

Designing meaningful vehicle for older users: culture, technology, and experience

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DOI: 10.21606/drs.2016.277

Abstract: This study aimed to achieve understanding from the middle-aged vehicle users and from older vehicle users about differences between their current travel experience and future travel needs. A methodological triangulation consisting of interviews, logbook and co-discovery was used to collect multiple forms of data and explore the older vehicle users travel-needs-influencing factors within the Chinese cultural frameworks. This paper built a concept model to integrate these travel-needs-influencing elements that might give designers new knowledge to assist their innovations. It is envisaged that the proposed model can play an important role in the design process to help designers to better understand the relationship between culture, technology, older users' experience and design. The application of the model will focus on designing meaningful concept vehicle for the older Chinese users as a representative example.

Keywords: vehicle design; product meaning; older vehicle users; experience design

1. Introduction

With one fifth of the world's population, China is the first-largest automobile market in the world in terms of the number of vehicle users. Its rapidly growing economy, rising consumer income, large number of aging populations and particular socio-cultural context present automobile manufacturers with enormous market potentials. It is important to note that the original Western or Japanese designed vehicles need to be redesigned or changed for the Chinese market. The optional design changes needed to adapt to local market factors, especially to local older users' needs, are more difficult to make because the required information is not available. Therefore, it is necessary to study older vehicle users' experience within the particular technological and cultural context.



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Vehicle designers need frameworks for making transitions from theoretical understanding of older Chinese vehicle users to design implementation. The aim of this study is to explore the travel needs of older Chinese vehicle users, and to develop a theoretical model to synthesize older vehicle users' travel-needs-influencing factors which assist in designing meaningful vehicle for the target users. Margolin (2002) recognizes that today's artificial is a much more complex phenomenon than postulated by Simon (1969). An artefact's meanings become a strategic concept that exists pragmatically at the interface of design and use. Its value is determined by operation rather than semantic concerns (Margolin, 2002). The system of products is more coherent than the system of needs (Baudrillard, 1988). In order to explore the older vehicle user's needs, it is necessary to study meanings embedded in the product system and transfer meaning into the users' needs and experience.

2. Vehicle meaning structure and older users' needs

The product initially has no meaning in its own right and physical property. In using these products, users interact with the form of the object, which tells people about the functional and aesthetic design, the materials technology and the manufacturing techniques in the material culture of origin. These features of the material culture are embedded within the object and released as it is used (Dant, 1999). Therefore, artefacts are not only material objects, but also function as signs which both denote and connote meaning. The making of meaning is vital to the design process. Designers can be defined as cultural intermediaries who help users find meaning, identity and sense in a highly confusing world (Press & Cooper, 2003). Design innovations developed to cope with a specific problem have a way of changing the way people do things and of altering how they relate to each other; eventually they affect the way people experience their lives (Csikszentmihalyi & Rochberg-Halton, 1981). On the other hand, users can give to the object new meaning when they find new connections to their socio-cultural context and explore new symbolic values and patterns of interaction with the product.

Considering vehicle design issue, the automobile can be defined as a metal container that can be filled with any number of social and cultural meanings (Beckmann, 2002). The older vehicle user as a subject imposes his or her wants on the object and defines the car's uses according to his or her own needs. Simultaneously, the older user is defined by the vehicle's particular way of responding to the older user's needs. That is, a vehicle is used by many, and for many purposes. It is no longer only a machine for travelling through space, but a car that is 'constructed' to overcome a variety of other daily life problems. Vehicle designers take responsibility to translate multiple changes such as technology and material into forms with credibility and cultural validity (Sparke, 2002). The growth of economies and the unique cultural traditions in China at this time require China to distinguish itself both as a means of consolidating an eastern orientated identity for its elderly users and so show a distinctive face to the rest of world. On the other hand, vehicle meaning can be constructed differently due to different users' cultural backgrounds. From this point, do older Chinese vehicle users look on their private cars the same way that American users do? If cultural differences lead

to meaning-making differences, why do older users who live in different cultural contexts drive similar vehicles designed by multinational vehicle manufacturers? These questions need to be explored through focusing on user–artefact meaning and user experience in different technological and cultural contexts.

3. Exploratory study

3.1 Research methodology

The experiment was divided into two sections (Sections A and B) in relation to investigating current older and middle-aged vehicle users' travel activities; and exploring the future older Chinese vehicle users' travel needs. A methodological triangulation approach consisting of interview, logbook and co-discovery helped to collect multiple forms of visual and textual data to explore the older users' needs. In Section A, the co-discovery method was employed to explore the older Chinese vehicle users' future travel-related needs. The participants were divided into eighteen groups to discuss and envisage their future travel activities and lifestyles, and sketch their own future car. Section B was designed to investigate present older and middle-aged vehicle users' travel patterns, experiences and needs. The interview and travel logbook are employed in the section B. This study involved eighteen middle-aged (45-59 years old) and eighteen older (60 years old and above) vehicle users. To ensure the research validity, the participants' pool cover different genders, educational backgrounds and occupations.

3.2 Data analysis procedure

This study utilized grounded theory (Strauss & Corbin, 1998) to analyze the travel activities of two age cohorts and compare travel-needs-influencing factors in different category levels. The data analysis procedures were based on three steps for interpretation of outcomes. In the first step, this study focused on transcribing verbal and textual data collected from the experiment, and developing a coding framework (Table 1) to start the chain of theory development. In the second step, themes and categories were related to their subcategories to form more precise explanations about travel phenomena. This study was designed to rate the themes from the point of view of frequency, and so identify the significant themes. The third step of analysis moved to cross-age comparisons and analysis at category, sub-category and conceptual levels. Frequencies of categories and sub-categories were compared across four participant groups: (i) between middle-aged vehicle users' current travel activities and older vehicle users' current activities; (ii) between middle-aged vehicle users' future travel activities and older vehicle users' future activities. Once the key factors emerged in such cross-age comparisons, the analysis focussed on producing an interpretation of these interrelationships and building a theoretical model to structure all categories from the design point of view. Current travel activities were used as a reference framework for comparison, because seeing into the future is easier if researchers have a clear view of the current situation (Press & Cooper, 2003). Atlas.ti was used in the coding and data analysis.

Table 1 Coding scheme.

Themes	Codes	Categories
Social practice	SAL	Social activity for maintaining daily routine life
	SRA	Social role adaptation
	SAP	Social acceptability
	SAS	Social accessibility
Local context	SEF	Socio-economic factors
	LGF	Local geography
	LCT	Local customs
Travel activity adaptation	TPT	Travel patterns
	DBV	Driving behaviour
Vehicle meaning	PMN	Practical meaning
	SMN	Social meaning
	CMN	Cultural meaning
Vehicle property	ECM	Economy
	STT	Structure
	FCT	Function
	TNG	Technology
	ATS	Aesthetics

4. Findings: older users' travel-needs-influencing categories

Central to the analysis of the data has been the identification of the factors influencing the needs of older vehicle users, and how the future older drivers' travel needs are shaped through interaction with vehicles. This identifies five travel-needs-influencing categories: social practice, local context, travel activity adaptation, vehicle meaning, and vehicle property involved. From these five themes, 17 codes were generated (Table 1). Through calculating the overall frequency counts of categories, vehicle meaning is identified as the most significant theme (Figure 1). Although these five travel-needs-influencing themes are mentioned with similar frequencies to each other for both age cohorts, their interpretations within their own categories and sub-categories differ. Figure 2 shows the integrated comparisons of travel-needs-influencing factors between two age cohorts at the category level. The higher frequency rate of occurrence of a particular travel-need-influencing factor shows its significance to the Chinese vehicle users travel needs. These five themes show strong linkages in the participants' travel needs and experience.

