DOCUMENT RESUME

ED 376 395 CG 025 800

AUTHOR	Melichar, Joseph F.
TITLE	System Models and Aging: A Driving Example.
INSTITUTION	San Francisco State Univ., CA. California Research Inst.
REPORT NO	HMSL9402
PUB DATE	Jun 94
NOTE	20p.; Paper presented at the Annual Meeting of the International Society for Systems Sciences (38th, Pacific Grove, CA, June 14-19, 1994).
PUB TYPE	Speeches/Conference Papers (150) -- Information Analyses (070)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	*Aging (Individuals); Geriatrics; *Gerontology; Interaction Process Analysis; Mobility; Models; *Older Adults; *Physical Mobility; Simulation; Systems Approach
IDENTIFIERS	Driver Performance; *Drivers; Driving; Population Aging; *Systems Modeling

ABSTRACT

Chronological age is a marker in time but it fails to measure accurately the performance or behavioral characteristics of individuals. This paper models the complexity of aging by using a system model and a human function paradigm. These models help facilitate representation of older adults, integrate research agendas, and enhance remediative services and educational approaches. To facilitate addressing the complexity, a model of the driving process is presented which has three main components: the driving environment, the person, and the interface between them. The purpose is to use identified component processes to produce a representational system to: (1) identify critical combinations of factors that produce risks to the older driver; (2) study the interaction of mobility and aging processes; and (3) guide research strategies and analysis of experimental data. The paper presents the model and the first stages of integration of the functional activities used in driving. The methods for identifying the component activities and processes involved are discussed along with the problems faced in integration of component activities, definitions of risk, relation of aging process variables to activities, and the identification of expected performance of an individual. A summary discusses the application to direct services, licensure, educational programs, and other mobility activities. (Contains 139 references.) (Author/RJM)

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HEALTH, MOBILITY, AND SAFETY LABORATORY

SAN FRANCISCO STATE UNIVERSITY

REPORT # HMSL9402

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Joseph F. Melichar, Ph.D.

Presented at and included in the proceedings of:

The 38th Annual Meeting of the
International Society for Systems Sciences
Asolimar Conference Center, Pacific Grove, CA
14-19 June 1994

Darlene Yee, Ed.D., CHES, Director
Joseph F. Melichar, Ph.D., Scientific Director

Contact: Gerontology Program, San Francisco State Univeristy
20 Tapia Drive, San Francisco, CA 94132
Telephone: (415) 338-1684 FAX: (415) 338-6378

System Models and Aging: A Driving Example

Joseph F. Melichar, Ph.D.
Adaptive Systems Corporation
P.O.Box 1148, San Mateo, CA 94403

Abstract: The complexity of the aging process is modeled using a **system model** and a human function paradigm to facilitate representation, integrate research agendas, provision of remediative services, and educational approaches. The representation focuses on mobility with its role in maintaining independence and quality of life in later years in a range of settings. One of these settings is the process of driving an automobile which has been approached experimentally through a general research protocol including a driving simulator. To facilitate addressing the complexity, a model of the driving process is presented which has three main components: the driving environment, the person, and the interface between them. The purpose is to use identified component processes to produce a representational system to: (a) identify critical combinations of factors that produce risks to the older driver, (b) study the interaction of mobility and aging processes, and (c) guide research strategies and analysis of experimental data. The paper presents the model and the first stages of integration of the functional activities used in driving. The methods for identifying the component activities and processes involved are discussed along with the problems faced in integration of component activities, definitions of risk, relation of aging process variables to activities, and the identification of expected performance of an individual. A summary discusses the application to direct services, licensure, educational programs, and other mobility activities.

Keywords: System Models, Aging, Mobility, Driving, Simulation
System model as a heuristic to study aging, mobility, and driving

The intent of this paper is to address the study of aging processes through the use of models to facilitate description, analysis, and understanding. Systems as an approach has been previously considered [62, 80], and recently described as a methodology of **system models** [22] with a focus on function [64, 73, 82]. In this paper, a specific model of driving will be presented relative to the older driver and related to the underlying aging process.

