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Early car history – investigation of the establishment of a ‘design paradigm’

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Abstract

The early development of the car appears to have been a period of uncertainty, with a selection of component layouts being developed before manufacturers hit on a particular embodiment that became a definitive ‘car’. This paper investigates how car form and layout became what is termed a ‘Design Paradigm’ (Dowlen 1999) for the car, during the late 19th and early 20th centuries.

Layout and form variables are investigated from 453 colour-slide examples over the whole period of the existence of the car. The results show that the layout is significant to the concept of a car, and shows that a tightly constrained design layout paradigm develops around 1904, developing from a broad range of layout concepts. Form is less significant, but shows an appreciable change to a relatively stable condition over a period of about five years from 1904.

The tightly constrained layout consists of a front-mounted longitudinal engine and drive by shaft to the rear wheels. There are a significant number of other layout variables that describe the layout. Before this date designers had many different ways of laying the components out, and there are some clusters of layouts, particularly with the US cars. In terms of their form, early cars are generally taller and with shorter bonnets than later cars, and tend to have a squarer form.

Early car history – investigation of the establishment of a ‘design paradigm’

Introduction

The early development of the car appears to have been a period of uncertainty, with a selection of component layouts being developed before manufacturers hit on a particular embodiment that became a definitive ‘car’.

This paper investigates something of the way in which the many and various forms and layouts of cars, automobiles, horseless carriages and whatever one might wish to call them became what is termed a ‘Design Paradigm’ for the car. The paper brings together work that has been carried out on a pragmatic level. Firstly, this has been concerned with using car history in teaching students of both engineering and design (Dowlen 1997), and secondly, this was developed, again at a pragmatic level, into a general theory about the development of these ‘Design Paradigms’ (Dowlen 1999). In parallel with this paper an overview paper, looking at the general evolution of the car has also been produced (Dowlen 2002). This paper is also concerned with the parallels between evolutionary theory in life forms and the evolution of the product, in this case the car.

The assertion is that the degree of change seen in the layout and form of the product during these early years of development was significantly greater than the degree of change seen in the layout and form during the period after the definitive car form and layout became established.

Invention and evolution

Who invented the car? Andrew Whyte (Whyte 1984), along with general tradition, states (page 8) that the first motor car was made in Germany, and that traditionally has always said the honour belongs jointly to Carl Benz and Gottlieb Daimler who separately produced vehicles powered by internal combustion engines in 1885 and 1886. Benz patented his ‘carriage with gas engine’ in January 1885. But in going along with tradition, not only do we ignore the claims of Siegfried Marcus who may have built a petrol powered car in Vienna in perhaps 1875, but we also have to insist that cars have internal combustion engines, and it is quite obviously true that not all of them do – some are powered by steam, some electricity, some by sunlight and some even by pedals (and we still call these cars and not something else). However, it would be very difficult to describe Nicolas Cugnot’s steam powered gun carriage of 1770 or Robert Trevithick’s steam carriage of 1801 as cars; but perhaps not so difficult to describe Amédée Bollée’s steam vehicles of the late 1870s and 1880s or Count de Dion’s steamers of a similar date as such.

There is also the argument that neither Benz nor Daimler could lay claim to the invention in 1886: the former because although his carriage was purpose-built, it only had three wheels and therefore classed as a tricycle and not a car; and the latter because his four-wheeled powered vehicle consisted of one that was originally horse drawn and was adapted by the fitting of an engine between the front and rear seats, cutting off the horse shafts and adding some sort of steering device.

In any event, it perhaps seems strange that two people working separately should come up with the same invention, but it could be argued that the notion of self-powered vehicles was something that was almost bound to become a reality, given the social setting at the time, the existence of steam-powered road (and rail) vehicles and the earlier invention of the four stroke internal combustion engine by Otto in 1876, itself a development of Lenoir’s gas-burning engine of 1860.