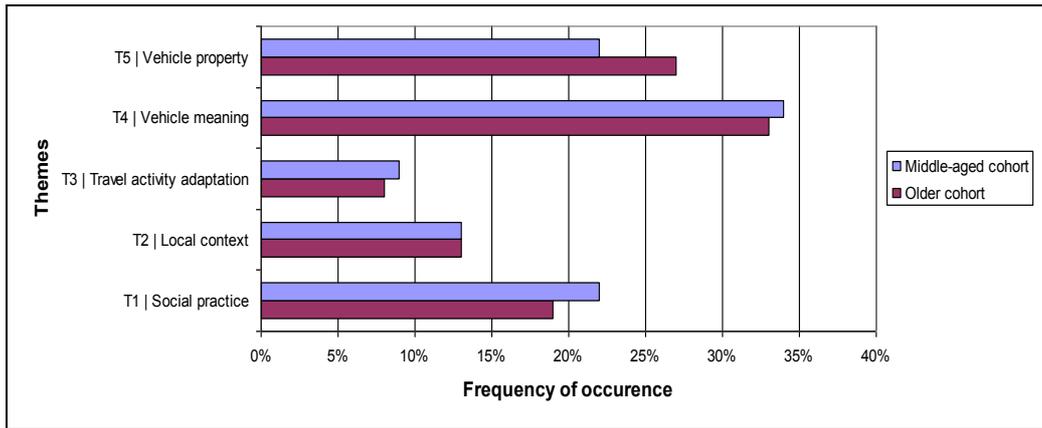


Figure 1 Theme comparisons between middle-aged and older cohorts.

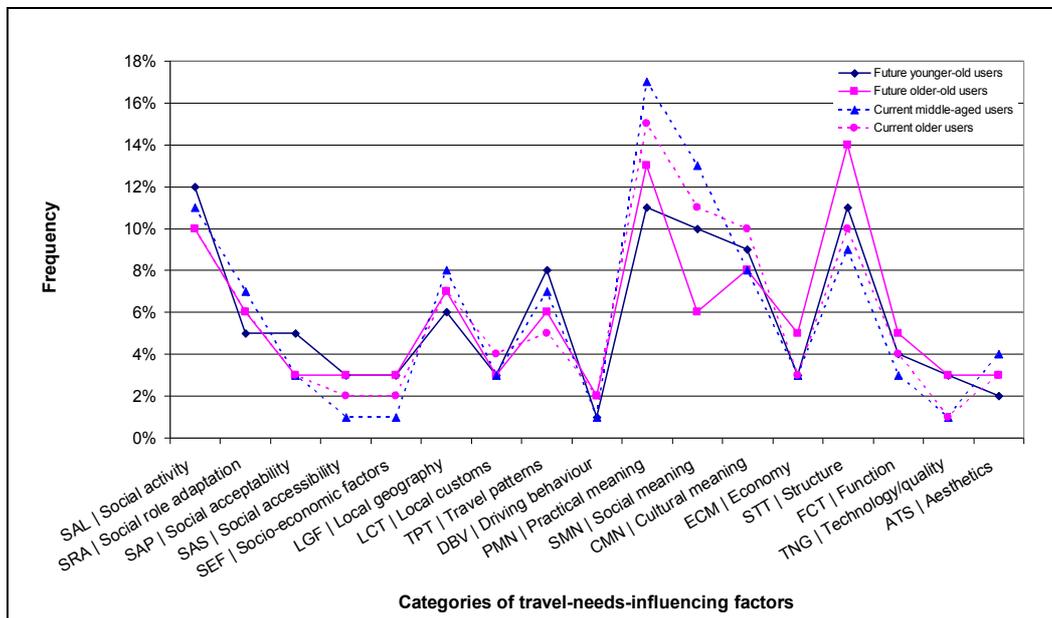


Figure 2 Integrated comparisons of travel-needs-influencing categories.

4.1 Social practice

Social practice plays an important role in explaining the investigated indicators of the aging population’s mobility. It has been defined as a condition for the Chinese vehicle users travel experience. Social practice theme (Figure 3) involved social activity for maintaining daily lifestyle (SAL), social role adaptation (SRA), social acceptability (SAP), and social accessibility (SAS). The categories of social practices (SAL, SRA, SAP and SAS) show different patterns between the two age cohorts (Figure 2).

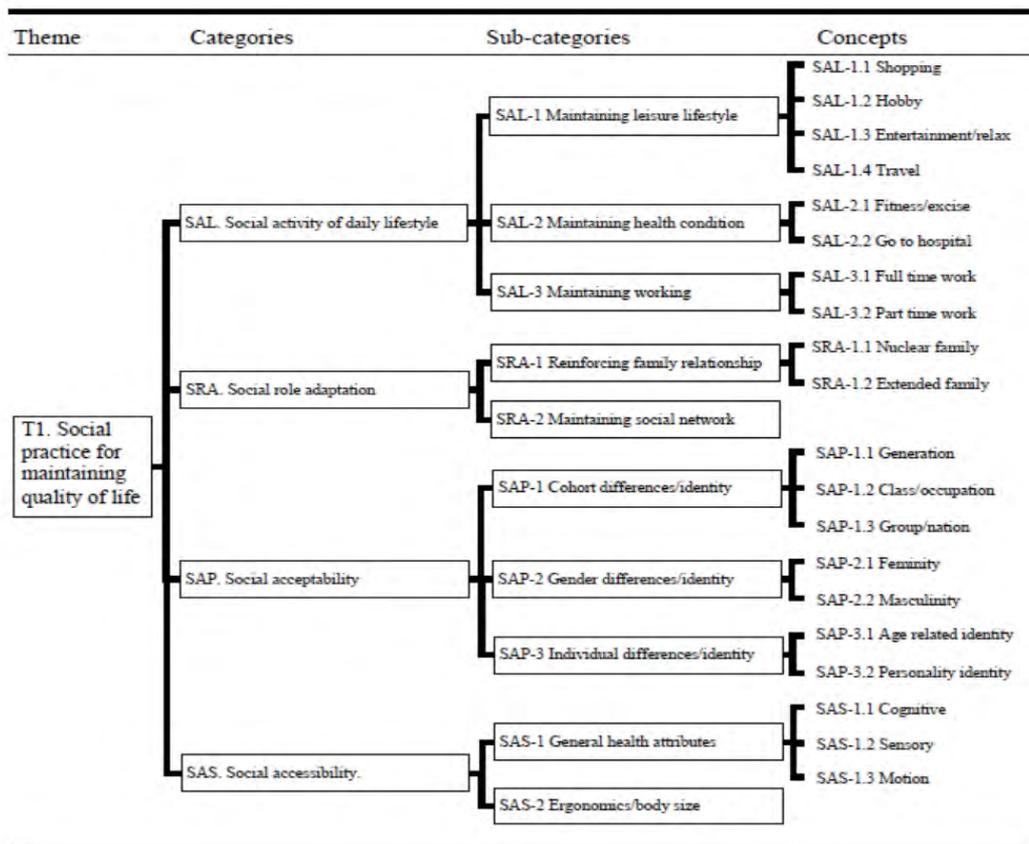


Figure 3 Social practice categories.

