechanisms

Most cars in circulation are less than ten years old. Cars are not like Old Masters or houses. Classic car possession and use, in spite of the assertion in the Classic and Sports Car magazine that the classic car business in the UK is worth £1.6 billion a year [11], is a minority pastime. Martindale comments that for most of us "... the evolution of art has about as much to do with you or me as the evolution of kangaroos... We are observers."[3] He then comments about Edsels (a late 1950s / early 1960s US car) "We can boycott Edsels, and they will become extinct." But we only need to have had one Edsel for the idea to be passed on. It needs to be where car enthusiasts will see it, and then it will become part of car culture. Breeding status for cars consists of a car idea being published. Thus cars work very like the art that Martindale is working with.

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4 Car history investigation

Car history appears to have an early, confused state, with designers not being sure how to design this product. It then settles down to a stable design paradigm [12]. This appears to change developmentally, when the emphasis moves from the car being a means of making transport work to becoming either a holiday or a means of carrying space around.

4.1 The investigative process

There is no shortage of car data. But it is difficult to select representative data. In practice, historic cars can be perceived as fossils, each contributing something to the knowledge bank. Palaeontologists, it is assumed, do not have the luxury of selecting whether individual fossils are representative or not. They use fossils that exist to fit into whatever they are investigating. Hence, provided enough data is there, being representative should not be a problem. Thus a messy set of data was used to investigate car history. This consisted of colour slides of 453 cars from 1878 to about 1999. These were produced out of interest with no attempt to produce a representative set, although some were used for teaching car history [13].

Each car was coded for layout and form. There were 19 layout variables and 47 form variables. Most were qualitative, using common motor industry descriptions for things such as suspension form. Some layout variables had default values, such as number of wheels (4), wheel layout (2F2R) and direction control (steering wheel).

Cars were split into five-year periods. In the early years it was difficult to find 'fossils', and there was only one vehicle from the first period, none from the second and only four from the third. During the First and Second World Wars there was little car manufacture; the 1915- 1919 period has six cars and the 1940-1944 period three. The slides were mostly taken at Classic Car events and in museums, so there are few cars from more recent periods, and many of these are non-representative such as replicas.

5 Results

5.1 Individual variable results

Engine position, driven wheels and crankshaft orientation were deemed to be fundamental to the layout, and they varied as expected, with initial uncertainty about where to put the engine. This stabilised to a layout with a front longitudinal engine and rear wheel drive as early as 1904. This was expected to change significantly after the Mini in 1959. In fact, the effect of this was later; only after the early 1970s transverse engines and front wheel drive became commonplace. More surprising was the change in front suspension design during the 1930s. In the 1930-1934 period most cars had beam axle front suspension. In 1935-39 there are 50% beam axles and 50% independent arrangements. After the

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Second World War, the front beam axle is virtually dead. With rear suspensions a similar shift occurs, but much later and more gradual, becoming almost complete by the early 1980s.

Another factor that had a major effect on car history has been the pneumatic tyre. The effect here is very marked. The 1895 Peugeot was billed as the first car fitted with pneumatic tyres: by 1900 virtually every car was so fitted and the transition is almost total, with only four later cars having solids.

5.2 Layout variable results

The nineteen layout variables were reduced to two dimensions using an optimal scaling process. Figure 1 shows the overall result.