The model has been presented previously as a guiding paradigm [24]. The current interest is to present the model components in more detail aimed at understanding their relationships, interactions and potential utilization in research, clinical, and representational situations. Data has and is being collated concurrently [63] to enable testing of the model once the components and relationships are defined more precisely.

Perspective of Aging Processes

A range of views of aging exist. The following paragraphs define how the term will be used in this paper. Aging is a process that can be described normatively, but is highly idiosyncratic to the individual. Dimensions of the process cannot easily be studied separately from other dimensions, or at least their effects on each other identified. Multiple disciplinary paradigmatic views are equally valid and can be reconciled with some difficulty (e.g., see the "Handbooks on Aging" for examples [47-50].

Chronological age is then a marker in time, but not a very precise meter of specific performance or behavioral characteristics (hereafter termed "function") of any individual at any point in their lives. There are general relationships between age and function, but specific levels and changes over time are idiosyncratic. Any representation (model) must allow for description of the normative process and allow its individualization, and function must be definable both as f(time) and f(time, individual). Age also can be a carrier variable [61] where the function and age are not truly independent.

The process aspect of aging requires ongoing change while allowing for specific marker events, transitions, or stages [75-77]. These terms are consistently used in human development and aging and reflect that life is a process with describable points of reference. Aging is then a continual change and adaptations to a biological and experiential process with a constant balancing of component elements from various dimension of the life process. Any model must allow for dynamicism, interaction, homeostatic and adaptive processes, and definable states. In so doing, the ability to represent highly individualized situational factors should be able to be included (e.g., experiential, health or disease related conditions, genetic differences, ...).

Any model of aging is a restricted representation reflecting a specific situation. In applying the model, the context [60] and bounds of the representation must be defined. The model is situation specific and at best portrays the aging process in a limited sense. The full dimensionality, complexity, and meaning of aging is severely under represented in any model.

In this paper, the aging process is imbedded in a driving situation which is representative of functions found in the overall aging process and more specifically in age-related influences on mobility. In representing or describing driving, it is then a reflection of the underlying aging process. By addressing aging through the driving model, the space limitations of any paper produce an under emphasis on the implications to general mobility and overall aging.

Aging, Mobility, and Driving

The age of the overall population is increasing and will continue to increase [54] along with the number and proportion of older drivers [17]. Approximately 33 million drivers age 55 and over constituted 22 percent of all drivers in 1987 [2], 28 percent in 1992, and 39 percent by the year 2000 [16]. Many drivers over age 55 have good driving records, but as a group when controlled for exposure they are disproportionately involved in traffic accidents and fatalities [6, 7, 34, 35] (more than any other age group except teenaged drivers [53]). Injuries from accidents are more likely cause hospitalization than for younger persons [3] and with slower recoveries [4].

The decrease in driving performance and safety stems from age-related changes interaction with the driving situation and conditions generated by the traffic mix of the highway and other drivers and automobiles. The adaptation to these changes within the traffic mix over time determines the older driver's ability to function safely, and in turn their mobility and independence in the community.

Mobility, Driving, and The Quality of Life

Mobility and independence are central to a sense of self esteem and to maintenance of adequate physical and mental well-being. According to Wiener [7], "losing one's driving privilege, voluntarily or otherwise, is probably second only to total confinement in its effect on lifestyle, access to benefits of society, and general well-being." In our automobile-oriented society with limited alternative transportation options, driving takes on a disproportionate importance to maintaining a quality of life. Also the use of alternative transportation modes are influenced by the same aversive aging influences even to the extent of the ability to walk distances or function in high density traffic areas.

Any reduction in mobility reduces the "quality of life" of an older adult. This reduction results from limits to the capacity for self-maintenance, restrictions in participation in constructive activities and interactions with other people, and in turn may contribute to reduced involvement and subsequent alienation from society [14]. Mobility and transportation are major facilitators between a person and his/her external environment and determines whether the community functions as an inhibiting environment or a favorable social support system [74,78]. Like everyone in our society, the elderly depend upon the ability to travel in order to acquire the basic necessities of life (food, clothing, and health care) as well as participating in educational, employment, religious, cultural, recreational, and social activities. To the extent that the elderly are denied transportation services, they are also denied full participation in meaningful community life [11,12].