Simonton (Simonton 1988) develops the proposition that ‘Creativity involves the participation of chance processes both in the origin of new ideas and in the social acceptance of those ideas by others’ (page 388), noting that the chance processes include obtaining of information and ideas from the social context as well as the acceptance of the outcomes into that social context. He goes on to cover the topic of multiple discovery and invention, where two or more people working independently make the same discovery or invention at the same or a similar time. He suggests that if the invention were given a generic name (he cites such as “steamboat” or “airplane”, p416) then such multiples are often completely different inventions. Looking at the 1886 vehicles of Daimler and Benz it is obvious that there are significant differences and that the major similarity is the accomplishment of self-powered transport using an internal combustion engine. Simonton’s theories on the mechanisms of creativity owe more to evolution than invention, and it is clear that this is the case in terms of the car.

Design paradigm

But one could assert that the car became in reality a car at a later date: that date when a definitive layout was established and when to build a car was to build a product that not only powered itself but that possessed the layout of a car and looked like one too. When students are asked the question about who invented the car, apart from the fact that most of them have no real idea, the most common answer is neither Benz nor Daimler, but Henry Ford: and they cite not his first conveyance of 1896 but relate more readily to Model T production, which started in 1908. This argument could be reasonably persuasive, but it needs a certain amount of clarification. If the car is going to be determined in these layout terms, it would be useful to, firstly, determine what the layout is, secondly how far removed from any definitive layout would a vehicle have to be in order to qualify as a ‘car’, as opposed to a cyclecar, a horseless carriage, a quadricycle or something else and thirdly, at what point in the history of powered road transport was such a concept determined. It would also be an interesting historical phenomenon to try to determine either which vehicle was the first with such a layout, who built it and whether subsequently that vehicle was taken up as being the original one that was looked to as the pioneer by the future car designers.

Thus the suggestion is that the answer to who invented what depends on the definition, and that this is in turn of a prototypical nature and is situation-dependent (Lakoff 1990; Shackleton and Sugiyama 1996). What we are seeking to determine is what was the original prototype (defined in these terms) for the car, what is the typical arrangement, layout of that car prototype and, if possible, who determined it and when. It is probably more easily understood if the term design paradigm for the car is used rather than prototype, as in the context of product development the term tends to mean the original example of a product that is later to be mass produced. It would be useful to know how closely defined this design paradigm would be, and at what stage either a car ceased to be a ‘car’ due to its distance from the typical example of the paradigm.

Analysis

This study forms part of a larger study to investigate the development and evolution of the car over the whole period of its existence. The data used in the study consists, initially, of the analysis of a series of cars, taken as being analogous to a series of fossils that might be used to investigate directions that natural evolution might have taken. As such, the fossils were considered by their existence to be examples that would have to be placed into the context rather than selected carefully as being representatives of whatever context was envisaged. What was required was a significant number of examples rather than a representative sample. It is debatable how such a representative sample could be achieved, as the criterion for selection would have to be that of influence over designers rather than, say, from sales or marketing figures, and this influence by its very nature is impossible to quantify. The series of cars used was 453 examples on colour slides covering cars from 1878 up to about 1999. These had been taken for interest rather than any other reason. At

some stage other examples of cars taken from published information, photographs can be added into the data set, and the hypotheses re-evaluated.

These car examples were divided for convenience into date periods of five years. This gave sufficient examples in most periods for a reasonable selection of results to be achieved, although the somewhat esoteric nature of the slide collection became obvious during the analysis. The periods with too few examples were the very early periods, because there were few cars and even fewer of the experimental examples were kept, the two world war periods, when, again, few cars were produced, and some of the more recent periods where the bias towards classic car events and the unusual became more obvious. They were analysed in qualitative terms for nineteen layout variables and forty-seven form variables. The country of origin was also noted.

Eight of the layout variables had what were taken as default values. These included such things as number of wheels (default, 4) and their orientation (default, 2F2R) and steering control (default, wheel). Most of the variables were taken as nominal, but a few were classed as ordinal, such as degrees of roundness (although these were described verbally) and a few, such as number of wheels, were obviously numerical in character. The nominal and ordinal variables were given categorical numerical values for analysis purposes.

The layout and form variables were reduced using the optimal scaling procedure within the SPSS program to two dimensions for the layout variables and three for the form ones.

Overall study results

The results over the whole period (not using the term in the five-year sense) showed some interesting progressions. Figure 1 outlines the results for the layout variables.

