

Special Section: In Honor of James Emmett Birren (1918-2016)

From Counterpart Theory to Janus Model:
In Memoriam – James E. Birren, Friend, Mentor, and Colleague

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This 'In memoriam for James E. Birren' is written in the form of an autobiographical article. The story of friendship and academic cooperation starts with my first visit to Jim Birren in 1966, when I was a young psychology student and ends more than fifty years later with the development of the Janus model, based essentially on Jim's general theory of 'Aging as a counterpart of development'. The use of the metaphor 'counterpart' is meant to express the idea that there are latent structures of behavior (emotions, cognitions, and motivations)—carried forward from earlier experience—that interact with present situations. Since 1980, we worked closely together on the clarification of implicit 'Metaphors of development and aging', because making them explicit can provide us with a deeper understanding of existing theories but also because they tend to generate a whole body of theoretical problems and solutions. Based on the study of metaphors, a 'dynamic systems' approach to development (growth) and aging (senescing) was started. These two general processes have been translated in terms of order (information) and disorder (entropy). From this perspective it is inferred that the aging of human beings can be conceived as a series of transformations or 'branching points' into higher and/or lower order structures or processes, showing a progressive trend toward more disorder than order over the course of life. Thus, a new theory was born in 1994 under the title 'Gerodynamics, a branching theory of aging'. Theorizing on the basis of metaphors has its limitations. In the year 2000 a breakthrough took place when the metaphorical approach to development and aging was exchanged for a mathematical model of 'growth & decline' processes, called *Janus*. The universal '*Janus model*' solves the transition problems of development into aging for all kinds of living systems, from cell to society. In recognition of Jim Birren's scholarly work on '*Guided Autobiography*', computer simulations using the Janus model have been conducted with autobiographical memory data, collected with the *Lifeline Interview Method* (LIM). Simulation of the '*reminiscence bump*' resulted in an explanation of the mechanism behind the 'bump'.

In 1966 I met James E. Birren for the first time in Los Angeles. He had invited me to visit him at the University of Southern California (USC) because of my letter of interest concerning the advanced electronic equipment he used in experiments on the relations between behavior, aging, and the nervous system (Welford & Birren, 1965). As a 23 year old bachelors-level student of psychology and physiology from the Netherlands, I was fascinated by his research, bought a \$99 ticket on a Greyhound bus, and went abroad to the New World.

On a hot Friday afternoon in August, I walked into Dr. Birren's office on the USC campus. He gave me a short tour of the gerontology institute and invited me to come back next Monday because, he said, "There is always an empty desk where I might work". Alas, the magic reaction time machine, for which I came all the way from

Amsterdam, didn't work for some reason, much to my disappointment. Fortunately, Dr. Birren organized a seminar on the 'Welford & Birren' book especially for me and helped me write a bibliography on the relationship between 'Aging, Reaction Time, Cerebro- and Cardiovascular disease, and Personality'. My first introduction to gerontology couldn't have been more successful, the more so because Dr. Birren gave me a grant of \$200 when he heard of my financial problems. Filled with inspiration and feelings of lifelong friendship for Jim Birren, I returned to The Netherlands to get a master's degree in industrial and experimental psychology at the Free University Amsterdam (1970).

The next time I met Jim was in 1979 for a one-year research fellowship at the Andrus Gerontology Center, USC. After many years of sending Christmas cards and letters to keep in close contact, Jim invited me for a sabbatical after I had completed my doctoral degree in the Faculty of Social Sciences, Free University Amsterdam¹. I was supposed to assist with the evaluation of 'guided autobiography' data, but, unfortunately, the project leader had to drop out soon after I arrived. Jim Birren came to the

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¹ PhD thesis: *Cognitive development, learning potential and school achievement* (Schroots, 1979).

rescue and invited me to assist him in his research, and that turned out to be the start of our lifelong collaboration.