Aging Effects on Mobility

The physical and psychological well-being of older adults often is related to their mobility within an interactive social environment and provides them a sense of control and independence. Any restrictions in the ability to drive produces a negative cycle of increasing dependence, reduced self-perception and esteem, and a restricted life style. One of the main problems facing older drivers stems from the decline of some of the performance skills necessary for safe driving [27, 40]: (1) sensing the situation, (2) deciding what to do, and (3) acting quickly [5]. Various age-related visual, auditory, and psychomotor changes have an adverse effect on driving ability [6]. These factors have been combined into the driving situation model [21] to be presented.

Visual impairment can be the most devastating to driving performance. Cataract, glaucoma, senile macular degeneration, and several qualities of visual perception such as visual acuity, field of vision, distance judgment, illumination, glare sensitivity, night vision, and color recognition change with age. Similar changes occur in hearing, proprioception, and kinesthetic sense. The sensing changes require the older person to adjust their driving or alter their process to make needed adjustments.

Age-related changes in decision-making include decline in speed, processing efficiency, and selective attention and vigilance [30, 50-51]. Judgement and response time to action changes making it harder to react to the high number of decisions [20] required per mile. Similarly, increase in anxiety, decrease in short term memory [50], and some reduction in patience produce added demands on processing. Slower motor responses results in increased reaction time with age compounding slower processing and decrease sensing abilities [47].

Problem Faced

Older adults face a loss of functional capability which impacts upon their mobility and ability to drive. They must adapt their driving habits to the changes in their skills, and also eliminate past bad habits for which previously used adjustments are limited by decreased abilities. Simultaneously they experience a reduced ability to use public transportation or walk long distances, but have the same mobility requirements to maintain themselves in the community.

The reduction in capability coupled with its requirement to adapt while the external demand on the person remains the same produces a risk situation. The risk situation reduces safety and increases the risk of accident and injury, and/or reduction in willingness to drive. The result is of immediate importance to the older driver who faces a loss of freedom of movement, to their family who must provide alternative support, and increasingly to society as the number of older drivers on the nation's roadways increases [4].

Surveys [17-18] reveal that driving is how older persons prefer to maintain mobility. There is consensus among traffic safety authorities that older drivers should be kept on the roadways as long as they can drive safely. Although chronological age as the sole indicator of driving ability [19, 34, 39] is not desired to be used, it has proven difficult to establish a more functionally based meter. The case for general mobility has proven even more elusive.

Resolving the need for transportation services is beneficial to older adults whose activities otherwise would be limited, but also is of economic value to society by supporting the older individual's capacity for independent living within his or her community [15]. Thus, transportation serves to postpone or prevent costly short-term institutional care (e.g. acute care hospital) and/or unnecessary long-term institutionalization (e.g. skilled nursing facility). The cost to society of providing alternative means of mobility would be enormous; hence, older drivers need to be encouraged to drive as long as safely as possible. Public policy has to address the balance between safety, cost, and a desire to maintain the quality of life of the older person.

Part of the problem is to understand aging effects on general mobility to help the older person maintain their mobility and driving skills for as long as possible with a minimum of risk. The general problem is to determine how best to assess and subsequently remediate any mobility and driving deficits of the older person and remain within safety standards. These deficits include knowledge and skills and in the processes to adapt to their changing functional capabilities. Responding effectively to the general problem requires identification of the at-risk driver and/or prevention or amelioration of the at-risk situation within the older driver population and similarly for general mobility and pedestrian activities.

System Model and Functional Approaches

The transition from defining a problem to addressing a solution was posed based on two approaches. **System models** [22] were used as a framework for representing the situation. Human function [73] was linked to the system model approach to create the components of the model representing a human activity with the basic underling process imbedded. In this case, mobility is represented in driving allowing review of the aging process. This section provides a brief overview of the two approaches.