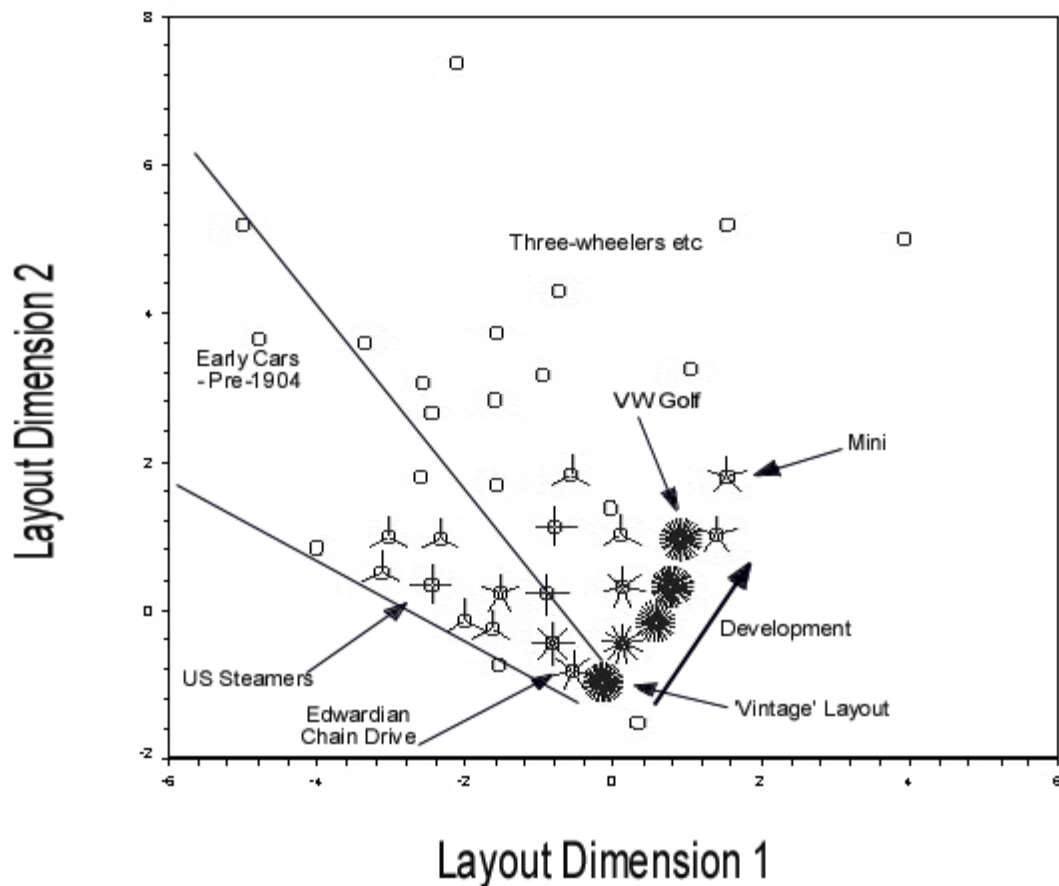


Figure 1: Optimally Scaled Layout Dimensions

Essentially, this demonstrates that in the early periods, car designers had little history to guide their developments and a design paradigm had not really been established. By about 1904, the first car in the cluster of results labelled 'Vintage layout' had been built, and this layout continued to be the prime layout for cars from this date right through what are known as the Edwardian (1905-1919) and Vintage (1919-1930) periods, and into the next five year period of the study (to 1934). During the 1930s, there is a significant shift and the layout develops in the direction shown. The general process is that a pioneer moves out in the general direction and then others come in 'behind' as it were, to fill the gap between the pioneer and the current paradigm.

Figures 2 and 3 show the results for Form variables, with the dimensions 1 and 2 plotted against each other and dimensions 2 and 3 plotted against each other.