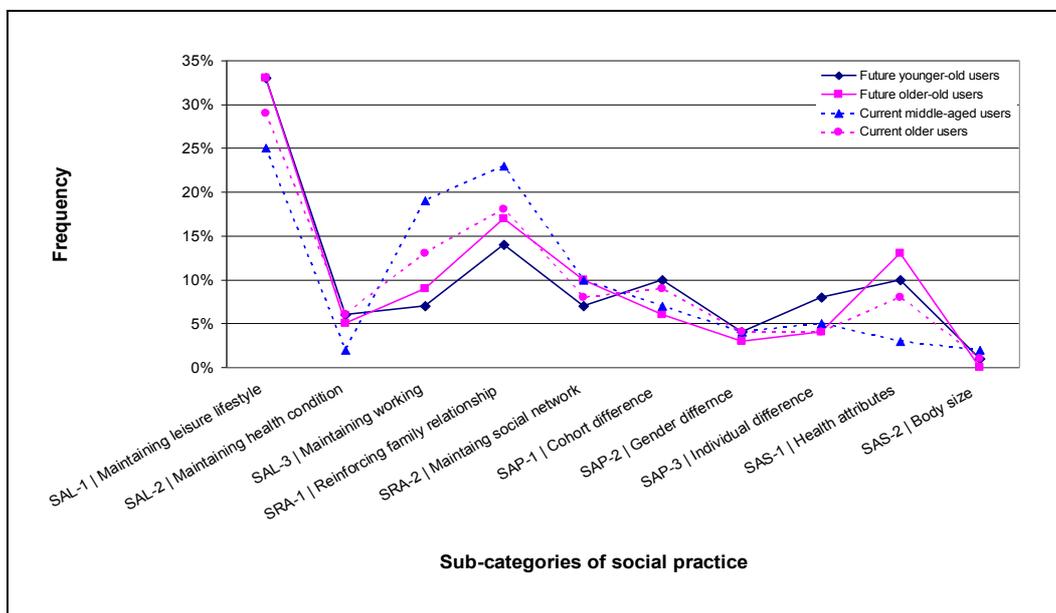


Figure 4 Integrated comparisons of social practice at the sub-category level.

Social activities for maintaining daily lifestyle encompass regular patterns of activity that represent habitual or customary behaviour and social affinities in daily life. The major sub-

categories of social activity are maintaining leisure lifestyle (SAL-1), maintaining health condition (SAL-2) and maintaining working (SAL-3) (Figure 3). Social activities undertaken to maintain leisurely lifestyle (SAL-1) are one of the most frequently occurring types of activity within the social-practice theme (Figure 4). In the near future, the new older generation will retire and spend their savings on having a good time, which involves maintaining leisure pursuits such as shopping, hobbies, entertainment and travel (Figure 3). The future elderly vehicle users might travel more miles for maintaining their hobby due to lifestyle changes such as being retired from a full time job (Table 2). Travel to a leisure destination implies the transport of luggage and recreational equipment such as fishing tackle, camping equipment, pets and items for picnics. Such activities can be easily linked to the proper vehicle meanings such as the vehicle as a tool for carrying material objects (PMN-1.1) and a tool for exploring (PMN-1.7). Designers can also predict details of vehicle properties such as compatibility of vehicle capacity (STT-1) and food preparation accessories (STT-2) based on analysing users' activities and vehicle meanings.

Table 2 Statements on vehicle meaning and property supporting hobbies.

Participant	Statements
Participant 2:	My hobby is antique collecting. I would like to drive to the countryside or flea market to collect folk artworks and antiques when I am retired. So I need a vehicle which can not only carry these artworks but also protect these treasures when I am travelling in the countryside.

Social role adaptation can be defined as social position and responsibility adjustment combined with the aging process. Social role adaptation for reinforcing family relationships (SRA-1) is one of the most significant sub-categories which follow the social activity for maintaining a leisurely lifestyle (SAL-1) (Figure 4). The difference between future and current travel needs for both age cohorts has been identified at the concept level of adaptation for reinforcing family relationships (SRA-1). Both current and future aging generations pay more attention to the extended family (SRA-1.2) than the contemporary middle-aged people do. The concept of the extended family is important to vehicle design for the elderly Chinese users. The needs of extended family members such as grandchildren, oldest-old parents and distant relatives should be considered in the vehicle design stage. Using a vehicle to reinforce extended family relationships can be interpreted as tangible vehicle properties such as compatibility capacity for a gathering of relatives, childcare facility for grandchildren's safety, and emergency support accessories for oldest-old parents health care. Clearly, although culture as an intangible element in shaping the future aging generations' travel needs, it can be decoded as particular vehicle meanings and properties to support future aging generation's travel activities.

Social acceptability refers to the socially oriented benefits attained through ownership and experience with vehicle. Considerable differences emerged at the social acceptability category (SAP) between the two age cohorts. Future younger-old users emphasized social

acceptability (SAP) more than current elderly and middle-aged people did (Figure 2). Clearly, future Chinese younger-old users seek self-identity through using vehicles within the global markets. Personal vehicles are important shapers of the self-identity in middle-age, and continue in later life as symbols of social acceptability for the future younger-old users. The Chinese vehicle users express their identity as a certain generation, class, group, gender or individual by the use of a personal car (Figure 3). This study shows that future elderly users are concerned about cohort identity (SAP-1) more frequently than they are at middle age (Figure 4). The Chinese users are group-oriented towards the social units with which interactions have been found (Yau, 1994). For instance, participant 5 in Table 3 shows that older Chinese vehicle users would like to take part in leisure activities by a particular group which is based on a similar hobby, early life experience and age cohort. Chinese elderly vehicle users prefer using ‘we’ rather than ‘I’ to describe the concept of self when they become old (Table 3: Participants 5 and 12), compared with using ‘I’ to emphasis personality during middle age (Table 3: Participant 4). This change with age, from self-identity to group-identity, matches different patterns between modern and traditional cultural values, which are hybrid within contemporary Chinese society. The elderly Chinese vehicle users defined and cultivated their individuality by using the personal vehicles that enable them to exist among certain groups. The local cultural elements play important roles in inspiring vehicle innovation by the use of appropriate form, colour, structure and function, in which multiple-status identity could be achieved.