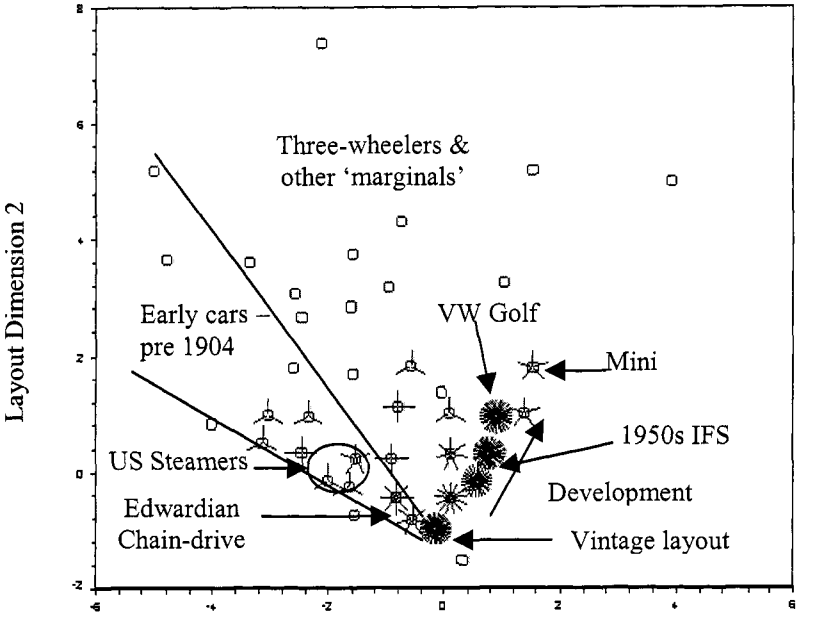

Figure 1 Optimally Scaled Layout Dimensions

This plot shows four major concentrations of cars (denoted by 'star' points) in an inclined line in a rough NNE direction, plus some lesser concentrations. For early periods up to 1904 the results start by being broadly spread, narrowing time to point at the star at the lower end of the major inclined line. This star is very closely defined, with very little spread and a very large number of cars. They are effectively the most common layout from the Edwardian period up until the end of the Vintage period, from about 1904 up until the mid 1930s. The layout

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consists of a longitudinal engine at the front of a channel chassis, rear wheel drive by shaft and rigid axle suspension using semi-elliptic leaf springs at both ends. There may be four or six cylinders, or occasionally eight, normally with an in-line configuration. Bodies are wooden framed with applied steel or aluminium panels and are non-structural. Figure 2 shows some examples of this layout.

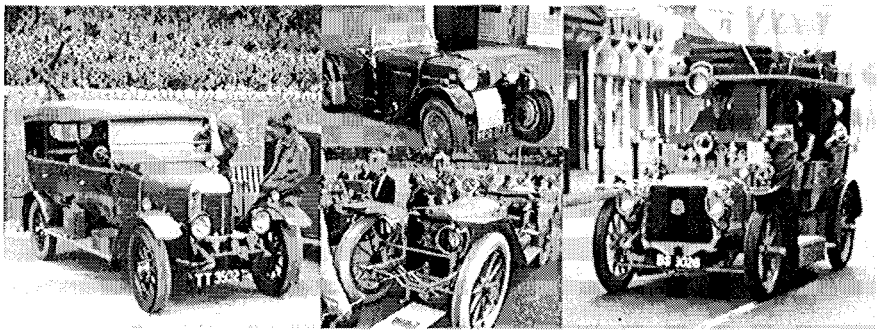

Figure 2: Examples of the 'Vintage' layout paradigm

After this the layout develops, resulting in the three major star points and the minor ones along the inclined line. This consists of independent suspension at the front, integral structure, and front wheel drive. What appears to happen is that a pioneer moves out along the line, and then imitators close the gap between the status quo. Typical pioneers were the Lancia Lambda of 1922, Citroën *Traction* 11 of the 1930s and the BMC Mini in 1959. The Mini is somewhat out on a limb to the right, with a significant number of layout innovations. Later cars move towards that position but, for instance, kept coil spring suspension. The VW Golf, Vauxhall Astra and similar cars occupy a tightly constrained star. In between these front-wheel drive, transverse engined cars there are some other star points. These represent rear-wheel and front-wheel drive vehicles, of about the 1950s. These have independent front suspension, with struts or wishbones using coil springs, but probably rear beam axles, using coil springs or leaf springs.

The component loading vectors tend to be roughly parallel and perpendicular to this inclined line. Parallel components include structure type, suspension variables, engine type and driven wheels. Perpendicular ones include steering control, number of wheels, number of cylinders, crank orientation, engine position, driver position, final drive type and tyre type. Although some of these do not define marginality, it would appear that cars further from the inclined line become less car-like in character. Engines move from being in the front to being behind the driver, and they shed cylinders: cyclecars may not have shaft drive and may be chain-or belt-driven: drivers may be in the centre or even behind the passenger and steering may be by handlebars or (in early days) a tiller. Even further removed from the inclined line are cars with three wheels, solar power, electricity or steam. If the car is be defined in 'folk' terms, a suitable measure

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may be how far the vehicle was away from this inclined line. Figure 3 shows a smattering of these eccentric vehicles – or are they cars?