System Model for Human Function

Addressing human function and services has proven to be problematic, yet is central to our understanding, analysis and description of human activities (e.g, mobility) and basic process (e.g., aging). A **system model** approach within a human function paradigm has been suggested [22] as a means of representing human performance and activities, such as, the mobility and aging interaction. The **system model** approach integrated a series of methods which are consistent with the representation of human function; namely, general systems theory [83], the "systems approach", structuralism [84], object-oriented methods [85], categorization [88], and knowledge-based systems[87].

The approach stresses the **system models** are representation of a situation and any model is only one of a range of valid models. The criteria for defining a model is [22]: "generally consistent with existing knowledge, operationally replicable, and clearly defined and documented. Any representation based on it, then can convey the situation modeled to others who can replicate and use it." Consensus agreement about the representation is not required, only that the model produced can be understood by a knowledgeable person in the field and there is a general consistency with existing knowledge.

Implementation of the **system model** approach requires the definition of: context, purpose/goals, uses, and a delineation of the range and depth of coverage of the representation. A model resulting from the **system model** approach is a part of a class of hierarchically ordered models reflecting different degrees of detail. Each level of the hierarchy, component of, or relation has to be distinct and delineable in replicable fashion. Each component must be clearly delineated as a bounded unit, with specified relationships to surrounding units and produce clear outcomes (events) when applied to a specified input. Any series of linked events in the operation of the model forms a process, and the process outcome must bear a direct relationship to the context and the process applied.

A given **system model** applied from different contexts and/or starting points can yield different results (e.g., two models addressing the same situation can produce two useful and different models). In the approach, a process is provided that describes both outcomes and characteristics typical of human situations. The resulting representation from that process should have a clear and exact meaning and tightly define the situation. The ordered approach provides the benefits of replicability and a specified representational form; i.e., a model produced by it has specified order and structure. Although focused towards addressing human activities the application of the approach can benefit from added focus. The following subsection describes a functional paradigm which adds the focus and helps to make the transition to a specific model (the next section is drawn from previous work by the author [22,64, and 73] and edited for the purposes of this description).

Functional Paradigm

Human function is a general term which is given meaning by specific applications and contexts. The creation of a human function **system model** is based on understanding the meaning of function in the context of the human experience. The characteristics desired of the model are:
1. operate irrespective of context, situation, or application,
2. be flexible and adaptable to a range of situations yet replicable for a given function and situation,
3. functions must be able to be decomposed into smaller (more specific) functions or combined with similar hierarchical level functions to produce a more general function,
4. function must serve a unifying role in addressing human activity and always will retain a person-centered view (versus a focus on an activity or action versus upon the person),
5. function must derive from a replicable process and be measurable, and
6. function must be separate from an outcome produced by the function.

Function is defined to be an action or response to a stimuli, or alternatively, a demand which is expected to address either normatively and/or idiosyncratically. Function is a basic attribute of human performance and as such is a common baseline for addressing related matters. Understanding function leads to understanding the situation or problem being faced by the individual or an intervention to that problem. The individual is the focal point of the model and exists within an environment which places demands on them. The person evaluates the demand and expected response, marshals resources and supports, and responds. The person expends these resources to accomplish the outcome by a coping adaptation mechanism [84, 88, 81]. This process is identified in general terms as function and represents a general perspective of how humans address and respond to their environment, or alternatively, function in this scheme is defined to be:

an action in response to demand set within an environment utilizing a person's resources and supports and altering the person's state of being.

The outcome or functional response then stems from a demand on the individual. The demand is an imbalance between the environment and individual or within the individual. The imbalance is an unstable state causing the person to: adjust, bear some discomfort, or resolve it. The process of resolution is the functional response process with the functional response being the resolution altering the person's state of being.

The functional response has a cost because it requires expenditure of means (personal resources and supports available to the person). A lack of response capability (e.g., physical skills) requires alternative means to resolve the demand or to live with it. The expenditure of effort is a real cost of producing the functional response illustrating the integrated perspective of the person. The situation, demand, functional response, outcome, and use of resources are related parts of a single systematic representation.