In those days, Jim was interested in the psychological characterization of short autobiographical essays on the major branching points in life. During one of our walks we made a thorough search for a single personality descriptor, which would reflect both unique and more general traits of the individual (an impossible task), and an animal metaphor seemed to be a good candidate. For example, what is more appealing to the imagination than that we think of a person as a hyena or a lion? Immediately we see a different person. I became intrigued by the use of metaphors for the description of complex matters and bought Ortony's *Metaphor and Thought* (1979) to learn more about it. This book inspired our thinking and research for the decade ahead.

Metaphors of Development and Aging

The 1960s and 1970s had shown a reappraisal of the role of metaphor in science. Serious claims have been made that science is in an essential way metaphorical and characteristically employs metaphors, particularly so called implicit, hidden or root metaphors inherent to many scientific theories. It has been argued that we ought to make them explicit, not only because these metaphors provide us with a deeper understanding of existing theories, but also because they tend to generate or create a whole body of theoretical problems and solutions.

Many theories of human development and aging in the social sciences are influenced by biological conceptions of human life. Jim and I became aware once more that development is often compared with incremental processes like biological growth, and that aging stands for decremental processes like deterioration. Psychological and social phenomena, however, do not necessarily follow the same course in life as biological phenomena. Jim pointed out, for example, that the psychological attribute "wisdom" traditionally represents a progressive aspect of change in adulthood and the later years of life (Clayton & Birren, 1980). After many rounds of Socratic dialogue, we introduced new metaphors in order to embrace or integrate various conceptions of *human ontogenesis*, i.e., the course of life between beginning and end (Birren & Schroots, 1980). The term 'ontogenesis' embraces both child and adult change, both development and aging (See Figure 1).

Figure 1 shows our attempts to generate new metaphors of development and aging according to the principle of *catachresis*. That is, new metaphors are developed to introduce theoretical terminology where none previously existed so that they become, almost imperceptibly, constitutive of the theories or conceptions they express. As such, development and aging are viewed as consisting of

three metaphors. The processes of biological, psychological, and social *development* were identified, successively, as *growing*, *maturing* and *adulting*. Next, the processes of biological, psychological, and social *aging* were labeled with the metaphorical terms of *senescing*, *geronting*, and *eldering* (see definitions below figure 1). Before I knew it, I was the proud co-author of three papers that all contain sections on constructivism in science and metaphors of growth and development versus senescence and aging. What started as curiosity out of pure intellectual interest soon turned into a scientific goldmine. Two conferences were organized: the (unpublished) 1982 Vancouver Conference on Metaphors in the Study of Aging and the very successful 1990 New Brunswick Conference on Metaphors of Aging in Science and the Humanities (Schroots, Birren & Kenyon, 1991).

One question, however, kept nagging in my mind: "How are the processes of development and aging related to each other?" Given the gap between these two processes as pictured in figure 1, there must be some *transition* at some *time* for the different levels of ontogenesis. A definitive answer had to wait till the twenty-first century, but in the next section I will show our first step to a solution of the 'gap' problem.

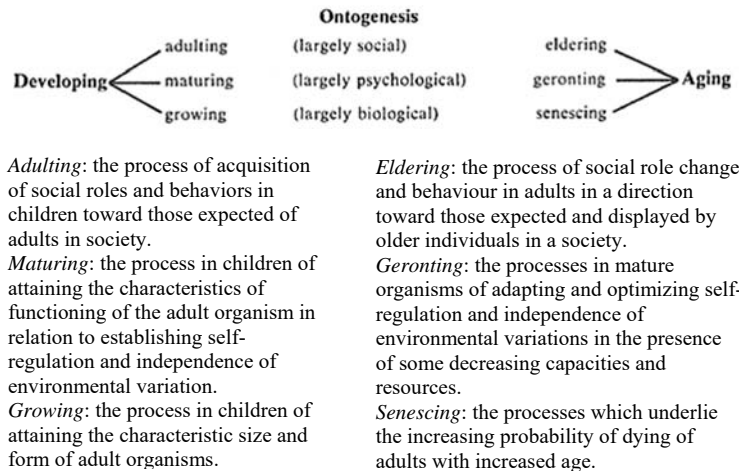


Figure 1. Diagram of human ontogenesis (Birren & Schroots, 1980).