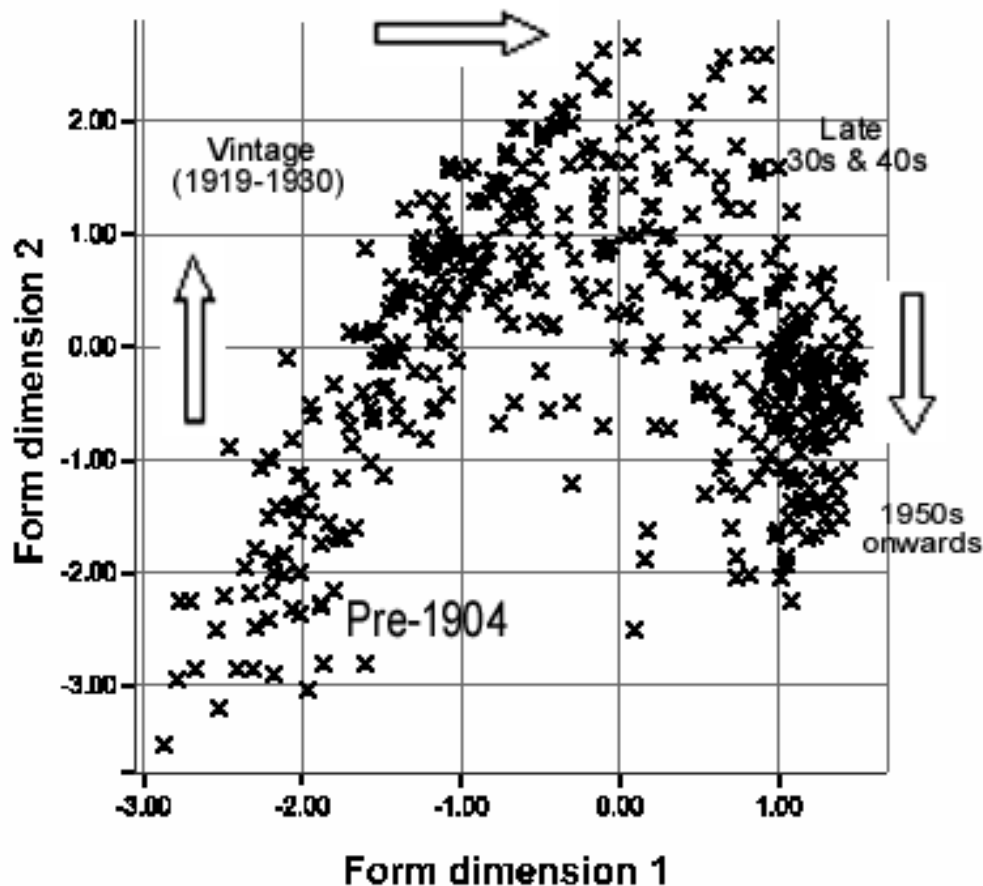


Figure 2: Form dimensions 1 & 2

Figure 2 has been annotated to indicate that a general direction of development occurs; with cars from the early periods almost exclusively being in the lower left quadrant, and those from the Edwardian periods moving towards the upper left one. The Vintage periods from 1919 to 1934 show results primarily in the upper left quadrant, with a significant move into the upper right quadrant from 1935 onwards. In the 1950s there is a further move into the lower right quadrant, from where there appears to be no significant movement to the present.

Figure 3 (and particularly dimension 3) shows little clear movement with period, but does show different types of cars in the different quadrants, with those with more rows of seats and more formality being in the upper left quadrant: two-seaters being in the lower right. Cars in the lower left quadrant tend to be those with rather skimpy bodywork, running boards and separate wings. In the upper right quadrant, the cars have longer bonnets and are more rounded.

It is a little difficult to ascertain exactly what the three form dimensions relate to, but it would appear that form dimension 1 relates to roundedness criteria, form dimension 2 relates to proportion, particularly the length of bonnet and position of the screen as well as simply length and height, and form dimension 3 seems to relate to formality and carrying capacity.