Function can be decomposed into smaller units, and the functional units can be ordered into a hierarchy. These units are essential in the representational process as they form the boundaries for: categorization, object orientation, classes, and definable functional units. The specific characteristics of function can be summarized by the pseudo-equation:

FUNCTION = AN ACTIVITY/ACTION REQUIRED --> A DEMAND ON A PERSON

Within this framework, function has prescribed limits, is an action and a process. The action is an outcome or end point of a process and as such is measurable. The function may be reflexive or non-reflexive, but non-reflexive requires evaluation of demand and a decision to act. The action is dependent on the availability of ability and personal resources and results in a cost (expenditure of resource) to individual. The function, functional response, and personal resources reflect biologic, physiologic, psychological, social, and cultural components.

Function differs from functional response. Functional response is an outcome to a demand and is a specific act or behavior. Function is an identifiable outcome that can be replicated and is normative (the function exists in most people). Function can be discussed relative to a normative or general class of demand process through a normative functional response process.

The person-system component represents an integrated perspective of the individual and their actions within their environment. The person-system enables representing the person's state in the **system model.** The representation is selected dependent upon the purpose to which the representation will be applied and the detail desired. In this effort, a focus on function was identified as the basis of the work being undertaken and the model representing the person in systematic terms must be able to support production of function."

Driving Model

The combination of the **system model** approach and the human function paradigm provide a means to represent a human activity. The activity selected is driving an automobile with a goal of being able to address age related influences on driving performance. An environment, demand, person-system, functional response supra model [22] provides a starting point to define a more specific model. The general format can be improved by developing a context from existing work on older drivers.

As discussed earlier, there is a decrease in the driving performance and safety of older drivers which has been linked to declines with age in some of the skills essential for safe driving. Marsh [1960] specifically identified changes in visual, auditory, psychological, and psychomotor skills to adverse effects on driving ability. These skills generally have been categorized into three areas of human performance necessary for safe driving: (1) sensing the situation; (2) deciding what to do; and (3) acting quickly [5 pp 71-76]. Alternatively, Planek [20 p 22] also divided the driving task into three analogous categories: (1) sensory reception and perception; (3) neural processing and transmission; and (3) motor response.

The number of driver characteristics possible to include is too large to use; hence, the three general major categorizations suggested by the literature review [21,24] (sensing and perception, processing, and response) will be used. More detailed characteristics from the literature review were then associated with their appropriate main category. The characteristics could be broken down into sub/subclasses, but that exceeds the limits set on the particular representational level desired of this model. The **system model** approach requires the representation of characteristics as a related set of elements with defined relationships and an ordering of information and relationships relative to driver characteristics.

The three areas of human performance suggest a common way of viewing the driving situation which is the basis of the general model [24, 22] depicted in Figure 1. The validity of the model was tested by developing an assessment scheme [21, 24] and analysis framework for a large study of older drivers [24]. In the model, the driving condition (environment) and driver response is separated. An interactive link between the two represents the dynamic interchange that occurs the driving process. The interaction between the environment and the person and their response occurs through an interface system comprised of the automobile and its controls.

The driver senses changes in the driving situation through the interface, perceives the driving conditions, processes the information, and responds back through the interface altering the driving situation. The driving situation then can be changed by the driver within the constraints imposed by the environment, traffic,and road conditions. The driver and his/her abilities are integral to this ongoing process. The application of the heuristic to the older driver is dependent on understanding the aging parameters which influence the older person's driving performance.

Environmental Level

The environmental level is comprised of three main components: ennviroment, road conditions, and traffic. Environment is the general situation in which the driving activity occurs. It includes the surroundings and general conditions experienced and defines the general parameters of the driving situation. This component delimits the "world" to a specific location and conditions.