Counterparts of Development and Aging

In his function as mentor, Jim introduced me to his general theory of 'Aging as a counterpart of development' (Birren, 1960). The use of the metaphor 'counterpart' is meant to express the idea that there are latent structures of behavior (emotions, cognitions, and motivations) – carried forward from earlier experience—that interact with present situations. Aging is viewed as a transformation of the biological and behavioral development of the organism expressed in a 'counterpart manner' in variable ecological contexts. Counterpart theory primarily describes the diachronic or *sequential* relationship between development and aging and does not explicitly address the issue

of their synchronic or *simultaneous* relations. To fill the gap, Jim and I developed a simple diagram of human ontogenesis, much later called the '*butterfly*', in which development and aging are conceptualized as two parallel but related processes of change, or as the two sides of a unitary life trajectory (Figure 2).

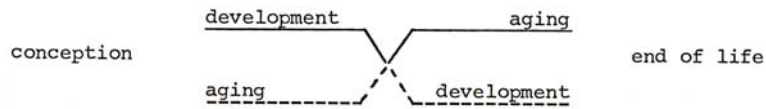


Figure 2. Butterfly diagram of human ontogenesis (Birren & Schroots, 1984; Schroots, 1982).

The '*butterfly*' diagram demonstrates that at the start of ontogenesis (conception), the developmental process is most visible or *manifest*, while the signs of aging are at the time still obscure or *latent*, and *vice versa* at the end of life. The diagram has been very inspiring for our theoretical thinking (Schroots, 1982; Birren & Schroots, 1984), but what the diagram does not show is that the *transition point* varies across the lifespan from function to function, from system to system, and from individual to individual. The discovery of the mechanism behind the varying transitions would take another twenty years.

Dynamic Systems of Growth and Senescence

From 1980 to 1985, Jim and I worked apart or together on several '*metaphor*' papers for journals, books and conferences. Working together was a very stimulating experience. As Jim would say: 'I am picking your brain', to which I would reply: 'please, be my guest, because you show me a whole new world for free'. In the spring of 1985 I received a letter from Jim inviting to spend another sabbatical with him, this time at the Andrew Norman Institute (ANI) for Advanced Study in Gerontology and Geriatrics, connected to USC. Every year a limited number of promising researchers from different disciplines in gerontology were invited to spend their sabbatical at the ANI for in-depth study and learned discussions with other fellows.

My intention was to write a series of essays on growth and senescence in which changes of form would be discussed as a continuation of previous essays that I had written on '*Life*' and '*Time*'. These essays, then, would be my required contribution to the ANI book, *Emergent Theories of Aging* (under the editorship of J. E. Birren & V. L. Bengtson). It was tradition at the ANI that draft versions of various contributions (chapters) were discussed at length during weekly lunch meetings. In view of the outstanding academic qualities of fellows and guests, the multidisciplinary ANI meetings ensured scholarly discussions. Anxiously, therefore, I presented my newest ideas about growth and senescence on the basis of earlier (translated) essays on metaphors of life and time (Schroots, 1985 a,b). It soon became clear that the group of 12 fellows

didn't really appreciate my '*natural philosophy*' approach to the empirical science of growth and senescence (metaphors, bah!). The judgement of the fellows was anything but positive, to say the least.

I still had two months left to create some *order* in the chaos of my thoughts, so Jim suggested that I should write about the same subject but differently, following the academic rules and format of a scientific paper. I then worked like a maniac day and night on the ANI book chapter "*On Growing, Formative Change and Aging*" (Schroots, 1988), which still has the typical features of an essay. Essentially, my contribution is about Prigogine's revolutionary interpretation of the second law of thermodynamics, which states that

there is an increase of *entropy* (disorder, chaos) with age in living systems, resulting in the system's death (Prigogine & Stengers, 1984). Prigogine, however, postulates that internal or external fluctuations of dynamic systems can pass a *critical point*—the transformation, transition, bifurcation or branching point—and create *order* (negative entropy, information) out of *disorder* (chaos, entropy) through a process of *self-organization*, that is, a process by which a structure or pattern of change emerges with the passage of time.