Table 3 Statements on social acceptability of cohort identity.

Participant	Statements
Participant 5:	I will join a group composed of our generation when I retire. Members of such a group must have similar experiences, hobbies and income. We will drive our personal car and travel together.
Participant 12:	When we become older, our cohort’s attitude must be different from the current 60’s older people. We are more active than the current old generation.
Participant 4:	I enjoy being in a private car by myself. For my personality, I like to stay in a quiet and peaceful environment. This space is owned by myself. Nobody can disturb me when I sit in such a personal and independent small space.

The future new aging generations show more concern about their age-related differences from social and culture perspectives than from a *physical accessibility* perspective. This challenges earlier road safety research (Anstey, Wood, Lord, & Walker, 2005; Hakamies-Blomqvist, Siren, & Davidse, 2004) which highlights the age-related sensory and cognitive differences. Continuing driving in older age represented a significant way to ward off an ‘old age identity’.

4.2 Vehicle meaning

Vehicle meaning allows designers to explore the manner and extent to which middle-aged and older vehicle users' past experience biases future use interactions. This study shows that vehicle meaning is one of the most significant categories (Figure 1). There are a total of 27 meanings given by Chinese vehicle users related to their current and future travel needs. These are categorized in three core groups: practical meaning, social meaning and cultural meaning (Figure 5). Significant differences between the two age cohorts emerged at practical and social meanings (Figure 2).

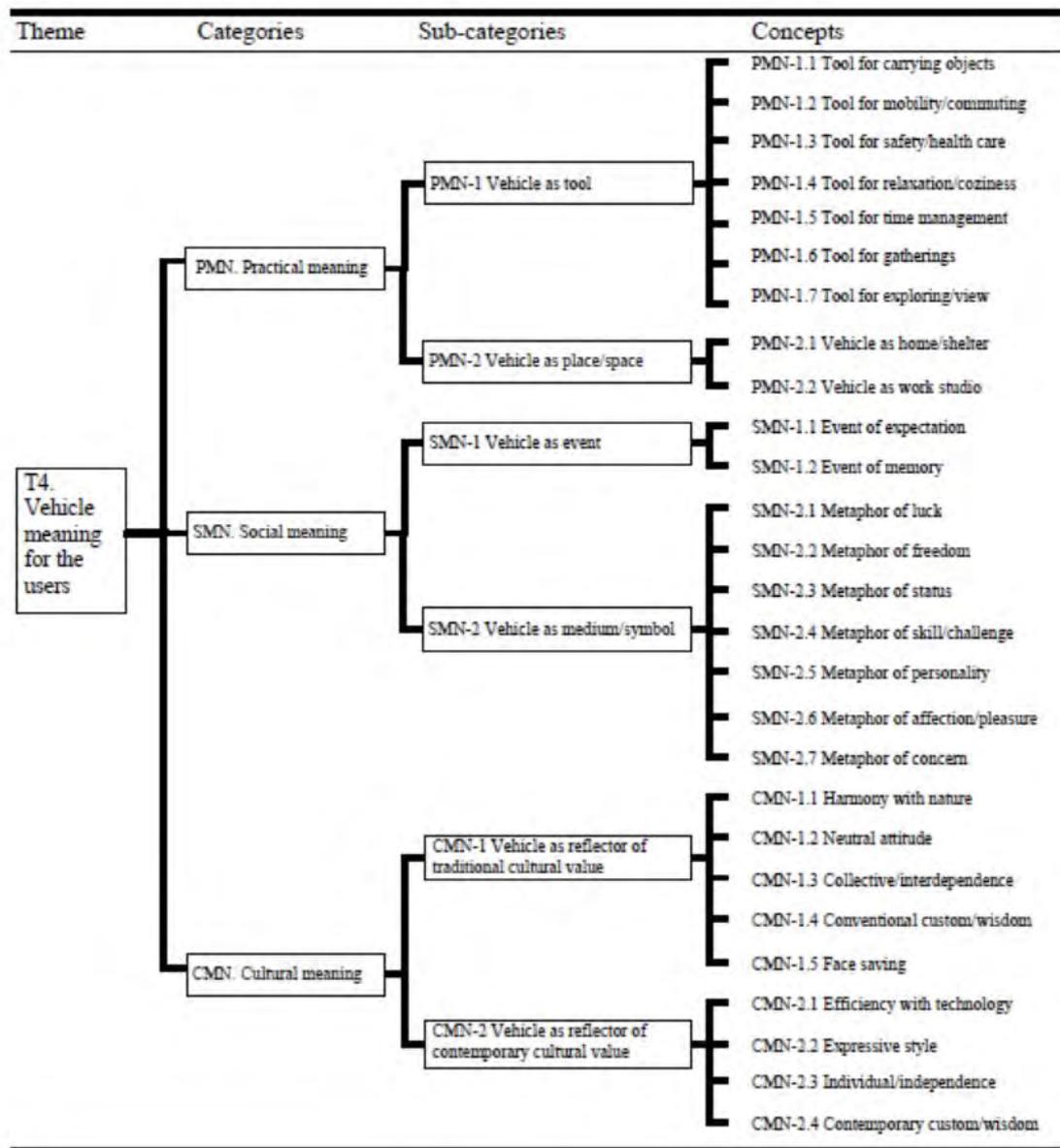


Figure 5 Vehicle meaning categories.

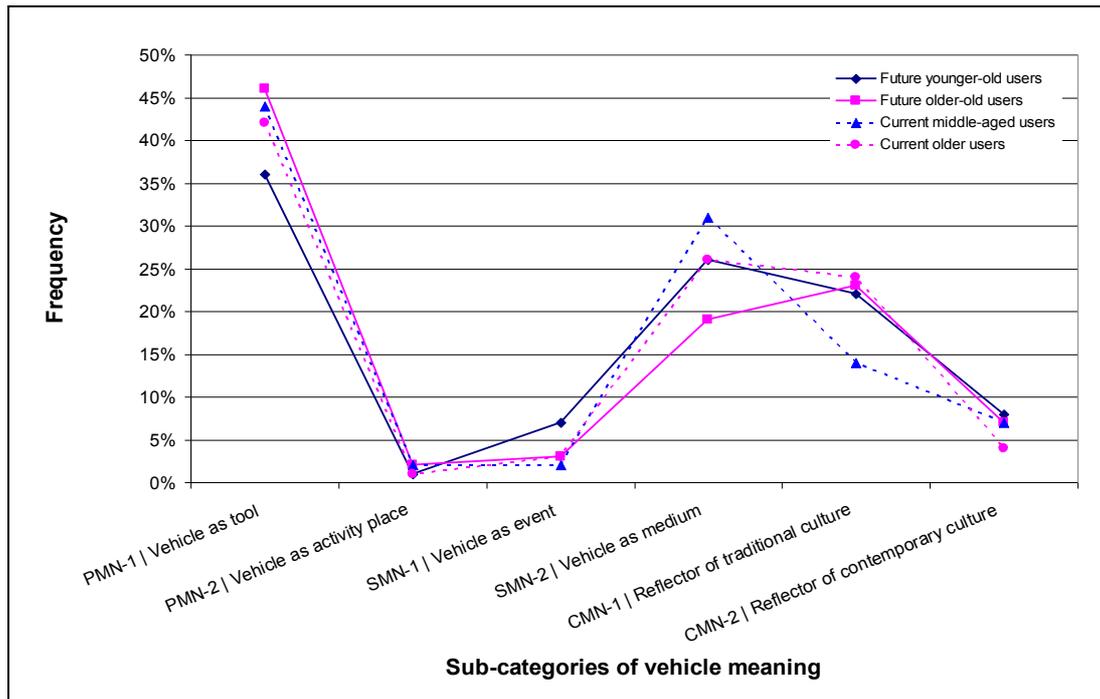


Figure 6 Integrated comparisons of vehicle meaning at sub-category level.