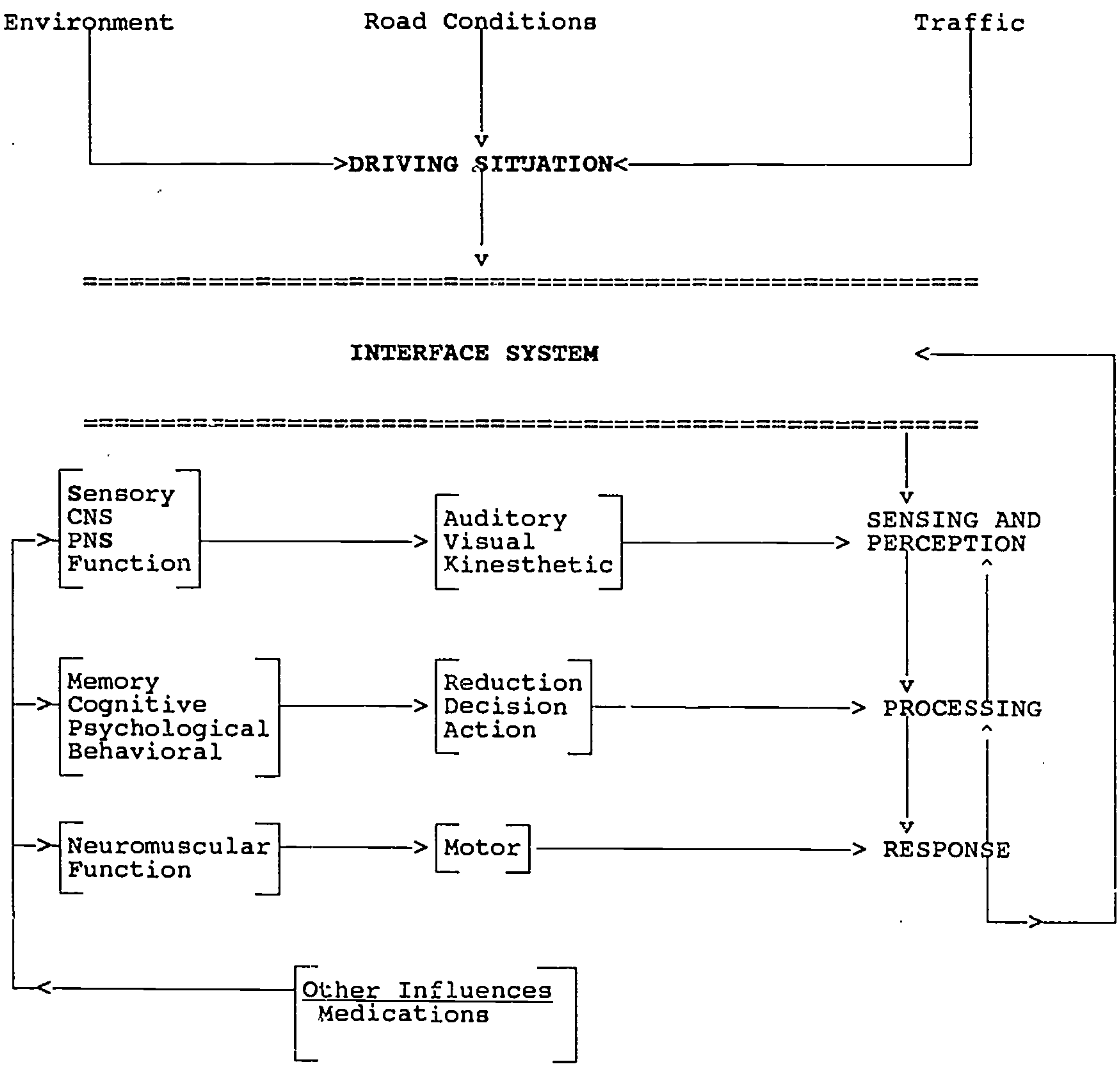

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Figure 1. General Model of Driving Situation

"Road conditions" represent the conditions immediately impacting on the driving situation. The type and condition of the road is the most obvious condition. This component provides a means of representing the very specific elements of the environment on which the automobile operates.