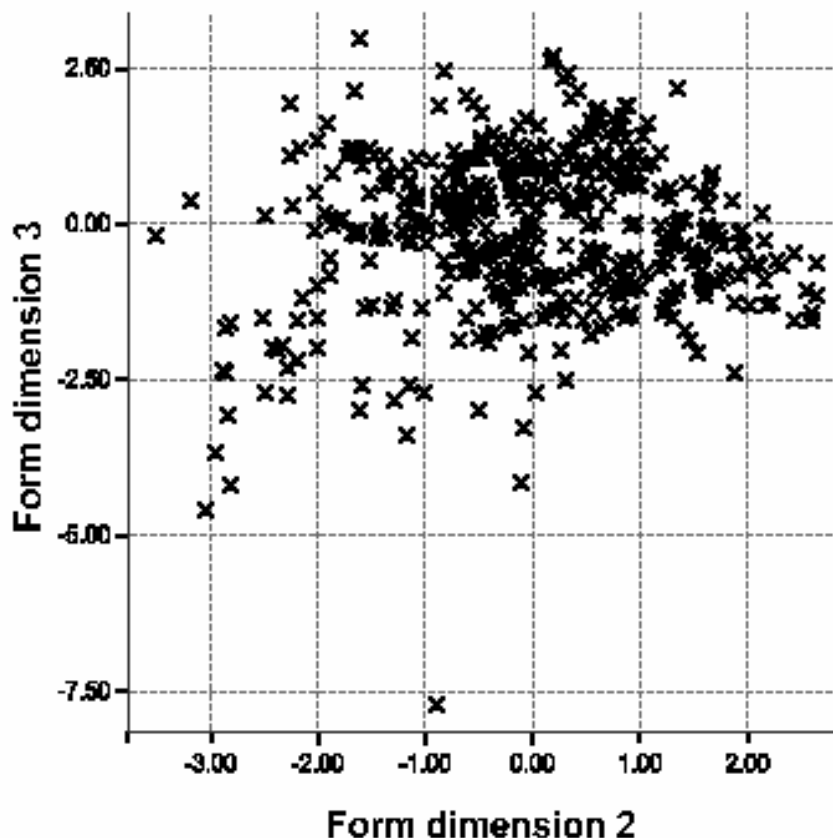


Figure 3: Form dimensions 2 & 3

The early periods

These are the results for the whole study. It is particularly interesting to focus in more detail on the results for the early periods, as it would seem that something significant takes place at around 1904 both in terms of layout and the first two form dimensions.

The earliest car (if that be the correct title) in the slide survey was the Amedée Bollée's La Mancelle of 1878. This was a steam driven vehicle designed for use by a wealthy individual with a driving position at the front, carriage compartment further towards the rear and boiler and firemen at the rear. It is the only vehicle in the first period, and there are no slides in the next period from 1880 to 1884. In period three there are four vehicles: two by Benz and two by Daimler. One of each of these is their first internally-powered vehicle, and the other is a development, but while Benz's first three-wheeled effort looked more like a bicycle than Daimler's modified carriage, Daimler's development is more along cycle lines and Benz's tends towards carriage form, although still a three wheeler. In period four there are five examples, three by Benz and one each by Panhard and Peugeot. However, in the next period, 1895-1899, there are as many as nineteen examples and in the sixth there are thirty-three. For the subsequent period, 1905-1909, there are sixteen cars. The larger number of cars in period six is simply because they are the most numerous period for the Veteran Car Club's annual Brighton run, and many of the pictures were taken during this. Four countries are represented: France, Germany, Britain and the USA.

Layout development

As was perhaps expected, the major layout variables of engine position, crankshaft orientation and driven wheels show that the layout quickly settles down to a front mounted engine with longitudinal crankshaft and rear wheel drive. Table 1 shows the early variations:

These data on their own suggest that there is more of an evolution rather than a definite adoption of a particular way of thinking. Looking at the other, perhaps minor variables, including suspension characteristics, steering control, wheel sizes and tyre types, the development that stands out significantly in this early period is the take-up of the pneumatic tyre. The 1895 Peugeot was billed as the first car with pneumatic tyres. By 1900 any other form of tyre appears to be virtually dead. After that date there are only four cars in the total survey without pneumatic tyres: one of these is a half-track and one is a pedal car, leaving only two examples seriously putting forward the use of solids. Pneumatic tyres have the character of an invention rather than a development.