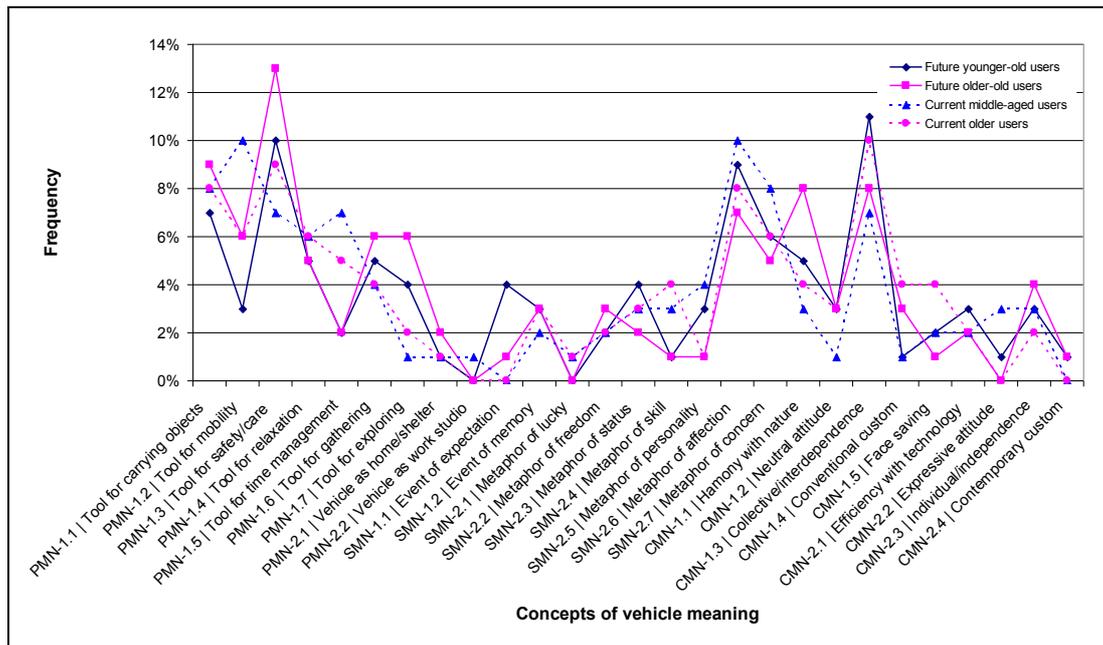


Figure 7 Integrated comparisons of vehicle meaning at concept level.

Practical meaning is intimately tied to the product’s physical attributes and benefits, and the inherent need satisfaction these provide. The middle-aged cohort was concerned about practical meaning more currently and less in the future than the elderly cohort was. Future younger-old users mentioned the practical meaning least frequently (Figure 2). Practical meaning can be divided into two sub-categories: vehicle as tool (PMN-1) and vehicle as

activity place (PMN-2). Figure 6 shows that the vehicle as a tool (PMN-1) is most frequently mentioned by both age cohorts.

There are many differences patterns that emerged at the concepts of vehicle as tool (PMN-1) between two age cohorts (Figure 7). The data suggest that the vehicle as a tool for time management had different meanings, which include the efficient use of time, saving time, reordering time and killing time. For example, the vehicle as time management was often related to the efficient use of time by switching a time consuming or boring activity to a different meaningful activity niche (Table 4). It is clear that reinforcing family relationships (SRA-1) is an important condition for leading Chinese future older generations to adapt their travel activities (child education escort). This particular activity was based on the Chinese collective (family) cultural value, and generated the specific vehicle meaning (tool for time management), which might guide the design of new vehicle properties such as entertainment support accessories and working support facilities. In addition, both age cohorts had similar attitudes toward the vehicle as a tool for social gatherings (PMN-1.6) (Figure 7). This attitude is rooted in Chinese collective culture values (cultural meaning) and associates with social role adaptations (maintaining social network), local customs (social ritual), travel patterns (travel by group), social meanings (metaphor of concern), and vehicle framework (compatibility capacity).

Table 4 Statements on practical meaning.

Participant	Statements
Participant 12:	I need to drive to take my son to study karate on Thursday evenings. I have to wait for him in the car for two hours. It is so boring and wastes time. So, I read a book or keep working in the car. Actually, it is hard to keep reading due to the weak light in the car. It is also hard to use a laptop in my car, due to the small space and inadequate in-vehicle accessories... My next car should solve these problems because I will escort my grandson to school as well when I retire.

Social meaning of the vehicle involved two categories: vehicle as event (SMN-1) and vehicle as medium/symbol (SMN-2) (Figure 5). Artefacts can be defined as social agents in the limited sense that they extend user activity and mediate social meanings between users (Dant, 1999). In this study, social meaning (SMN) category shows one of the most skewed distributions by age. Figure 2 illustrates that 13 per cent of current middle-aged users mentioned social meaning versus 10 per cent of future younger-old users and only 6 per cent of future older-old users. It is clear that future new aging generations highlighted social meaning significantly more often than the current elderly.

Figure 6 illustrates that the vehicle as medium/symbol (SMN-2) was considered as more important than the vehicle as event (SMN-1) for both age cohorts. The vehicle's symbolic meaning declines from the middle-aged cohort to the older cohort. The different patterns are emerged between two age cohorts at the concepts level of symbolic meaning. Firstly,

the vehicle as metaphor of luck (SMN-2.1) is identified as a stable factor for the both age cohorts. The representative examples of the luck metaphor are the decorations of auspicious symbols that are placed in different parts of the vehicle space. For example, the right-hand picture in the Figure 8 illustrates the typical location of lucky symbols, which are usually hung below the inner rear mirror. Some vehicle users put a traditional talisman, such as a tiger, in the back of the vehicle to avoid a rear-end crash (the left-hand picture in Figure 8). Relying on superstitious power for protection is rooted in traditional Chinese cultural values (LCT). Designing vehicles for the safety need is related not only to the use of technology to extend elderly drivers' physical capabilities, but also to the employment of proper lucky symbols to reinforce older people's safety-related spirituality and confidence. Secondly, Future younger-old users were more concerned about the vehicle as a metaphor of status (SMN-2.3) than were the future older-old users. Thirdly, the vehicle as metaphor of affection/pleasure (SMN-2.6) is broadly related to other categories. For example, Participant 23 (Table 5) claimed that the vehicle model plays an important role in shaping the female users' gender identity (SAP-2.1) and further influences her affection (SMN-2.6).