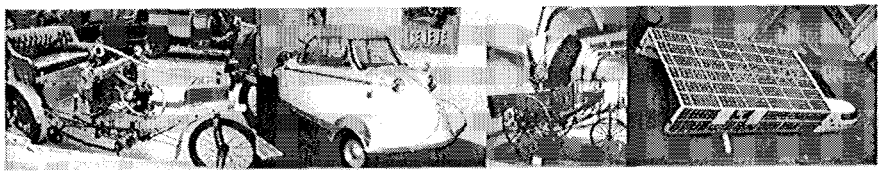

Figure 3: Non-mainstream cars

5.3 Form variable results

Form variables were reduced using the optimal scaling process, but in three dimensions.

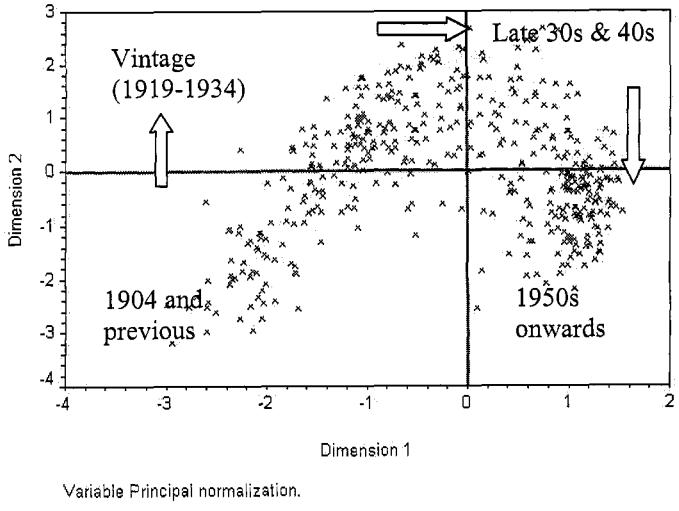

Figure 4: Form Dimensions 1 & 2

The plot of the first two dimensions, Figure 4, shows a progression. Early cars, before about 1904, are almost exclusively in the lower left quadrant. In the next period, 1905-1909, about two thirds of the cars are in that quadrant, with the other third in the upper left. The next period shows cars in the same two quadrants, but proportions are reversed. From the First World War to the early thirties the upper left quadrant predominates, but there is a shift to the upper right quadrant in the late thirties. Post Second World War, the upper right quadrant predominates, but during the 1950s the emphasis shifts to the lower right quadrant, and it stays there subsequently. See comments written on Figure 4. It is

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difficult to identify what characterises each dimension: it is easier to describe the quadrants. The lower right one is characterised by height variables, the upper right by roundedness. The lower right quadrant appears to be characterised by wing types and headlight positions. Bonnet length and cockpit front position load in the direction of the second dimension. Typical cars from each quadrant are in Figure 5.