From this meta-theoretical perspective, I inferred that the aging of human beings could be conceived as a series of transformations (literally "changes of form") into higher and/or lower order structures or processes, showing a progressive trend toward more disorder (chaos, entropy) than order (information, negative entropy) over the course of life. In other words, lower order transformations at the biological or psychological level of functioning, e.g., illness or divorce, do not always result in lower order behavior. Some people, for instance, are strengthened by illness, and divorce may have a positive rather than a negative effect on mental health and lifespan. But, of course, in the end we will all die. Jim, who was already my friend and mentor, now also became my best colleague.

Intermezzo

From 1985, Jim and I worked together at least once or twice a year, to begin at the Annual Scientific Meetings of the Gerontological Society of America, after which I was invited for a couple of weeks to the Birren's home in Pacific Palisades (CA) to celebrate Thanksgiving and to prepare articles and international conferences in the field of '*Health and Aging*' (Schroots, Birren, & Svanborg, 1988) and '*Autobiography*' (Schroots & Birren, 1993). In the meantime I had started my own research institute ERGO (European Research Institute of Health and Aging, Amsterdam) with Jim as adviser, from where EXCELSA was started, the first Cross-European Longitudinal Study of Aging (Schroots, Fernandez-Ballesteros, & Rudinger, 1999). The most important articles and proceedings of relevant conferences are referenced in the bibliography.

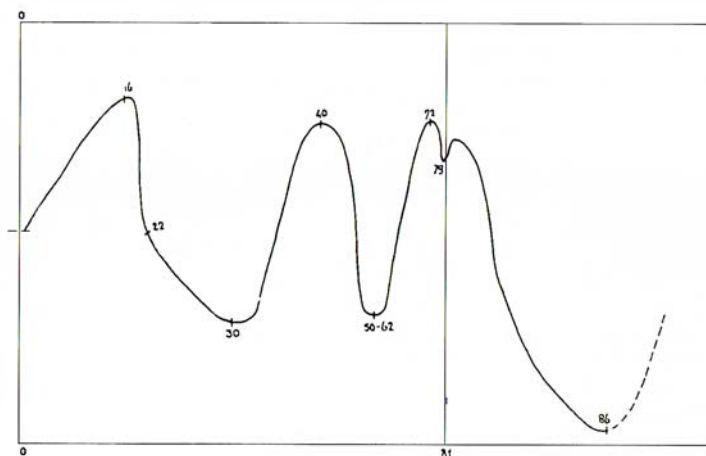
Lifeline Interview Method (LIM)

Since my first fellowship (1979-1980) at USC and alongside of my work on the dynamics of health and aging, I have been following a second line of research, based on *metaphors of life*. When people are asked to describe their life, they frequently use metaphors like the 'river' or 'footpath'. The river symbolizes the stream of life, and the footpath stands for the journey one makes from birth to death, when one alternately crosses the mountains and valleys of life. Both metaphors enclose the temporal dimension of individual life, but only the 'footpath' metaphor refers explicitly to the dimension of affect. For example, when people say, "I'm feeling *up*" or "I'm really *low* these days", they are using a spatial metaphor, i.e., *hilly country*, to express the positive and negative feelings they had in life.

From the 'footpath' metaphor to the development of a biographical assessment method is only one step as soon as one realizes that the graphical, two-dimensional representation of a footpath—with *time* on the horizontal dimension and *affect* on the vertical dimension—symbolizes the course of human life. When I asked people to map their life in the form of a line, they were perfectly able to do this, much to my surprise. Back in 1980 a new biographical tool was born, called the *Lifeline Interview Method* or LIM for short, with volunteers from the Andrus Gerontology Center as godfather and godmother. In a typical LIM session, a person is asked to place perceptions of his or her life visually in a temporal framework by drawing a lifeline. With the help of this method one can elicit biographical information about affective, important or critical events, experiences or happenings in a non-verbal, visual way. As soon as the lifeline has been drawn, the interviewee is asked to label each peak and each dip by chronological age and to tell what happened at a certain moment or during an indicated period; in short, to tell his life story. At the same time, the interviewer makes a verbatim report of what the subject views as the most important events in his or her life. Figure 3 shows the lifeline and abbreviated life story of Mrs. K., a depressed 81-year-old-Dutch widow, who expected to die at the age of 86 (Schroots, 1996).