The "traffic" component by contrast describes the mix of other automobiles, traffic density, pedestrians, and other conditions placed upon the road conditions. The "environment" is the most static component. The "road conditions change as the person moves through the "environment". The "traffic" conditions are highly variable and create the most demand on perception and processing of information.

Interface

The "interface" is the component of the model through which the demand to respond emanates. The functional paradigm requires a demand be placed on the individual as part of a functional response. The demand grows out of the situation in the environment. The interface includes the mechanism to transfer the information, but also contains the mechanism to respond (in this case it is the automobile and its controls).

If the automobile were removed as the interface, the same model could be applied to representing a pedestrian in the same environment. The interface would be the demand of the functional model [22,73]. In this situation, the demand includes the transfer and response agent.

Sensing-Perception

The "sensory-perception" dimension represents the intake of information from the environment. The highest level of the response are the major summative sensory-perceptual functions: vision, auditory, kinesthesis, proprioception, and tactile. These capability rest on specialized central and peripheral nervous system and brain functions. The inclusion of the sub-functions or "enablers" allows easier inclusion of biological and physiological aspects of the aging process.

The accuracy of the sensory-perceptive function determines how well a demand is sensed. The basic information about the external situation and the demand must be internalized. A failure or degradation of the quality or accuracy of the information would reduce the potential to internalize and then evaluate the external demand. On a very simple level, if a situation is not seen a person lacks the basis to respond.

Processing

The "processing" dimension represents the person taking the internalized information and ascribing a meaning to it. In "processing" the information sensed is evaluated, weighed against related information, past experience, and knowledge, and reduced to a format which can be used to determine a response. The information gathered by the senses is being transformed into a potential to respond.

The processing dimension is a complex both as a process for transforming information to action, but also in trying to define the internal processes. It is relatively simple to discuss sensory information, an object is seen or not seen, but processing must define the object, a need to address it in some manner, and define an appropriate response. The process is the least understood and defined, and its failures most easily ascribed to sensing-perception or response functions.

The highest level of "processing" includes activities, such as, evaluation, judgement, decision making, action formulation, and the initiation of the implementation of a response. It draws on an enabling level which includes; memory, cognition, psychological and behavioral attributes, and emotion. These very basic internal dimensions of human function are the hardest to define, and are required to enable the effect representation of the "processing" dimension.

Response

The "response" level represents carrying out a desired reaction. The preceding levels gathered and valued information to form a desired response, at this level the response occurs. The response should reduce the demand found in the initiating situation.

The response is principally a motor function with imbedded behavioral, psychological, physiological, and emotional components. The motor response draws on the neuromuscular system, but the response cannot solely be measured physically or the other components are not included. By contrast to the other two levels (sensory-perceptual and processing), the "response" level can be observed and measured much more easily.

Hierarchical and Interactive Nature of Model Components

In the levels of the dimensions described above, a clearly discernible movement toward a hierarchy can be viewed. On a more general basis, each part of each dimension can be broken down into component elements. In effect, the model is the top layer of a hierarchy of models. This characteristic is important, because it enables reducing the component elements to their contributing parts. These parts can in turn be reduced, ...

The ability to do these reductions in the hierarchical format provides the capability to build a model with the appropriate degree of detail for a specific representational task. The model presented only illustrates the upper portions of such a model. The addition of detail would be required as the model were moved from a general descriptive paradigm to one aimed at helping to define predictive relationships, or perhaps to understand a particular response in a given situation.

The inclusion of "other influences" on the bottom of the model highlights this flexibility. For example, specific medications or drugs (e.g.,-alcohol) could be included in the model with the goal or representing their effects on specific situations and responses. The addition of this component also illustrates the complex interactions, since it is portrayed as influencing each of the three dimensions concurrently. This concurrence represents another characteristic of the model - interaction.

The interaction is depicted through arrows depicting relationships. The strength of each relationship would have to be defined by the context of the situation, and the particular dimensions (e.g., sensing and perception) and elements (e.g., vision) involved. The development and use of the model has to address these definitions. The model allows for feedback, feedwithin, and feedforward [89]. The appropriateness of each needs to be defined in the specific situation being represented.