Figure 8 Auspicious symbols as representative on vehicle as metaphor of luck.

Table 5 Statements on social meaning of the vehicle.

Participant	Statement
Participant 4:	I remember how hard it was when I sold my old car. I felt so depressed when I had to give the car's keys to other people. It was like my kid, and it had been with me for six years. I drove it and carried my family and friends. It contains a lot of stories and memories. For a man, his car contains a particular affection.
Participant 23:	I love the streamlined model. It is so beautiful. As a woman, I like a car that is fashionable and beautiful.

This study shows that meaning referring to the past (SMN-1.2) increases from the middle-aged to the elderly (Figure 7). The vehicle is a sign of past events, of ties to family, to other people and to emotional experiences for the older Chinese users. Vehicle designers have to know the history and past experience of the future younger-old users. Participant 4 in Table

5 shows that the vehicle's social meanings derive from the user's memories of the occasions on which the vehicle was a tool for personal mobility (PMN-1.2), the metaphor of concern in a social network (SMN-2.7), the moment of intimacy over the years in which one may have expressed to a friend, one's appreciation of this object. Clearly, the vehicle as event is closely associated with the vehicle as metaphor of affection. The design features such as shape and colour serve the physical medium to contain or express these kinds of meanings.

Cultural meaning is made a visible, demonstrable part of the material world through interactions between users and vehicles. This study shows that vehicles have a significance that goes beyond their functional character and social value. This significance has its roots largely in their ability to carry and communicate cultural meanings (McCracken, 1986). The data suggest the duality of dimensions of cultural meaning, which comprises traditional and contemporary sub-categories and concepts (Figure 5). Compared with practical and social meanings, cultural meaning presents a more-stable pattern than the others in that both age cohorts present similar frequency of this category (Figure 2).

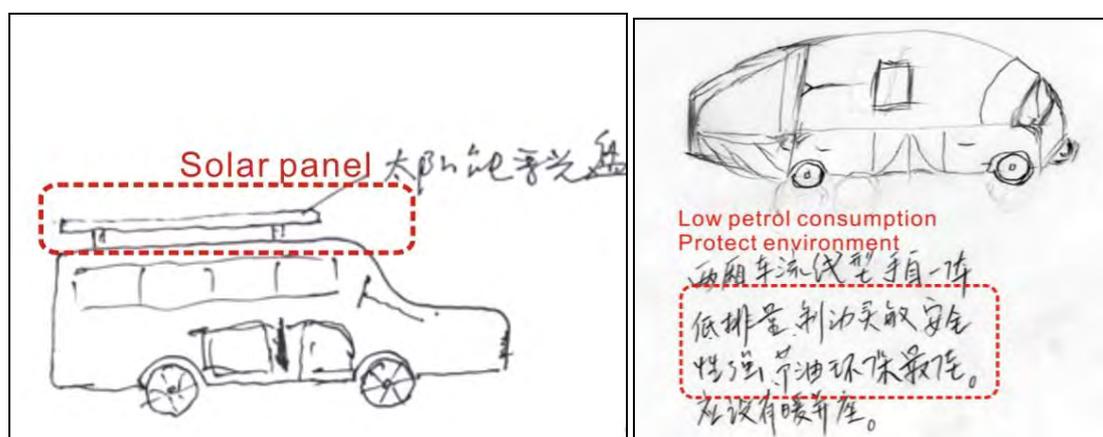


Figure 9 Participants' sketches of vehicles as a reflector of harmony with nature.

The vehicle as a reflector of traditional cultural values (CMN-1) has been identified as one of the most significant sub-categories (Figure 6). The aging population are concerned about traditional cultural values more than the current middle-aged users. Firstly, the vehicle as a reflector of collective cultural values (CMN-1.3) has been identified as one of the most significant concepts and the aging populations paid more attention to this concept than the current middle-aged people (Figure 7). In Chinese culture, people are integrated into strong cohesive in-groups and individuals act predominantly as members of a group (Hofstede, 1997). Moreover, collective cultural meaning is broadly embedded in other major themes such as social practice, travel activity and local context. The data (Table 6) show that collective cultural meaning can be observed by older people's activities such as gatherings of extended family members and social networks (SRA and PMN), celebrating traditional festivals (LCT) and travelling in groups (TPT). It also can be interpreted within the compatibility vehicle framework and food preparation accessories, which provide tangible properties to support vehicle users' collective social activities within the Chinese cultural

context. Designing vehicles for the elderly users should focus on collaborative activity, should highlight reliability and quality, and should imagine groups of people using the vehicle. Secondly, concept of harmony with nature (CMN-1.1) can be interpreted by the sustainable transport demands and environmentally ‘green’ travel behaviour. The new technology (TNG) is not only assisting elderly users to reduce petrol consumption (ECM), but is also reshaping the vehicle’s appearance. For example, in the left-hand picture of Figure 9, the elderly user has drawn a large sustainable-technology device (a solar panel on top) which dominates the profile of his new vehicle. Such original sketches (Figure 9) generated by elderly users can give designers valuable inspiration in designing the next generation of sustainable transportation for the future aging population.

Table 6 Statements on vehicle as reflector of collective cultural value.

Participant	Statements
Participant 34:	I enjoy organising an elderly Chinese opera club. The members are elderly people like me. I use my car to carry these elderly fans and instruments to participate in some community performance, especially during the traditional festivals.
Participant 12:	I need a big camping car. A group of people... they probably drive several camping cars to travel together. At the destination, these camping cars make a circular space that looks like a Chinese yard. We can celebrate the Chinese new year in this yard, cooking and eating together, playing games together, and helping each other...you know, my family, my friends, a group of people...

4.3 Vehicle property

The vehicle property theme refers to a vehicle’s physical attributes such as economy (ECM), structure (STT), function (FCT), technology (TNG) and aesthetics (ATS). Designers of transportation need to have details about physical vehicle properties from users’ perspectives. However, this study found that vehicle users cannot exactly identify the kind of vehicle properties — such as form, colour and function — they want because they do not have professional design knowledge. They can only explain what kind of the lifestyle they want, how they perceive their vehicle, and how they want to use their personal vehicle in the future. Therefore, although overall statistics show that the vehicle property theme is mentioned by the participants frequently (Figure 1), it is hard to get useful information to guide design innovation from the ambiguous and general verbal protocols. Vehicle innovation for the local elderly users might systematically study the user–vehicle interaction rather than focus on the products properties in isolation.