The Lifeline Interview Method proved to be a practical instrument for the clinical study of individual lives and also a very useful tool for the investigation of autobiographical memory.² In 1995 the first wave of the Amsterdam Longitudinal Study of Autobiographical

Memory (ALSAM) was started. Another three waves would follow in 1997, 2000, and 2010, which produced more data than one researcher can handle. With the help of students, however, data from the first three waves have been documented, analyzed, and reported in a special



Past (0 yr): I had a very happy childhood, that's for sure. When I was 16, I had to leave school (1). I suppose I was fortunate in being able to stay on even for that long, but I would have liked to have been a teacher like my eldest sister. She was allowed to continue her studies because the family didn't consider her suitable enough to help at home as I, being more practical, was made to do. My mother wasn't very strong, she had a weak heart, and therefore needed help. Because of her bad health, we were advised to move to the country side. I continued helping at home, until I was 22, when I married (2) etc etc.

Future (81 yr):I haven't much faith in the future. I'm constantly afraid of my failing health. I also think of the end of the world. When I look around me and see what is happening to people: for money they seem to do everything. Apart from that, all they do is complain. And all those unemployed.....No, I don't want to sound like a pessimist, but I hope that I, nor my children, will have to live through it all over again (86 yr).

Figure 3. LIM: Lifeline (top) and abbreviated life story (bottom) of Mrs. K. (Schroots, 1986; Birren & Schroots, 1984).

volume (Assink & Schroots, 2010), which includes the translated manual of the LIM.³ Data from the fourth wave (2010) is in progress.

Autobiographical Memory (AM)

While Jim was teaching and writing about *Guided Autobiography* with the emphasis on the narrative self in groups (Birren & Cochran, 2001), I continued with exploring the LIM data, i.e., the memories (past) and expectations (future) of individuals over the course of life, which are usually labeled with the generic term of life events. Life events are the building blocks of life stories. The sampling of autobiographical memory (AM) in terms of life events without restrictions on time of occurrence or type of event produces some remarkable patterns (Conway & Pleydell-Pearce, 2000): (a) *Forgetting* or retention curve

² A simplified version of the LIM, adapted for groups, is included in the 'Branching points' theme of 'Guiding autobiography groups for older adults' (Birren & Deutchman, 1991; Schroots & van Dongen, 1995).

³ The manual of the LIM has been translated (2011) from English into Swedish by Monica Vester, PhD., under the supervision of Cheryl Svensson, PhD. For information contact the author: jjf.schroots@senesco.nl

in the form of a mathematical power function. The pattern of this curve shows a steep drop in the beginning of the retention period (the so-called 'recency' effect) and a slower decline as retention time increases; (b) *Childhood amnesia*. This pattern reflects the reduction or absence of memories coming from the first years of life; and (c) *Reminiscence* or *Autobiographical Memory Bump* (fig.4). The 'bump' pattern is only found for people over the age of 40. The distribution of memories departs from a simple forgetting function and turns into a roughly bimodal distribution of memories with a concentration of memories from the recent past (recency effect) and another between 10 and 30 years of age, called the 'bump.'