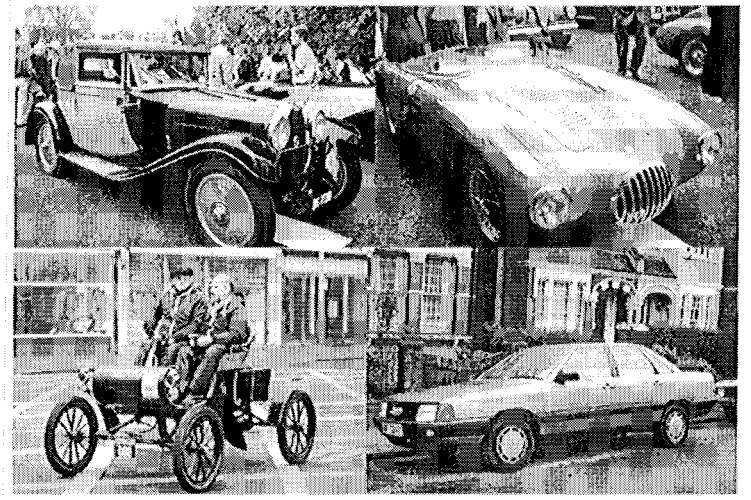

Figure 5: Examples of cars from each of the Form 1 and 2 Quadrants

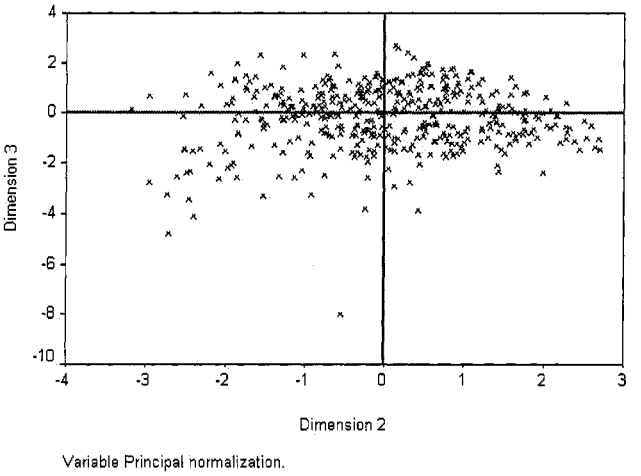

Figure 6: Form Dimensions 2 & 3

Figure 6 shows form dimensions 2 and 3. The position in terms of period is less clear. There appears to be no clear progression. However, three of the

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quadrants are reasonably easy to describe. Cars in the lower left quadrant tend to be those with rather skimpy bodywork, running boards and separate wings. Those in the upper left tend towards more formal; higher, and with more rows of seats. In the upper right quadrant, the cars have longer bonnets and are more rounded. It is a difficult to determine what is in the lower right quadrant: small cars such as the 1925 Citroën 5CV and Fiat Topolino jostle with more sporting ones such as the Jaguar XK120. Figure 7 shows examples of cars from each quadrant.

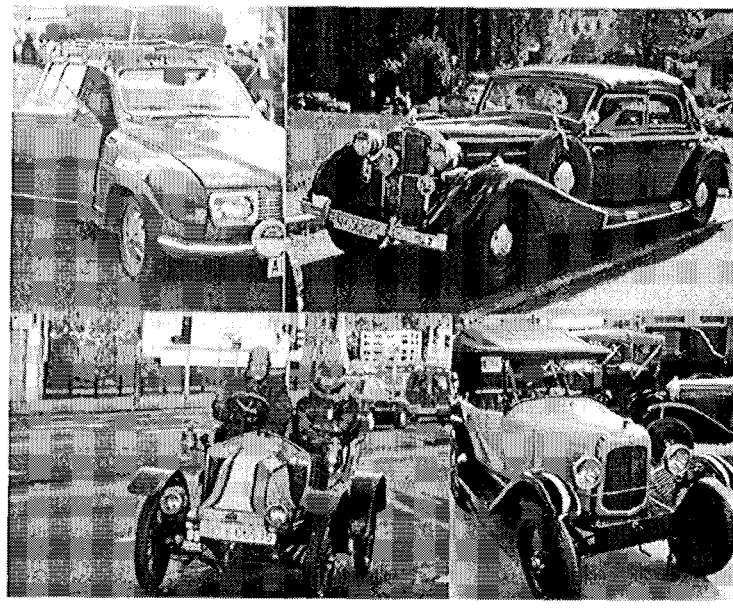

Figure 7: Examples of cars from each of the Form 2 and 3 Quadrants

6 Conclusions

It would seem very clear that knowledge of recent cars forms part of the inherited understanding possessed by car designers. This is particularly clear when layout parameters are measured and is significant when car form is measured, even with the unrepresentative data used for measurement. The fact that the data is in the form of 'cars which were interesting enough to take pictures of' rather than any coherent set of cars from, say, sales figures, would tend to confirm that it is indeed something other than sales figures that forms the major criterion for car designers.

In terms of car layout, the data confirms the clear existence of a design paradigm from a very early date, which is then developed. Cars that are a significant distance away from the accepted line of car development tend to be

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regarded as marginal vehicles and a little eccentric rather than serious contenders in the market.

It is also clear that knowledge of cars from some time ago is not considered relevant for car designers, either in terms of its form or its technology. While one recognises that technological improvements have taken place, something of, say, a 'classic' form may have been envisaged for cars, harking back to what might have been perceived as a 'Golden Age' – perhaps the Vintage period, in a similar way to the classic revivals in Architecture.

This would seem to be clear evidence that something akin to the processes of evolution is indeed taking place in the development of the car.

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