Integration of Functions and Aging Process

The integration of the aging process into the model is fairly straight forward. Changes in any characteristic at any level, dimension, dimension component, or further sub-elements of a hierarchy can easily be introduced. The relationship between the component to which an age change has been introduced than can be traced through out the model. The assumption is that the relationships can be defined to allow the tracing process, but the capability to include age changes exists in the model.

The application will likely be more complex than a single age-related change. Usually changes occur across multiple dimensions reflecting underlying changes to the human organism (e.g., vision may decrease as cognitive function decreases). Addressing aging means addressing multiple changes. In dealing with a demand in this functional model, the representation must address all the dimensions to try to accurately describe the functional response and the problems experienced in producing it. Through this process there is an excellent opportunity to try to structure and evaluate aging influences on the sensing of the demand, the processing of the sensed information, and the response.

The model also suggests an important factor that often is not addressed, the response is part of an ongoing process. In responding to a demand, a new situation arises and with it a new demand. The person has to again respond. In some cases there may be a cumulative effect of responses as exhibited in fatigue, anxiety, stress, or reduced capability to cope.

Data Sources and Simulation as a Means of Validation

Work is concurrently proceeding to gather information to test the model [24, 63]. Data has and is being collected on older driver responses using a general protocol which includes a profiling [21] of driving responses. This data is supplemented by data from the general literature. Part of the assessment uses a driving simulator to provide dynamic and interactive situations to which the older person must respond. The result is measures of both static and dynamic performance across a span of ages.

The data will be used in some traditional analyses, but also will be used to start to build and validate the model. The intention is to be able to use the dynamic situations and the persons' responses to begin to understand both the components elements and the relationships. The simulation activity is perhaps the most crucial for this purpose, because it is dynamic and requires multiple functions to respond. The simulation also provides for ongoing activity to enable the assessment of cumulative effects of repeated reactions.

The current work is nearing a plateau. The existing protocol has reached the point where it can be improved based on current experience, and a greater amount of information gathered in the same time frame. The current data is being evaluated to determine where and how to make these modifications.

Applications

The reason for undertaking this line of research is to: study the aging process as it relates to mobility, improve understanding of how older drivers function, learn about methods for assessment of mobility and especially driving, and learn how to create methods for remediating any deficits or problems established. Licensing bodies also are desirous of finding better ways for determine who should be licensed, and when licenses should be restricted or revoked. The ability to define risk would help in avoiding accidents.

Simulation has not been used very widely for assessment. Driving simulators are thought of as training tools to learn to drive. In the scenario presented they are a tool for assessing age effects and/or their influence on driving capability. The modeling helps in both the design and evaluation of simulation hardware and software, and the evaluation systems needed to evaluate the data from the simulation.

Persons who work on training older drivers to improve their knowledge and skills, also have a direct need for this information. Currently, training tends to include the presentation of the same material to a group of older persons. There is no differentiation to specific needs of each individual and there also is a tendency to be totally knowledge oriented. The model represents the production of a level of knowledge about the person that would all w more focused interventions.

Discussion

A valid question would be what does the model and system methods provide that other approaches do not yield. There is an increased focus on interaction and relationships between components. The approach stresses the dynamic and interactive aspects of a complex situation. A stronger emphasis is placed on functional response to a specific demand yield a greater possibility that some sense of cause and effect might eventually be identified.

The model helps us to visualize the complexities being addressed, and underscores that single dimension approaches probably leave out a lot. In reviewing the model, there is a sense of integration and interaction of component dimensions which comprise human functioning that we tend to overlook to make analyses workable. The use of a model also suggests different paradigms for studying the process that are more similar to a physical science approach.

Again, the model is only one of many possible models that would validly represent the situation addressed. It has proven useful as a heuristic to guide work done to date, but it also can be used more aggressively to try to define components and relationships in the driving situation. From studying that situation with elderly persons, information about the aging process is gained.

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