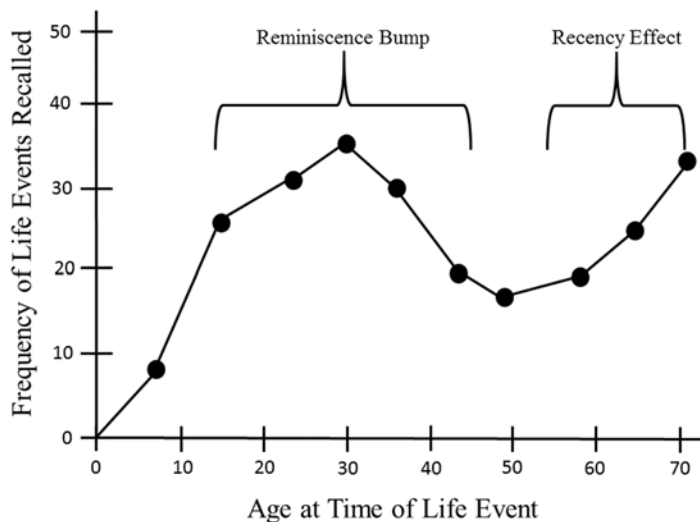


Figure 4. AM bump or reminiscence bump

The AM bump of life events is a universal phenomenon and has been empirically demonstrated with widely divergent techniques, including the LIM (Schroots & Assink, 2005). Many interpretations have been proposed regarding this complex, bimodal pattern, for which Rubin, Rahhal, and Poon (1998) have produced conclusive evidence: "... for older adults the period from 10 to 30 years of age produces recall of the most autobiographical memories, the most vivid memories, and the most important memories. It is the period in which are developed peoples' favorite films, music, and books, and the period from which they judge the most important world events to have originated" (p.3). It is not difficult to see that the life stories, as told in Jim's guided autobiography groups, show a remarkable similarity with the life story as produced by the lifeline interview method. Once again and along different roads, Jim and I worked together on the same subject: *'Autobiographical memory and the narrative self over the lifespan'* (Birren & Schroots, 2006), and it was published in the 6th edition of the *'Handbook of the Psychology of Aging'* (Birren & Schaie, 2006). But a satisfactory explanation for the emergence of the AM bump, representing the disproportional concentration of memories between ages 10 and 30, was not presented.

From Metaphor to Model

The terms model and metaphor are often used interchangeably in the research literature. Their relative significance, however, is expressed by the phrase that models are more general, extended, and systematic metaphors. A recent trend is for systematic metaphors to be formalized in mathematical terms. The question then becomes how, for example, the metaphors of development and aging can be turned into a mathematical model, fit for computer simulation of their dynamics.

First of all, the widely interpretable terms and processes of development and aging (Figure 1) should be reduced to the more elementary form of one-dimensional growth, which follows an S-shaped power curve in which there is a limit to growth, i.e. the logistic or limited growth curve. Mathematically, the logistic curve can be expressed in a differential equation in terms of either negative or positive growth. Coupling of the two (negative and positive) equations results in a bell-shaped 'growth and decline' curve, which might be interpreted as the product of synchronic developmental and aging processes, or as the life-trajectory of some vital system (V). By using algebra, I finally succeeded in answering my question of twenty years ago "How are the processes of development and aging related to each other."

Rates of growth and decline, as well as the emerging curve, may vary across the lifespan. The mathematical formula of bell-shaped curve V with variables x (growth/development) and y (decline/aging) has been extended, therefore, with two parameters, p and q , according to the following formula: $V = pxqy / (px + qy)$, which is at the basis of a mathematical model, called *Janus* after the Roman god with two faces—one face looking into the future and one into the past. Computer simulation of this model over a period of 100 years shows that the relative peak of the (a) symmetrical bell might move up and down, and from left to right across the lifespan, dependent on the rates of growth and decline (Schroots, 2008).

Again, by using algebra, I succeeded in solving a second problem of twenty years ago, when I wondered what the mechanism was behind the transition point or peak, which varies across the lifespan from function to function, from system to system, and from individual to individual. It is the action of *'simultaneous'* growth & decline curves, from birth to death, which produces the two-phase life-trajectory of *'sequential'* development & aging processes, with the transition or peak in-between. The relatively simple Janus model turned out to be of universal importance, and the key question is 'how this model can shed light on the emergence of the reminiscence bump at older age'.

Two Memory Systems Behind the Bump

Our memory can be characterized roughly by two neural systems: (a) speed of information processing, and (b) storage of information. Most neural systems reach their optimum between 15 and 30 years (bump period). Superficially, speed and storage operate as one and the same memory system, but basic research has shown that speed rides piggyback on storage; that is, the information processing of life events occurs before the storage of events in long-term memory. Consequently, if neural speed decreases after age 30 (Birren & Fisher, 1995), less and less information will be stored in memory, while the information already stored in long-term memory is retained. In other words, as people grow older they will have disproportionately more life events stored in memory for the age period of 15–30 years than at a later age. This memory phenomenon is explored more fully in Schroots, van Dijkum, & Assink (2004).