Period	Dates	% Front engine	% Longitudinal Crankshaft	% Rear wheel drive	% all three
1	1875-79	100	100	100	100
3	1885-89	0	0	100	0
4	1890-94	20	100	100	20
5	1895-99	32	38	95	21
6	1900-04	55	64	100	47
7	1905-09	86	73	100	67
8	1910-14	96	93	100	93

Table 1: Change towards front engine – rear wheel drive configuration

Values obtained from the optimally scaled outputs can only be regarded as comparative as the scaling doesn't relate significantly to any particular variable, and the variables in any case have nominal values. But nevertheless it is interesting to compare the values obtained during this early period. Overall, the values for the first layout dimension vary from about -5 to $+4$, and for the second from about -1.5 to $+7.4$. During the early periods, up to 1904, the values for dimension 1 are all negative, and those for dimension 2 vary from -1.06 to $+5.2$. The nature of the clustering is interesting. Over the whole of the analysis, the 'Vintage' layout cluster contains fully 49 examples (11%) of all the cars within a square of ± 0.05 in both axes, on the same scale. If the tolerance is opened out to ± 0.2 , this cluster contains 95 cars, or 21% of the whole. The characteristics of cars in this cluster are very closely determined.

Not only do they have front longitudinal engines and rear wheel drive using a shaft, but they also have channel chassis frames, coachbuilt bodies using ash framing and either aluminium or steel panelling and rigid axles at front and rear using semi-elliptic leaf springs. Steering is by steering wheel, with the driver sitting at one side the front, and the cars run on four equally sized wheels shod with pneumatic tyres. Their engines have four or six in line cylinders in an in-line configuration. The earliest cars in this cluster in the survey are three cars from period 6 (1900-1904): a 1902 Panhard Levassor, the 1904 Peerless Green Dragon and a 1903 Mors. The arrangement of front engine, rear wheel drive is generally known as the *Système Panhard*, and although it is actually named after the earlier, less defined layout that was produced in 1892, it would seem that Panhard were still in the position where they were influential, although of course there is not the completeness of the data that would be appreciated in determining this.

At a later date, starting during the late 1930s, there appears to be a developmental movement, moving in a line at about 30° from the vertical (dimension 2) axis. This could perhaps be described as a line of car development, with cars away from the line signifying their distance from being 'cars' or 'real cars' in general parlance.