Vehicle structure (STT) category demonstrates that current automobiles designed for universal global markets cannot fulfil the Chinese vehicle users’ culture-specific travel needs. Local users can only adapt their current personal vehicles through changing some minor accessories to fulfil the unmet needs because it is impossible to do the framework changes for their current cars by themselves. However, when local users talked about the next car

they wanted to buy, they needed the new generation vehicles which will be designed totally based on their particular travel needs. That is, vehicle innovation is related to not only accessory adaptations, but also to revolutions in structure. The major elderly user's consideration was the vehicle's physical compatibility with different things stored inside and with different abilities of the people seated inside. The appropriateness to elderly users' activity such as adaptation social role (SRA-1) for caring of oldest-old parents (SMN-2), and transporting objects (PMN-1) for leisure lifestyle (SAL-1) emerges as another way of defining compatibility. In the users' sketches, these factors become explicit by the tall vehicle roof, well-matched boot, flexible-adjustment seats, and travel-related devices.

Technology category shows a constant characteristic (Figure 2). Although prior research (Fisk, Rogers, Charness, Czaja, & Sharit, 2004) claims that old people were more ready to transfer their anxiousness to new technology, this study shows that the future younger-old generation wishes to use smart technology to extend their driving ability and to ensure their driving safety. The future elderly often mentioned assistive technology devices such as GPS, audio warning systems, auto transmissions, in-vehicle internet, automatic car locks and energy saving systems. Such smart technologies are closely related to the vehicle accessories adaptation (STT), and vehicle function innovations (FCT) to reshape a vehicle's practical, social and cultural meanings.

4.4 Local context

The local context theme includes socio-economic factors (SEF), local geography (LGF) and local customs (LCT). Under socio-economic factors, this study groups general economy factors and national regulation factors. Under local geography are grouped residential patterns, travel resource and local climate. The local customs category comprises beliefs/philosophy and social ritual sub-categories. Compared with the social practice theme, which constructs Chinese subjective culture, local context shapes Chinese objective culture (Stewart & Bennett, 1991). Middle-aged and elderly cohorts present similar frequency among the local context categories and sub-categories.

The data suggest that most leisure travel demands rest on underlying *local geography* (LGF) and cultural tensions, particularly where the countryside and heritage are concerned by elderly vehicle users. Therefore, considering the traffic infrastructure and road conditions in the Chinese countryside, future older users' vehicles might have reliable quality, solid form, and off-road functions to support leisure travelling to the countryside.

Local custom (LCT) shows the stable characteristic in this study. Within the local custom category, the concept of social ethics can be easily linked to social role adaptation for reinforcing the family relationship category (SRA-1). For example, the filial piety doctrine, which is primary a Chinese ethical principle, drives the younger-old user to use a car to take care the oldest-old parents. The festivals in China strengthen familial bonds which involve family reunions and ancestral worship. Chinese older people organize various travel-related activities to celebrate festivals to help younger generations gain a deeper understanding of

their own roots. Therefore, they look on the personal car as a tool to gather the family members within this cultural context.

4.5 Travel activity adaptation

This study emphasises using context-dependent heuristics to explore the travel activity and travel needs. Figure 1 illustrates that both age cohorts mentioned the travel activity adaptation theme (T3) least frequently comparing with other themes. This finding demonstrates that there are considerable limitations if research only focuses on the travel behaviour per se. Vehicle design research should look into travel activities that relate to conditions such as social practice and local context, and to consequences such as vehicle meanings and properties.

Travel patterns (TPT) have close relationships with social activity (SAT) to shape a vehicle's practical meaning (PMN). This study demonstrates that car dependence is a significant characteristic of the future younger-old generation. The elderly Chinese people reliant on public transport have considerable difficulties accessing facilities and maintaining social contacts. Regular public transport services in China are of limited utility. Since future older generations often leave the city centre for leisure purposes (SAL-1), the vehicle is a frequently used means of exploring (PMN-1.7). The vehicle should be designed to afford long-distance and long-time journeys for the elderly users. To achieve this aim, designers need not only to understand the users' age-related cognitive and physical changes, but also to research older users' trip-related activities and contexts.

5. Discussion: structuring and interrelating categories

This study provided evidence that different meanings of vehicles and activities of the older users closely affect the vehicle design for a local market, not only with regard to the experience of the older users, but also with respect to the transfer of these connotations to the innovation and evaluation of the vehicle. Correlative analyses were used to identify the main covariates (Helfenstein, 2005) that were needed to establish the interrelationships among the elderly users' experience, vehicle meanings and vehicle properties. By associating core categories that emerged from analysis, this study argues that practical meanings link with vehicle structure more densely, and social meanings associate with aesthetics more frequently. Meanwhile, cultural meanings present stable characteristics because variables within the cultural meanings are evenly distributed among the different vehicle properties. The complex symbol systems such as form, feature and colour give rise to metaphor, grammar, and semantics for vehicle design. The interactions between older users and vehicles also construct these symbolic systems which reflect a particular subjective culture. Therefore, this study argues that vehicle designing should go beyond the surface level of the objective cultural system. Designers should integrate the objective culture, which is embedded in the local context, and the subjective culture, which is embedded in the social practice. It is essential for the human-centred design approach to explore this macro-level of

context because characteristics of elderly users' needs variables firmly depend on changes of social practice and local context.

This study develops a conceptual model which suggests an approach for the collection and structuring of user information during the vehicle design process (Figure 10). Through examining the data from the perspective of their influence on elderly users' needs, designers will easily be able to relate the data to vehicle properties as defined by older users themselves. In the users' domain, understanding the objective and subjective cultural contexts helps predict future younger-old vehicle users' needs. The variables within the social practice and local context drive the future elderly users' travel activity adaptations. The *cultural elements* play an important role in integrating these categories. In the vehicle domain, to fulfil the future younger-old users' needs, the *technology* drives the intangible and tangible attributes such as economy, structure, function, and aesthetics to shape physical vehicle properties. The vehicle meanings generated by the interaction between the vehicle domain and the older users' domain help designers to better understand the relationships among the properties, and the experiences that they provide. Such understanding in depth helps designers to identify the details of elderly users' needs. The overall interactions among the older users' domain, the vehicle domain and the vehicle meaning construct the design performance domain, which is driven by multiple dynamics such as *culture, technology and experience*.