Janus Model

The relatively simple Janus model of one vital system (V) with only one transition or peak needs to be extended with an extra term to cover the bimodal event distribution of two systems with two peaks or transitions⁴. The extended, more complex Janus model ($J = V_1 + V_2$) of two vital systems, V_1 and V_2 (with two transitions or peaks), which in the present case represent the memory systems of 'speed' and 'storage', might cover then the composed pattern of forgetting and the reminiscence bump (Figure 4). Computer simulation of the observed memory patterns from the *Amsterdam Longitudinal Study of Autobiographical Memory* (ALSAM), using the complex Janus model, provides convincing evidence for the bump (Schroots & van Dijkum, 2004; Schroots & Assink, 2005).

Figure 5 shows the dynamics of autobiographical memory for life-events as simulated with the complex Janus model (Schroots & Pierce, 2012). In the present case the idealized event-distributions (memories) from the ALSAM study are simulated for three age groups: Young (age = 25 yr), Middle (age = 50 yr) and Older (75 yr).

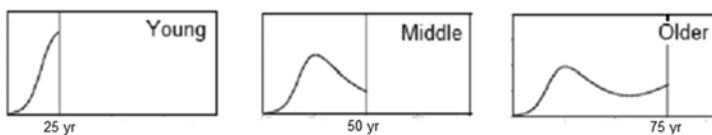


Figure 5. Simulation of the reminiscence bump

As expected, the memory curve J of the *Young* age group shows a steep drop in the beginning of the retention period ('recency' effect) and a slower decline as retention time increases, which is typical for the classic forgetting curve. Notice that the frequency distribution of memories

has a much higher peak than the middle and older age groups. Both speed & storage systems reach their maximum in young adults with the effect that the maximum of the speed system (V_1) is added to the maximum of the storage system (V_2) or long term memory.

The memory curve J of the *Middle* age group is the result of an (imaginary) young age group, who has grown older till the age of 50 years. This means that their speed of information processing is decreasing (neural slowing), while the storage system continues to function more or less normally, as it is less susceptible to neural slowing. What we see in the middle-age group is a different frequency distribution with a lower peak and no forgetting curve. The question is how we should interpret this distribution.

The memory curve J of the *Older* age group contains the solution. As people grow older, the frequency distribution of life-events (memories), which according to tradition should follow the classic forgetting curve, gets slowly divided in two latent distributions of life-events, one for forgetting and one for the bump, which—added together—form the manifest 'bump' pattern of memories. During the 'bump' period of 10-30 years, when neural systems as speed of information processing and storage of information reach their maximum capacity, the events of life are stored firmly in long term memory and will not be forgotten. In other words, if people grow older than 40 they will lose some capacity for the storage of recent memories because of neural slowing (decreasing speed), but the storage of memories from the age period of 10-30 remains intact, relatively speaking. It is not surprising, therefore, that middle-aged and older people, when they are reminiscing about life produce a disproportionately high number of memories from young adulthood.

In Retrospect

The Danish philosopher Søren Kierkegaard wrote about life history when he stated that "Life can only be understood backwards, but it must be lived forwards." Looking back to my first visit to Jim Birren in 1966, I could not imagine that this would be perhaps the most important turning point in my life. I was an ambitious young student, not interested at all in aging or gerontology. The behavioral study of rats or older people, was all the same to me. More than fifty years later, I know better, due to the profound influence of Jim as mentor and colleague, but above all as friend. I still miss him every day, but from somewhere I hear his voice telling me "Hans, we can't spend all our time living in the past, we have to take what we have learned from our experiences and use it to make new decisions in the future." These are the words of a wise man, *in memoriam James E. Birren*.

⁴ Formulas and details are presented in Schroots (2008).

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