Figure 4: 1902 Panhard and 1903 Mors

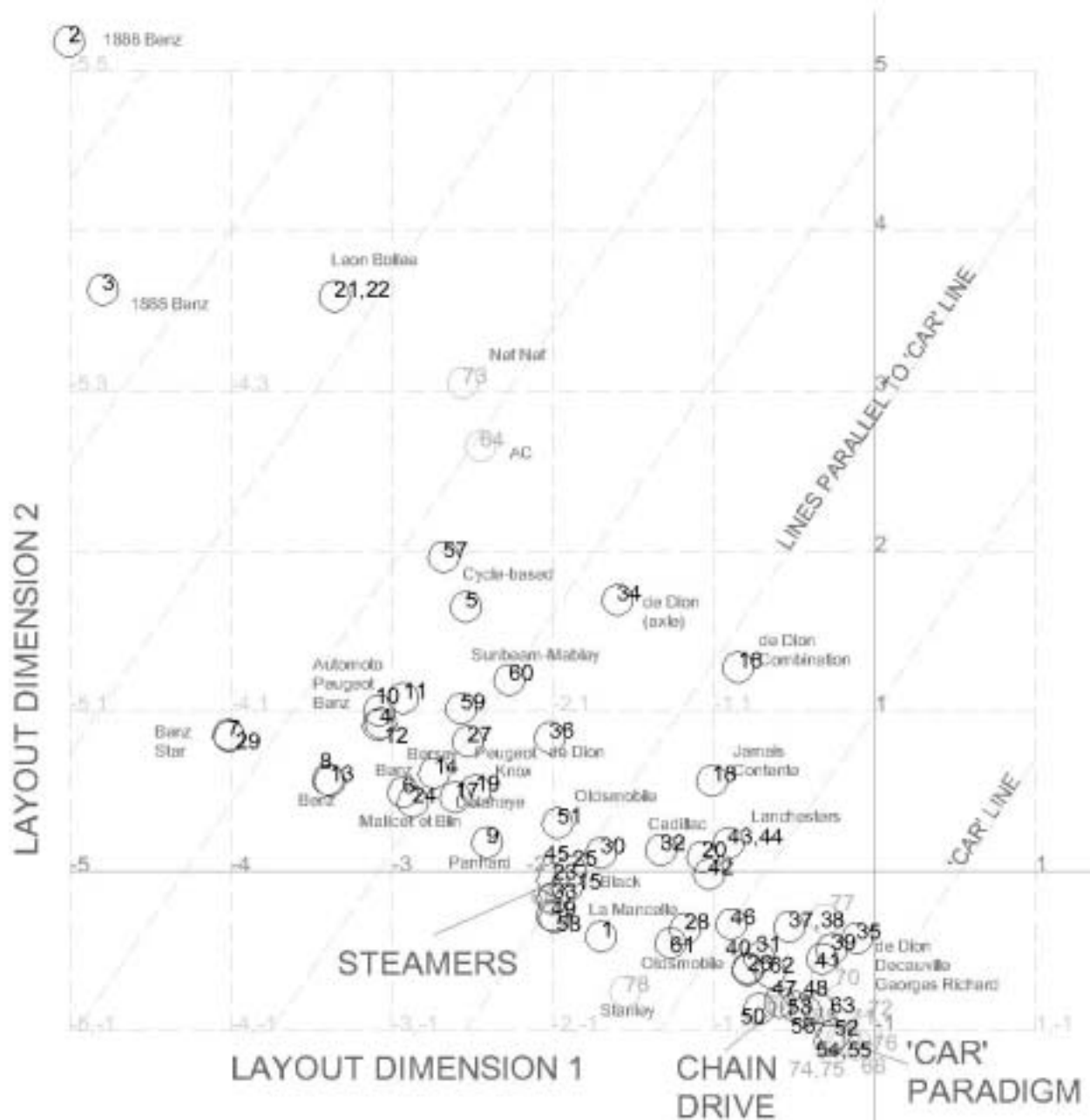


Figure 5: Layout results for early years with annotation
Results up to period 6 in black: period 6 in grey

In the early periods, the movement appears to be from a position of uncertainty towards this 'Vintage' layout, with cars from the early periods, up to and including period 6, lying roughly in a sector to and pointing towards the 'Vintage' point.

Within this sector there are nevertheless a number of clusters of cars. Just behind the Vintage point is a small cluster with shaft drive, but a smaller number of cylinders, one or two, than the norm, and another cluster with chain drive rather than shaft drive: a smaller cluster slightly further away contains a small group of cars with steam engines under the driver's seat, suspension by full elliptic front and rear on a pram frame: steering is by tiller. This cluster is perhaps epitomised by the Locomobile Steam Buggy. Although not part of the analysis, this entire cluster hails from the United States. Developments of this cluster, again mostly in the United States, move away from it when suspension systems are improved, engines become internal combustion and steering is by

wheel, but there are still examples of the arrangement – such as the Stanley Steamer, shown on the diagram in grey – being built up to the First World War. Thus although the cars are all in similar places in the layout analysis, the cluster becomes dispersed and confused by other cars such as early Panhards and Daimlers (front engine, chain drive, solid or iron tyres, twin cylinder engines) forming another loose cluster on top of them. An even broader group of cars is that formed by the early Benz models – calling them a group may be a little far-fetched, as they all seem to just appear somewhere in the same place on the diagram. The very early Benz models were three wheelers, and these seem to be very far away from the ‘car’ paradigm. Other three wheelers such as the Léon Bollée tri-cars are also far removed from the ‘car’ line.



Figure 6: Skene (top left), Mobile (top right) and Locomobile (lower) steamers



Figure 7: 1900 Daimler (left) and 1892 Panhard (right). Note iron tyres.

Form development

With the form variables, the clustering element is not so great, particularly with cars of this sort of date. This would appear to be an indication that every car at this sort of date would have been unique, particularly where the form of the body is concerned, which is what is being measured or at least compared. When the results of the first two form dimensions are inspected, there is a clear progression with time, although the precise positions of data points is still somewhat arbitrary due to the type of analysis performed. In the early periods, such as the ones being investigated particularly in this instance, most of the results for these two dimensions load into the lower left quadrant. With the next few periods, the entries tend to be moving into the upper left quadrant, and during the late 1930s the entries move into the upper right one, to reach the lower right quadrant in about the 1950s.