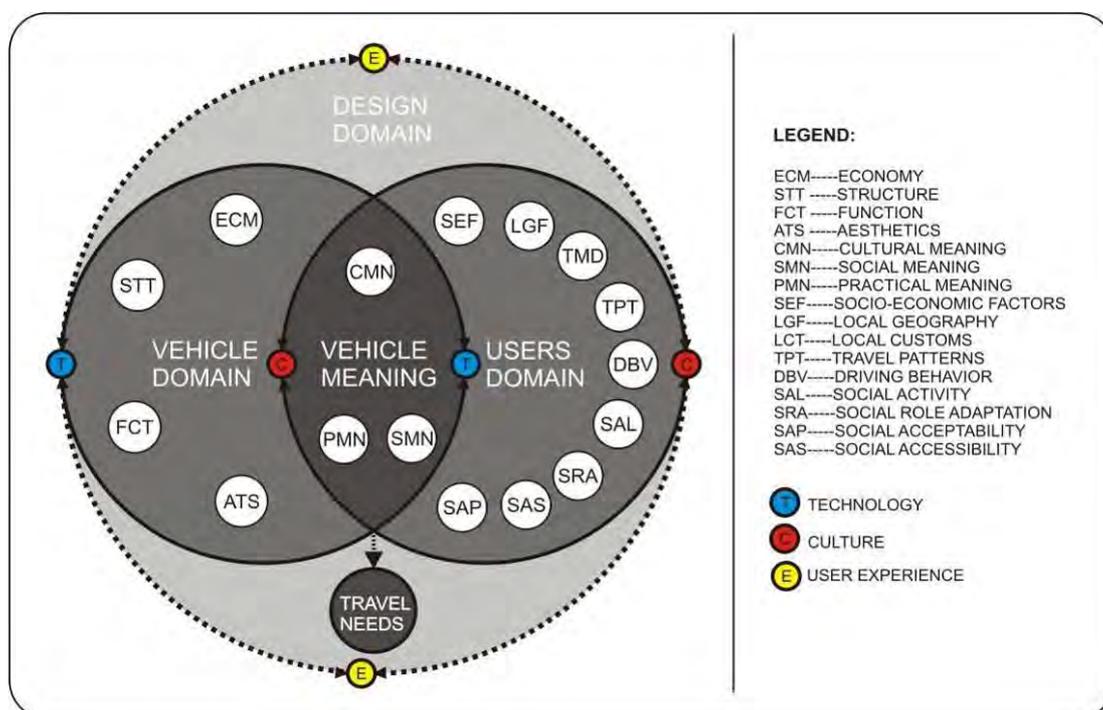


Figure 10 The conceptual model for structuring user information.

Designers expect that potential users have some preconception and attitude toward their products, and their use at the initial interaction with artefacts (Helfenstein, 2005). Users carry over such experience-based information contents to novel interactions with artefacts.

The older vehicle users' *experiences* involve not only *cultural context*, but also *technological factors* when they interact with motor vehicles. These contents will affect both physiological and psychological representations that future older users construct of interactions between vehicles and themselves, in which certain vehicle meanings are generated. The designed vehicles are the media that provide these experiences. On the other hand, such experiences help to define the contemporary and traditional Chinese cultures, and indeed to redefine the future younger-old vehicle users and provide them with meaning.

All in all, Figure 10 attempts to demonstrate the dynamic factors for the future older Chinese vehicle users: *culture*, *technology* and *experience*. Vehicle design can be defined as a cultural production and technology adaptation system to construct the future older users' experience. The concept of experience for the future younger-old users is essential as a unifying issue between the culture and technology of design, as a means of understanding the context of vehicle design, and as dynamic factors to inspire design thinking. Therefore, this conceptual model has integrated the structures of all categories generated by this research. It suggests how these categories relate to each other and how design activity synthesizes them logically. This theoretical model provides a framework for identifying a boundary between a coherent body of knowledge specific to designing and the body of knowledge related to other disciplines. That is, it develops a theory on the interactions involving human (older users), objects (vehicles), and contexts (Chinese social and cultural contexts) together.

6. Conclusion and recommendations for further study

This study provided evidence that different meanings of vehicles and activities of the older users closely affect the vehicle design for a local market, not only with regard to the In this study, the travel-needs-influencing factors between middle-aged and elderly Chinese vehicle users are systematically compared. Vehicle meaning is identified as the most significant theme for both age cohorts. Meanwhile, local contexts show constant characteristics for the Chinese participants. The interpretations of older Chinese users' travel-needs-influencing factors suggest that most categories have implicit or explicit relationships associated with others. Culture, technology, and older users' experience play the dynamic roles to drive design innovation for the future aging generation. Designing meaningful vehicle can be defined as a cultural production and technology adaptation system to construct the future older users' experience. The application of the model will focus on designing meaningful concept vehicle for the older Chinese users as a representative example. Based on understanding the theoretical model generated by this study, designers will design concept vehicle for the Chinese future older drivers. The concept of vehicle design as outcome of further research will serve as a bridge between theoretical research and design practice.

7. References

- Anstey, K. J., Wood, J., Lord, S., & Walker, J. G. (2005). Cognitive, Sensory and Physical Factors Enabling Driving Safety in Older Adults. *Clinical Psychology Review*, 25, 45-65.

- Baudrillard, J. (1988). The System of Objects. In M. Poster (Ed.), *Jean Baudrillard: Selected Writings*. Cambridge: Polity Press.
- Beckmann, J. (2002). Keeping the Holy Grail: The 'Mobility View' of the Danish Automobile Club FDM. In W. R. Black & P. Nijkamp (Eds.), *Social Change and Sustainable Transport* (pp. 101-106). Bloomington, Indiana: Indiana University Press.
- Csikszentmihalyi, M., & Rochberg-Halton, E. (1981). *The Meaning of Things: Domestic Symbols and the Self*. Cambridge: Cambridge University Press.
- Dant, T. (1999). *Material Culture in the Social World: Values, Activities, Lifestyles*. Buckingham: Open University Press.
- Fisk, A. D., Rogers, W. A., Charness, N., Czaja, S. J., & Sharit, J. (2004). *Designing for older adults : principles and creative human factors approaches*. Boca Raton: CRC Press.
- Hakamies-Blomqvist, L., Siren, A., & Davidse, R. (2004). Older drivers - a review. Linköping Sweden: Swedish National Road and Transport Research Institute.
- Helpfenstein, S. (2005). Product Meaning, Affective Use Evaluation, and Transfer: a Preliminary Study. *Human Technology*, 1(1), 76-100.
- Hofstede, G. (1997). *Cultures and Organizations: Software of the Mind*. New York: McGraw-Hill.
- Margolin, V. (2002). *The Politics of the Artificial: Essays on Design and Design Study*. Chicago: The University of Chicago Press.
- McCracken, G. (1986). Culture and Consumption: A Theoretical Account of the Structure and Movement of the Cultural Meaning of consumer Goods. *Journal of Consumer research*, 13, 71-84.
- Press, M., & Cooper, R. (2003). The design experience: the role of design and designers in the twenty-first century. Aldershot: Ashgate Publishing Limited.
- Simon, H. A. (1969). The sciences of the artificial. Cambridge, Mass: MIT Press.
- Sparke, P. (2002). A Century of Car Design. London: Mitchell Beazley.
- Stewart, E. C., & Bennett, M. J. (1991). *American Cultural Patterns: A Cross-cultural Perspective*. Yarmouth: Intercultural Press.
- Strauss, A. L., & Corbin, J. M. (1998). *Basics of qualitative research : techniques and procedures for developing grounded theory* (2nd ed. ed.). Thousand Oaks: Sage.
- Yau, O. H. M. (1994). *Consumer Behaviour in China: Customer Satisfaction and Cultural Values*. London: Poutledge.

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