Looking at the components, the lower left quadrant loads on the height and window height variables, and negatively on the bonnet length and various roundedness variables. This means that in our period we should expect cars to be characterised by being relatively high and short, with short bonnets and a general lack of roundedness, which is in fact what we get. At the end of the period, cars start to become longer and lower, with longer bonnets, such as the 60HP Mercedes and Peerless Green Dragon. Jenatzy's Land Speed Record car, which is in the same period, tends to be slightly out on a limb as it is considerably rounder than is normal in this period, being shaped like a pointed torpedo. It is in the upper left quadrant, almost into the upper right one.

Looking at the second and third dimensions a rather more confused picture emerges. The third form dimension does not really demonstrate much in the way of progression through time in the same way that the other dimensions do. Rather, it seems to load seat rows, rear of cockpit position, and numbers of doors in a positive direction – all things that contribute towards a more formal, staid car. Hence, in each period one might expect a selection of cars designed for carrying more people to have high values, and those designed for small numbers of people and sports use having low values. In our early periods, we would expect cars to have slightly lower values than in later periods, because of the relative absence of features such as doors, and indeed the mean value does rise a little. Typical cars with low values would be open two seaters with little formal bodywork such as

the Locomobile Steam Buggies, with those with more formal, closed bodies such as the 1903 Panhard Levassor to have higher values, which does indeed happen.



Figure 8: Jenatzy's La Jamais Contente, (right) 1904 Mercedes 60HP (left) and 1904 Peerless Green Dragon (lower)

Generally, during the early periods of the car, the results are more scattered than they are during later periods, indicating that there was a greater variety of form solutions as well as layout solutions, but with form variables there is not the same clear-cut 'car' paradigm as there is with the layout variables.

Progression

One of the particular difficulties of the somewhat 'messy' set of data used for this analysis is that there are a significant number of unusual cars within the data set. This, and the non-representative nature of the data, makes it difficult to obtain meaning from such things as means and deviation figures. Having said that, it would appear that there are a greater variety of approaches towards the design of cars within this early period, meaning that there are a greater variety of proposed solutions to the powered vehicle transport problem. After about 1904, it would appear that the changes in car layout slow down, focusing more on making the car more comfortable and usable than on altering the layout. Both layout dimensions show this slowing down, the second one particularly so. With the form variables it is much harder to indicate whether change decreases until a much later date. The relative importance of the variables should be ascertained, and this may indicate that a change in the nature of the form occurs, thus agreeing with the perceived changes.

Conclusions

It is quite clear that a number of closely determined design paradigms exist for the layout design of cars. In particular, the layout that commenced around 1904 persisted for a considerable time. Before that time there are a number of different car designs that form small clusters, but the general movement of car design is towards this very clearly determined paradigm from a broad range of layout possibilities.

Car form develops in a less closely defined manner, but still shows a definite progression. The change of character is much less marked than with layout, and it happens more gradually, from around 1904 to be completed within about five years.

Further work

There is no shortage of 'fossil' car material. The object of this study was to demonstrate that even with 'messy' data some useful trends could be discovered. A car layout and form database has been built up and needs to be augmented in order to confirm the findings of this investigation. It has been suggested that other methods of study such as Repertory Grid, used for determining conceptual thinking processes, might be usefully used in order to ascertain whether the measurements obtained are those that are perceived. This is particularly important in terms of the form variables, and could establish their relative importance.

References

Dowlen, C M C. 1997. Using Car History for Teaching Engineering and Design. *ICED'97*, 1997, at Tampere, Finland. Tampere University of Technology.

1999. Development of Design Paradigms. *International Conference on Engineering Design*, at Munich, Germany. Technical University, Munich.

2002. The Evolution of the car: An investigation into product history. Similarities, contrasts and questions. *Design and Nature*, In print, at Udine, Italy. Wessex Institute of Technology.

Lakoff, George. 1990. *Women, fire and dangerous things*. Paperback ed. Chicago: Chicago Press. Original edition, 1987.

Shackleton, John, and Kazuo Sugiyama. 1996. Attribute perception in Japanese recreational vehicle design. *Bulletin of JSSD* 43 (4).

Simonton, Dean Keith. 1988. Creativity, Leadership, and Chance. In *The Nature of Creativity*, edited by R. J. Sternberg. Cambridge: Cambridge University Press.

Whyte, Andrew. 1984. *The Century of the Car: 1885-1985*. London: Octopus Books.

